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6
Tell edh-Dhiba'i and the Southern Near Eastern Metalworking Tradition

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Research into ancient Near Eastern metallurgy is approaching the point where metallurgical traditions can be delineated. The remains of metalworkers' tools have been found from a wide range of sites throughout Iran, Mesopotamia, Anatolia, Cyprus, the Levant, and Egypt, and it is quite clear that there are a number of different metallurgical practices being used. But more important, there are a number of families of each type of implement being used for the same metallurgical process. It is these families that may form distinct traditions.

Here I investigate the metallurgical tradition that is represented by the metalworkers' collection found at Tell edh-Dhiba'i, a site now in the suburbs of modern Baghdad, Iraq (al-Gailani 1965; Davey 1983). The collection is dated to the Old Babylonian Period and may have been associated with a destruction of the city some time before 1750 B.C.

By the middle of the third millennium B.C., discoveries such as the Royal Cemetery at Ur reveal that metallurgy in Mesopotamia had reached a high level of sophistication (Smith 1981, p. 195). The evidence for the development of this industry has been documented by Moorey (1982 and this volume). Few metalworking implements come from third millennium B.C. Mesopotamia, but it is probable that the objects found at Tell edh-Dhiba'i represent the metallurgical tradition that developed in the area from the late fourth millennium and would therefore have been employed during the Early Dynastic and Akkadian periods. I propose that this tradition held sway from Mesopotamia to Egypt and that it should be called the "Southern Tradition" to distinguish it from that existing in Iran, Anatolia, the coast of the Levant, and the Mediterranean.

The Technology

Among the commonest objects in the Tell edh-Dhiba'i collection are the crucibles, and these objects by virtue of their shape are some of the most distinctive artifacts of the collection (figures 6.1 and 6.2). When the crucible is placed in its upright position, its shape is such that it will not hold a liquid. It was normally assumed that this problem was overcome by placing the crucible in the furnace in a laid back attitude and that, when the metal was to be poured, it was rolled forward. Such a method has been suggested for the Late Bronze Age crucible from Keos (Tylecote 1976, p. 18).

However, the Old Kingdom Egyptian tomb of Mereruka at Saqqara dating from the Fifth Dynasty, about 2400 B.C., has reliefs that depict this type of crucible in operation (figure 6.3). The reliefs show two crucibles of the Tell edh-Dhiba'i shape placed back to back in a furnace in an upright position. They also show that,

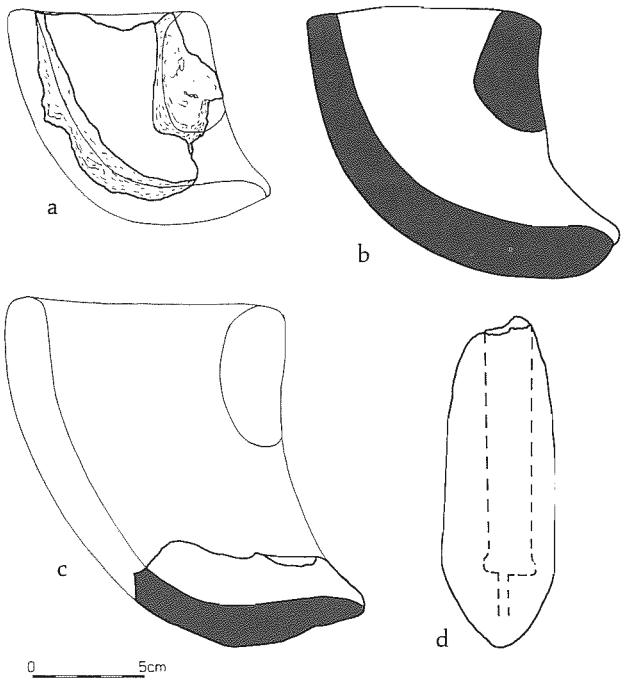

Figure 6.1 Drawings of (a) a reconstruction of the crucible from Tell el-Qitar, (b) a crucible from Tell edh-Dhiba'i (IM 65797), (c) a reconstruction of a crucible from Serabit el-Khadim, and (d) a possible bellows or blowpipe nozzle from Tell edh-Dhiba'i (Excavation 614/15).

