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From farms to factories: The development of copper production at Faynan, southern Jordan, during the Early Bronze Age

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Abstract

Excavations of several key sites relating to the production of copper ore in the Wadi Faynan region of southern Jordan during the years 1990 – 1993 have revealed a sequence of development for the period 3600 – 2000 BC, which suggests a change from small-scale non-intensive smelting of copper, to highly-developed large-scale intensive production on the scale of a manufactory. In particular, the primary change from this low-scale production to the more intensive 'industrialised' production takes place at the beginning of the Early Bronze Age II (c.2900 BC), at a time when other social changes include the development of specialised horticulture on a large scale and of the first fortified towns in the Levant. Previous scholarship has noted extensive changes in the appearance of copper products at this time throughout the eastern Mediterranean, from the Aegean to Egypt. Recent work at Faynan in Jordan, however, provides the first evidence of these processes from the perspective of the copper production sites. This paper will report on these changes in production occurring in the early third millennium BC, the evidence for this specialisation and intensification, and the likely social mechanisms that effect this rapid change.

Introduction

The investigation of copper metallurgy in the southern Levant has for many years focused upon the 'origins' of metallurgy, rooted in the fifth millennium Chalcolithic cultures, c.5000 – 3600 BC (Joffe and Dessel 1995). Since the pioneering work of Mallon (Mallon *et al.* 1934, 1940) and later Perrot (1955) in defining these cultures, this period and the development of copper metallurgy in the Levant have been investigated in great detail. In particular the discovery of the Nahal Mishmar hoard (Bar Adon 1962, 1980) led many scholars to assume that the introduction and use of copper in this period was both widespread and highly sophisticated. More recently, Levy (1995) has demonstrated quite convincingly, through his work in the Beersheva Basin and especially at Shiqmim in the northern Negev Desert, that in fact quite the opposite was true. Levy has suggested that the production and use of copper metal during the Chalcolithic was most likely highly-specialised and restricted knowledge, and may have amounted to a near monopoly on this activity in the southern Levant by the Beersheva Valley cultures. Nevertheless, investigation of this 'earliest' phase of the use of copper metal in the Levant has for many years overshadowed research into the expansion of the use of metals and their widespread adoption in society.

Copper Sources in the Levant

As late as the early 1980s only two of the three primary copper sources in the Levant, in Sinai and at Timna, had been investigated to any extent. Disappointingly, investigations at Timna provided little in the way of material culture or occupation sites, and the primary evidence in the region has come from the remains of extensive mining activities. These mines have been difficult to date accurately, since most were reused repeatedly in later periods, often obscuring to a large degree the earliest evidence of use (Conrad and Rothenberg 1980). It was not until the mid-1980s that attention shifted to the examination of the third as yet poorly-explored copper resource zone in the Levant at Faynan, in the eastern Wadi Arabah of Jordan.

Metallurgical Investigations at Faynan

From 1985, the German Mining Museum (Deutsches Bergbau Museum, hereafter DBM) project in early metallurgy carried out detailed investigation of the mines, smelting and processing sites related to prehistoric copper production at Faynan. Numerous publications resulted from this research, which documented the full range of copper metallurgy in the region and has recently been summarised by Hauptmann (2000). The DBM project was chiefly successful in defining the technological changes in copper production and putting these within a temporal framework through an extensive series of radiocarbon dates. Being concerned as they were with the technical aspects of metallurgy, the DBM team was somewhat less successful in the analysis of its social impact, and in documenting the social changes that accompanied these advances.

In cooperation with the DBM project, the writer undertook four field seasons of survey and excavation work at the western end of the Faynan drainage in the Wadi Fidan from 1989 – 1992, as part of doctoral research at the University of Sheffield, UK (Adams 1999). The main emphasis of this research was to examine the evidence for early copper production through the study of related habitation sites in this area. These sites dated to the Early Bronze Age and excavations produced extensive amounts of data relating to metallurgy in this period, which in conjunction with the work on the mines and smelting sites by the DBM team allowed for the first time a detailed analysis of the important developmental phases of metallurgy during the Early Bronze Age, and the ensuing cultural and social changes which accompanied these technological advances. This period, as will be shown below, marks the transition from small-scale low intensity production to large-scale intensive production on a near 'industrial' scale by the end of the period.

