THE COPPER SMELTING SITE AT CHRYSOCAMINO, CRETE

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The 1996 and 1997 excavations at Chrysokamino, Crete, have discovered new evidence that has substantially changed our view of the early history of Minoan metallurgy. When Keith Branigan wrote his definitive study of Aegean Metalwork of the Early and Middle Bronze Age, only a few scraps of copper from Mochlos were known from the Final Neolithic period (1974, 98). Because so little was known of Final Neolithic metallurgy, he quite rightly concluded (based on the available evidence) that Minoan metallurgy began in EM I, and that the EM I artifacts were "the early products of an infant metalworking industry" (1974, 105). We can now push the beginnings of this industry back into the Final Neolithic.

Chrysokamino is the site of a workshop where copper was smelted from the Final Neolithic until Early Minoan III. Although the beginning of Minoan metallurgy in this period may seem surprising by Aegean standards, it is less unusual when seen against the backdrop of Near Eastern metallurgical developments. Chalcolithic metallurgy has been recognized in the Near East for several years, and the new information simply means that the ideas of early metallurgy were more widely disseminated than was once thought.

The site of Chrysokamino is a headland on the north coast of Crete, near the village of Kavousi (Fig. 1). It is at the eastern side of the Gulf of Mirabello, a region that was already well settled by small villages and farmsteads by the Final Neolithic period. The site is a small saddle between outcrops of bedrock. It is a shallow trough that catches all the north wind, and the site almost always has a fierce wind in late summer and fall, even when the remainder of the same hill is more quiet. The location has been known since 1900 (Hawes 1908, 33), and it has been mentioned many times in the literature, although it has never been excavated before (Mosso, 1910, 289-292; Schachermeyr,

FIG.1 The headland at Chrysokamino, Crete.

1938; Faure 1966, 297-298; Branigan 1968, 50-51; Stos-Gale 1993, 124; Haggis 1992, Locus 50 and 88; 1996, 380-381 and 401-403; Zois [1993], 340-341.

After preliminary work was accomplished in 1995, excavations were conducted in two seasons (1996-97), under the direction of the writer with the collaboration of co-director James D. Muhly. A nearby habitation site, also first inhabited in the Final Neolithic but with continuing occupation until LM III, was supervised by the other co-director at the project, Cheryl R. Floyd. The project is sponsored by Temple University with the collaboration of the University of Pennsylvania Museum for Archaeology and Anthropology.[1]

The history of the site can be traced by its pottery. The earliest fragments are from Final Neolithic. They are all local, made from a coarse, dark-surfaced, burnished clay fabric. Shapes include bowls, jars, and a pouring vessel with horned handle. They are typical of the Final Neolithic pottery from central and eastern Crete. Only a single definitive sherd from EM I and a single sherd from EM II come from the site, but the undiagnostic jar fragments may include other pieces from these periods. Many sherds are from Early Minoan III, the final phase of the workshop. They include cooking vessels, jars, and fine pieces decorated in the typical East Cretan White-on-Dark Ware of EM III. The only building at the site is from this period.

No houses were found at the metalworking location. It was apparently used only as a workshop, and the workers lived elsewhere, presumably 500 meters away at the Chrysokamino habitation site where pottery from the Final Neolithic and Early Minoan periods has been found under the later levels of occupation. Finds at the metalworking site include stone tools, furnace fragments, large quantities of slag, small pieces of copper ore, and animal bones and shells as well as the pottery that allows the site to be assigned a date.

The slag occurs over the entire site, covering an area of over 2000 square meters, with a maximum depth of 60 cm. It is all in small pieces. The material is dark and glassy with small prills of copper included within the slag matrix.

Like the slag, broken furnaces occur over the complete site. The furnace fragments consist of clay pieces from cylinders with holes every few centimeters. Most of the furnaces seem to have had diameters of between 20 and 40 cm., with open tops and closed

FIG.2 Restoration of the use of the bellows used to enhance the draft in the Chrysokamino smelting operation, drawing by Lyla Brock based on suggestions by Harriet Blitzer.

bases. They were made of coarse, porous clay, with substantial chaff added to the paste. After use, the lower parts of the interiors of the furnaces were coated with slag, occasionally with small prills of copper in it.

The stone tools consist of simple pounding tools. They are made from naturally waterworn cobbles, and they show signs of wear from use as hammers, pounders, or grinders.

The most important other artifact class found at the site is a series of pieces of pot bellows. They were hollow cylinders with open bases and closed tops with holes cut in their upper surfaces to accommodate the leather of the bellows arrangement. A nozzle led from each bellows to the furnace.

One small building was discovered at the site. It was made of perishable materials, including wooden posts and some material for the walls that has disappeared. Soil was used for the floor. Three strata, consisting of separate floor levels, were found inside the structure. All were from EM III.

The small building was oriented north and south, with an apse at the north. It was 2.60 m wide and 3.5 m north to south. At the south, three post holes could be distinguished, arranged in an east-west line with a wider spacing between the western hole and its neighbor to the east. Additional post holes were at the sides of the building.

The floors were put directly over the slag, by bringing in soil and spreading it inside the building. A hearth, consisting of an informal burned area near the north of the floor, was in each stratum. Pottery and bellows fragments were on the middle floor.

A reconstruction of the steps in smelting suggests a simple operation. Probably the ore was brought in to the site from some other location. Whether the source was in Crete or outside of Crete is not known.

A furnace would be made by hand forming techniques, perhaps from local clay, using chaff as a tempering material. The furnace would be formed as a hollow cylinder, perforated with many holes.

Wood for charcoal would be cut locally, and it is perhaps the source of fuel that attracted the metalworkers to this location. It would almost certainly be made into charcoal, although evidence for this operation was not discovered. It would be packed into the small furnace along with pieces of copper ore. The charcoal would be set on fire, and the fire would be aided both by a natural draft and by bellows worked by the smelters (Fig. 2). After the ore was smelted, the furnace and its load would be broken into small pieces to remove the prills of copper. This practice must have been standard for slags resulting from smelting operations with poor separation of the metal. Only the smelting was done at this site, and the prills would be transported elsewhere for re-melting and for making artifacts. The site was abandoned after EM III.

NOTES

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ΠΕΡΙΛΗΨΗ

Η ΘΕΣΗ ΧΥΤΕΥΣΗΣ ΧΑΛΚΟΥ ΣΤΟ ΧΡΥΣΟΚΑΜΙΝΟ ΤΗΣ ΚΡΗΤΗΣ

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Ένα εργαστήρι χύτευσης απο την Πρωτομινωική περίοδο ανακαλύφθηκε στο Χρυσοκάμινο, στη βόρεια ακτή της Κρήτης, κοντά στο Καβούσι στην ανατολική πλευρά του νησιού. Η θέση είναι ένα μικρό ακρωτήρι κοντά σε μια μινωική αγροικία, η οποία λειτούργησε απο την Πρωτομινωική μεχρι την Υστερομινωική ΙΙ περίοδο.

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Το εργαστήρι χρησιμοποίησε ιμάντες για την ροή του αέρα. Η κεραμεική της θέσης είναι Ανατολικής Κρήτης, άσπρο πάνω σε σκούρο επίχρισμα (Πρωτομινωική ΙΙΙ). Μετάλλευμα χαλκού δεν έχει βρεθεί στη γύρω περιοχή και θεωρείται ότι μάλλον το μετάλλευμα έφτανε μέχρι το σημείο αυτό με πλοίο.