Figure 6.2 A crucible from Tell edh-Dhiba'i. Scale: 1 cm divisions (IM 65798).

Figure 6.3 Metalworkers depicted in the reliefs of the Old Kingdom Tomb of Mereruka, Saqqara, Egypt (after Duell 1938, pl. 30).

at the time of pouring, the metal was released from the crucible by poking the front of it with a stick. It therefore seems that the crucible was used with a bot or plug placed over part of the entrance (figure 6.4). When it was time to pour the molten metal, the crucible was taken to the mold and the plug pushed aside.

The reliefs depict the use of this crucible in considerable detail, much of which may escape the casual observer. Laboratory attempts to use replicas of these crucibles have revealed the precision of the reliefs.

In the furnace scene, for example, the two crucibles have lids on top of them. It was found when using replicas of these crucibles that, to get the most rapid temperature increase within the crucible, it was necessary to place a lid over the top of it. This may seem quite logical, but it appears to have escaped the attention of most observers who have described this relief scene. It also confirms the suggestion that the crucibles were not laid back, because in that position they would not have been able to support a flat lid. However, nothing resembling a lid was found at Tell edh-Dhiba'i.

Another notable aspect of the tomb reliefs is the angle at which the draft is applied to the crucible. The people holding the blowpipes are pointing them directly down into the front of the crucible and over the top of the plug or bot. This angle is quite critical because it determines the temperature gradients within the crucible. In this instance it is important that the draft is applied directly to the position of the metal to establish a concentration of heat at that point.

The blowpipes have ceramic nozzles that would have had small apertures in them so that the velocity of the draft would have been increased. High-velocity draft rather than high-volume draft was vital for achieving a rapid rise in furnace temperature. A rapid temperature increase was important, as it would prevent the fusing of the plug to the crucible, which could result from extended periods of heating.

In the Tell edh-Dhiba'i collection, pot bellows (figure 6.5) are an addition not depicted in the Tomb of Mereruka. There does appear, however, to be a nozzle in the collection that could have been used as a blowpipe or maybe as a tuyere (figures 6.1 and 6.6). The identification of this object is not entirely certain, as there is an opening at only one end, although a small

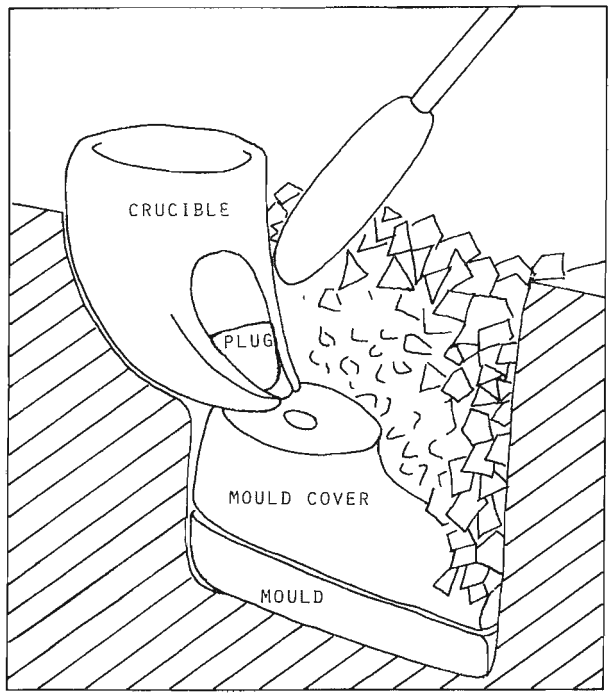

Figure 6.4 A reconstruction of a Tell edh-Dhiba'i furnace.