The Early Bronze Age at Faynan

The Early Bronze Age in the Levant spans a period of over 1500 years, from the mid-fourth millennium to the beginning of the second millennium BC (c.3600 – 2000 BC). Traditional chronology divides the EBA into four main phases: EBA I–III, and a fourth terminal phase known as EBA IV (often referred to as EB/MB or MB I by various regional schools of archaeology). In practical terms, however, despite the increase in use of radiocarbon dating, chronological distinctions are most marked between EBA I, EBA II–III, and EBA IV when clear and demonstrable differences in material culture (especially ceramics) provide visible markers of change. In the Faynan region these distinctions are particularly obvious with clear and significant changes between the EBA I and EBA II/III periods noted in a complete change in ceramic tradition from a regionally distinctive style to one in the EBA II/III which is broadly homogenous across the southern Levant. In the Faynan region this transition can be seen clearly in the ceramic repertoire and also in significant changes that take place in the technology and social process related to metallurgy.

Throughout the Levant during the Chalcolithic period society is dominated by chiefdom-based societies living in small nucleated villages, situated in a two-tier settlement hierarchy of numerous villages and larger regional village centres. With the decline of Chalcolithic society in the early fourth millennium, this pattern of nucleated villages continues into the EBA I period. It is in such a small village community that the earliest evidence for metallurgy at Faynan comes, from the site of Wadi Fidan 4.

Metallurgy at Faynan during the Early Bronze Age I period

The site at Wadi Fidan 4 is a small village complex of rectilinear and apsidal houses that occupy a terrace located some 25 metres above the wadi. On this terrace the arrangement of houses, courtyards and open spaces is much as one would find in any village complex in fourth-millennium BC Levant (Adams and Genz 1995). The site has been known since the initial survey work of Raikes (1980), and was the subject of some controversy about its dating based largely upon the ceramic data from surface survey, until radiocarbon dates from the excavations established that the site dates to the last half of the fourth millennium BC (Adams 1999: 112).

Preliminary excavations in 1993 in three areas of the site and a nearby midden deposit produced a substantial amount of material, including ceramics, flint and worked stone objects, all of which suggested that the site was a domestic habitation. Alongside the evidence for this domestic occupation was also a significant body of data which indicated that the occupants of the village used the local copper ores from the Faynan district for the production of beads and copper metal.

There was significant evidence for bead production throughout the village structures and from the off-site midden where a number of broken beads were found. The vast majority of the beads were made from the variety of copper minerals from the Faynan region, in a range of shapes: cylindrical, barrel shaped and diskoid. Evidence of a stone grinding slab for bead shaping was also recovered from the village, indicating that bead production may have been a specialised activity at the site, enough at least for the investment of time in the production of a specific tool for bead shaping.

Initial evidence for copper production at Wadi Fidan 4 came from the earliest surveys, since the site was covered in several areas by small copper prills and pieces of slag. Hauptmann's (1989) early analysis of slags and metals from the survey suggested that it was most likely a crucible-based metallurgy. From the excavations, the primary evidence for metallurgy came from one large building and a related courtyard in Area D in the eastern end of the site, where 26 clay crucible fragments with adhering slag and melted copper were found. These probably indicate a minimum of 4–6 crucibles. The volume of these crucibles was quite small, with each crucible averaging about 10 cm in diameter and 8–10 cm in depth. These are considerably smaller than known examples from several of the Beersheva Valley Chalcolithic sites. In area D the crucible fragments were found in association with a courtyard that had the remains of eight small clay ovens, all of which contained grey ash. Analysis of the botanical remains from the ovens suggested that they were fired by animal dung, and although no direct evidence exists for their use in metallurgical activities, this cannot be discounted (Adams 1999: 117; Meadows 1996).

Copper prills or droplets of copper as well as small but significant volumes of slag were found throughout the site, but their concentration was more dense in and around the building and courtyard in Area D. There were also quantities of copper ore and waste ore/host rock pieces suggesting on-site dressing of the ores prior to smelting or bead production. Only one finished copper object was found in the preliminary excavations, and this was the point of a small copper awl.

It has been suggested that the form of crucible smelting undertaken at the site was carried out in a crucible set in an oven or charcoal bed but heated primarily from above by blowpipes (Hauptmann 2000; Rehder 1994). Hauptmann also suggests that the volumes of slag produced were extremely low and that it was virtually slagless copper production, with the producers selecting nearly pure pieces of copper ore with a high copper content for smelting. Evidence from the excavations indicates that some volume of slag was produced, and that rather than a one-step process as suggested by Hauptmann, smelting was probably a multi-stage process, with preliminary smelting followed by crushing of the smelted charge to select pieces for secondary smelting. This may have been inevitable given the method of smelting, since the reduction process is likely to have been extremely difficult due to the infusion of oxygen from the blowpipes in the heating operation. Significant amounts of the ore were probably first reduced to cuprite and then reheated in the final smelt to form a relatively pure copper ingot.