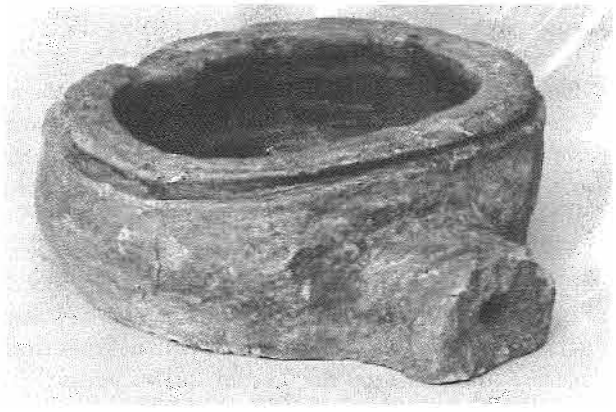

Figure 6.5 A pot bellows, diameter 0.4 m (Excavation 614/1).

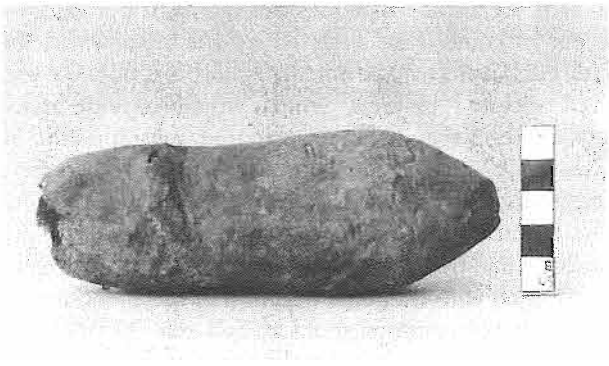

Figure 6.6 The possible blowpipe or bellows nozzle. Scale: 1 cm divisions (Excavation 614/15).

hole nearly breaks through the other end (Davey 1983, p. 180). The object may be either a reject nozzle or possibly one that may have been repairable by removing some of the end. Whatever the case, an object of this shape with a small hole in the end would have provided a choked down draft, the velocity of which would have been increased. This arrangement is consistent with that described for Tell Zeror (Tylecote 1981, p. 116).

The technology used at Tell edh-Dhiba'i in the Old Babylonian Period had developed from that depicted in the Tomb of Mereruka. The use of pot bellows is one obvious example of this development, and this has been discussed in detail elsewhere (Davey 1979). Of more significance is the molding technology. The mold in the Mereruka reliefs is an open mold. Tell edh-Dhiba'i also had numerous such molds, but in addition there were mold covers, which reveal a more developed molding technology.

At Tell edh-Dhiba'i the covered molds could be placed at the bottom of the furnace, where they would be preheated, thus improving the molding process. In this situation the crucible need not be removed from the furnace to make the pour, and the metal would flow more freely in the mold, thus reducing the required superheating, the time for casting, and the consumption of charcoal.

Also at Tell edh-Dhiba'i were *cire perdue* molding, indicated by a broken lost-wax mold for a pin (figure 6.7), and sand casting, for which there was an ax head pattern and a core. The lost-wax mold was for a pin similar to those found on Mesopotamian sites from 3000 B.C. The mold therefore demonstrates the antiquity of the metallurgical tradition represented by the Tell edh-Dhiba'i assemblage. It also reveals the commonplaceness of the lost-wax molding method in that a simple pin was produced by what is generally regarded as a sophisticated procedure.

The ax head mold (figure 6.8) is a contrast to the lost-wax mold. It is also for an object common in third millennium B.C. Mesopotamia but, unlike the pin, which would have been extracted from the mold in its final shape, the ax head would have required a certain amount of hammering to complete its fabrication.

The mold assemblage from Tell edh-Dhiba'i reveals the use of a variety of molding techniques simultaneously. These techniques were used for different objects according to their appropriateness. It is noteworthy, however, that two-piece molds were not found at Tell edh-Dhiba'i.

The melting and casting processes at Tell edh-Dhiba'i were developed to conserve fuel, which in an arid environment would have been comparatively scarce. The procedure achieved a rapid melting of the metal in the crucible so that only a minimum of the charcoal placed in the crucible and around its entrance would have been used. The casting procedure within the furnace

Figure 6.7 The lost-wax mold. Scale: 1 cm divisions (Excavation 614/19).

Figure 6.8 The ax head pattern. Scale: 1 cm divisions (IM 65791).

also reduced the amount of necessary charcoal because it minimized the required superheating of the metal.

The crucibles were constructed from highly refractive clay so that, although they are comparatively weak, they are highly insulating. The crucible shape is one that provides the maximum strength for a vessel with a large hole in its side. The cylindrical top of the crucible in particular provides sufficient strength for it to be carried with its molten charge.

The technology of bronze casting was sophisticated at Tell edh-Dhiba'i. The crucible design, construction, and operation together with preheated molds optimized the efficiency of the melting operation with respect to fuel consumption. The tradition of metalworking is therefore one that was compatible with an arid environment.

Comparative Near Eastern Material

Until recently the Tell edh-Dhiba'i type of crucible does not appear to have been found elsewhere in the ancient Near East. The crucible found by Petrie in Sinai is of quite a different shape, having a comparatively smaller side opening and being capable of containing a liquid when in an upright position (Davey 1985).

One crucible fragment was found in 1984 at Tell el-Qitar in northern Syria at Tom McClellan's archaeological excavation (figures 6.1 and 6.9). This fragment is small, fragile, and not immediately recognizable as a crucible.

Other fragments have been found recently in the Sinai. There is a large number of fragments in the collection dug up from caves in Wadi Serâbît el-Khâdim by a Tel Aviv University expedition (Beit-Arieh 1985). The crucibles from the Sinai were all broken near their bases. Experiments conducted at The Royal Melbourne Institute of Technology with replicas of this type of crucible revealed the area near the base to be the weakest point of the crucible and a common breakage pattern.

At present it appears that the Tell edh-Dhiba'i type of crucible has not been found in Iran. Tal-i Iblis, where a large number of crucible fragments were found, provides no evidence of this shape (Dougherty and Caldwell 1966; Caldwell 1967, 1968). Nor, it seems, does Anatolia at places such as Kultepe (Ozguç 1955; de Jesus 1980). The crucible has not been found in the metallurgical collections from the coast of the Levant at such places as Byblos (Dunand 1939, 1954, 1958) or in Cyprus (Dikaios 1969; Branigan 1974).

The Tell edh-Dhiba'i crucible shape therefore seems to be, at this stage at least, limited to the more arid parts of the Near East, Mesopotamia, inland northern Syria, Sinai, and Egypt. It is of course in these parts that charcoal was less plentiful.

The traditions relating to bellows have already been described, noting that there are two particular means of operation: by the feet and by the hands. The hand-operated method has been observed with bellows from Anatolia, the coast of the Levant, and Cyprus. The foot-operated variety, however, has been shown to exist during the late third and the first half of the second millennia B.C. in Mesopotamia, the inland of the Levant, Sinai, and Egypt.

It is significant that the foot-operated pot bellows seem to come from areas where the crucibles of the Tell edh-Dhiba'i shape are also found. It is possible that foot-operated bellows, which would provide much greater draft than the hand-operated, were found to be most suitable in those parts of the Near East where metallurgy was constrained by the provision of fuel for the furnace. Whatever the case, the foot-operated pot bellows and the Tell edh-Dhiba'i crucibles appear to be associated with the same tradition of metalworking.

The most common mold at Tell edh-Dhiba'i is the open mold. This type of mold has often been found at sites in Mesopotamia (Mallowan 1947, p. 160; Speiser 1935, p. 104), northern Syria (Braidwood and Braidwood 1960, p. 450, fig. 350/1; Thureau-Dangin and Dunand 1936, p. 87, fig. 26, pl. 34; Woolley 1955,

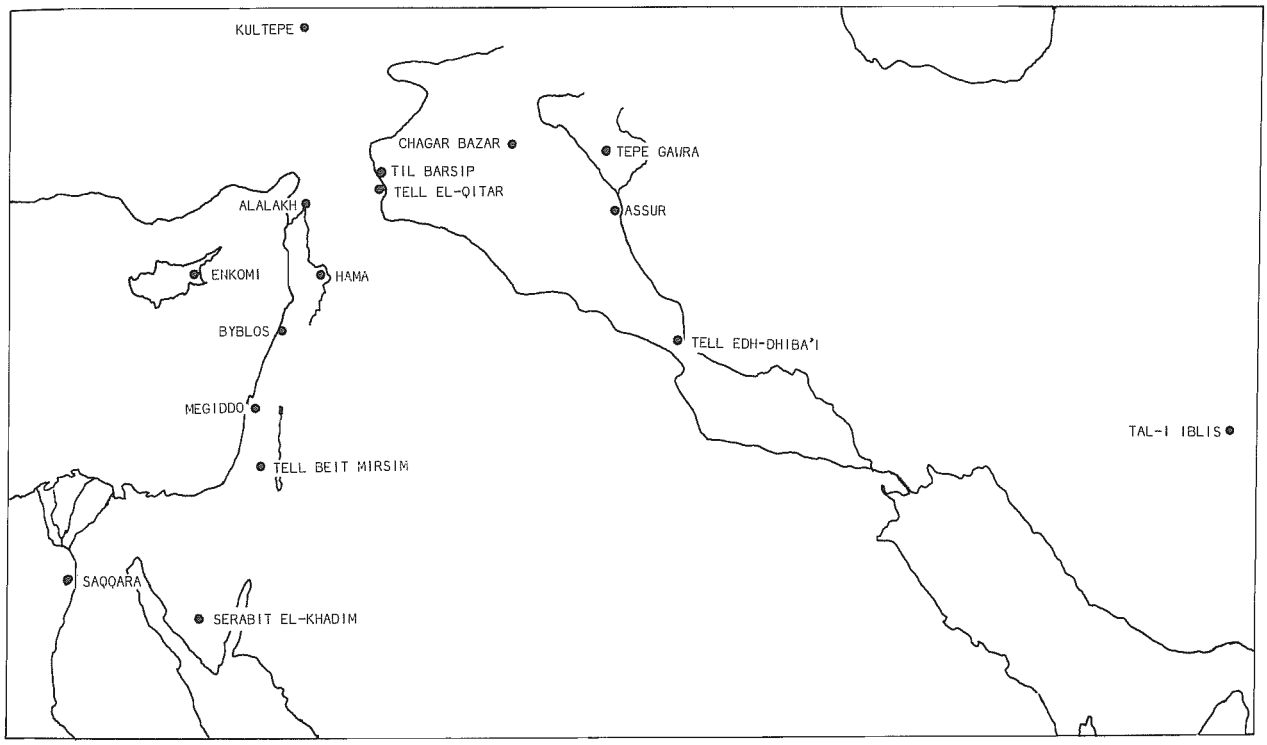

Figure 6.9 Map showing the sites where evidence of crucibles, pot bellows, and molds have been found.

p. 401, fig. 80b), and Palestine (Loud 1948, pp. 177, 185, pl. 269; Albright 1938, pp. 32, 53, pl. 43; Fugman 1958, p. 80, fig. 103, p. 95, fig. 117; Finet 1972, p. 66, pls. 13, 14). The recently published collection from Sinai has a large number of open molds made from stone (Beit-Arieh 1985). These molds are to be distinguished from the two-piece molds that are found in places such as Byblos (Dunand 1939, pl. 108, 1954, pl. 184) and Anatolia at Norsun Tepe. Open molds, of course, occur generally throughout the ancient world, but those from places such as Kultepe in Anatolia are often more finely made (Ozguç 1955, fig. 5).

The crucibles, bellows, and molds that compare to the Tell edh-Dhiba'i collection are found on sites on the plains of Mesopotamia and northern Syria, in Palestine, and Sinai from the first half of the second millennium B.C. The crucibles appear in Egyptian tomb reliefs of the Old Kingdom and the bellows in Egyptian tomb paintings of the New Kingdom. This metallurgical tradition is quite distinct from that found in the neighboring mountainous areas of Iran and Anatolia and the coast of the Levant, and it is suggested that the Southern Tradition is an appropriate name for it.

Discussion

It is clear that differences in metallurgical tradition do not necessarily relate to the type of metal that is being treated. During the Cappadocian trade between Assur and Kultepe, tin and copper were moving between the two locations, but the metallurgical traditions at Kultepe and at places in Mesopotamia such as Tell edh-Dhiba'i are remarkably different. Even where similar implements such as pot bellows existed, their mode of operation was quite different in the two areas.

The metal being used in the Mereruka scene is probably copper, whereas at Tell edh-Dhiba'i bronze was used. The same metalworking tradition therefore could be applied to different metals and alloys.

It is possible that the use of mold covers at Tell edh-Dhiba'i may have developed from contact with a metallurgical tradition that used two-piece molds that were preheated. It is also possible that the idea developed within Mesopotamia itself where *cire perdue* molds were used and probably preheated.

The molds found at Tell edh-Dhiba'i consist of open molds made from fired clay. The bellows were also made of clay. However, many of the open molds and bellows that have been referred to as being comparative to the Tell edh-Dhiba'i collection were made from stone and, in particular, limestone. This is especially true of those found in southern Palestine and in the Sinai. This occurrence reveals that within the same technological tradition there are two branches that have evolved to utilize most effectively the construction materials at hand.

It has been suggested that the metalworkers of the Sinai were itinerant and nomadic Semites (Beit-Arieh 1985, p. 115). However, stone molds and stone foot bellows of the early second millennium B.C. in Sinai

and Palestine do not appear to be convenient tools for the use of nomadic coppersmiths. These are the tools of people who are settled and who are working in a copper or bronze trade that has a high-volume production.

The beginning of this tradition is probably in the fourth millennium B.C. or even earlier. Sites such as Buhen in Nubia are likely to have elements of this tradition within its metallurgical objects. We are not likely to find much of the nomadic traditions of the Near East, as nomads carry and use only the bare essentials. The pattern ax head at Tell edh-Dhiba'i, which was used for casting in sand, may be a vestige of an earlier itinerent tradition. The use of sand molding is no doubt the precursor to the open molds of clay and of stone that became so common on sites of the third and early second millennia B.C. in the Levant.

The open molds, therefore, probably point to the origin of this tradition, and that origin is no doubt with the nomadic people who may have been Semites. They were people who were used to using meager resources of charcoal and who, like the Bedouin of today in the area, cast into open sand or clay molds. As these people settled into communities of the Near East, this tradition developed, so they made their implements larger and heavier, out of stone and clay, which enabled more metal to be cast without the need of refashioning tools to do the work.

It is therefore proposed from this technological analysis of the metalworking tools found at Tell edh-Dhiba'i and comparable sites that between about 3000 and 1500 B.C. there was a single metallurgical tradition in Mesopotamia, northern inland Syria, Palestine, and Egypt and that this tradition originated with nomadic people from desert regions. The name "Southern Tradition" is suggested for the metallurgical tradition as a means of distinguishing it from others that are found in Iran, Anatolia, and the Mediterranean. This conclusion means that the beginnings of the metallurgy of Sumer, Egypt, and Babylonia are not to be sought in the surrounding mountains, but in the deserts, in places such as Oman, Fenan, and western Saudi Arabia, where people are known to have mined and engaged in metallurgy.

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