The combination of the evidence for ore dressing, smelting, crushing and grinding installations and associated smelting and waste products suggests that there was significant production of copper on site, albeit perhaps concentrated in specific areas of the village. The evidence indicates a specialised technology, most likely limited to a specific portion of the Wadi Fidan 4 community. The concentration of metallurgical activity at Wadi Fidan 4 seems to support the suggestion that early metallurgy may have been a restricted form of knowledge (Budd and Taylor 1995). Although the actual technology of production was of a specialised nature, there is not enough evidence to suggest that the primary function of the site of Wadi Fidan 4 was to exploit ores for either bead production or metallurgy. The overall evidence suggests a largely domestic setting, which may have had a sort of 'community specialisation', perhaps by virtue of proximity to the copper ore resources. The occupants may have also been involved in mining (as evidenced by stone mining hammers and hammer 'blanks' found at the site), as well as the trading of ores and copper production activities as a supplement to general subsistence activities.

The evidence from the DBM work at Faynan suggests that a significant amount of mining took place there during the fourth millennium BC, with open gallery mines cut into the Umm Ishrin Sandstone formation (Rabb'a 1994) (also known as the Massive Brown Sandstone or MBS formation (Bender 1974)). The copper deposits from the lower Burj Dolomite Shale formation (Rabb'a 1994) (also known as the DLS (Bender 1974)), seem to have only been exploited where this was exposed by faulting and erosion. The mining of copper during this period was done with the use of crude stone hammers, and the resulting open gallery mines are similar to those at Timna, with irregular and rounded galleries cut only a short distance into the rock formation, following veins of ore (Conrad and Rothenberg 1980, Hauptmann 2000, fig. 52). The available evidence supports the trade of these ores further afield and Faynan ores are known from Chalcolithic sites in the Beersheva Basin and Egypt (Hauptmann and Pernicka 1989). It is likely that this trade in ore continued well into Early Bronze Age I, perhaps supplemented by trade in beads and to some extent copper metal, either in a finished or semi-finished state.

The overall impression, then, of mining and copper production during Early Bronze Age I is that it is very similar to that known from the Chalcolithic period (Levy 1995). Due to the available technology, mining was confined to exposed or easily mined ore bodies in the sandstone cliffs of Faynan. The mined ore was used for both bead and copper production undertaken on a limited basis within the village, perhaps by specialist members of the community.

The Early Bronze Age II period in the Levant

At the beginning of the Early Bronze Age II period, c.2900 BC, there is evidence for social changes affecting populations at Faynan. Throughout the Levant at this time, changing demographic conditions and a continued trend towards an 'urban' way of life are well underway. This trend, which began in the later EBA I, possibly as a result of contact with Egypt, reaches a peak during the EBA II, with major town centres springing up throughout the region. The overall increase in population and a reduction in the actual numbers of sites suggest that larger sites began to play an increasingly important role in EBA II society. In addition to the trend towards walled towns during this period, other major societal changes are taking place, with increased centralisation and control, and the development of large-scale building projects (Amiran and Gophna 1989). Joffe (1993: 73) has suggested that the trend towards what he calls "population agglomeration" and the "functional differentiation and specialisation of sites" at this time lead to new relationships between these town centres and their surrounding hinterlands that foster the concept of 'urban' and 'rural' space.

During this period there is evidence of increased specialisation of production in a variety of technologies, including ceramic and flint tool production, and especially in terms of horticultural developments. The combined evidence from this movement towards specialisation suggests changing patterns of consumption and the production of 'commodities' for trade. The term commodity is used here for convenience, to refer to an object or material that, simply stated, has a value which is determined within a specific social context. This value can be a result of a number of factors whether an item be used as a marker of prestige or simply as a useful and utilitarian material.

Changes in metallurgy at Faynan during the Early Bronze Age II period

At Faynan the beginning of the EBA II period is when the first evidence for major changes in copper production was noted by the DBM project. Unlike the preceding period when metallurgy was undertaken within the confines of the village, there is now significant evidence for the smelting of ores at close proximity to the mines. This is no doubt as a result of developments in the smelting process, since there is a move away from small volume crucible smelting to larger smelting furnaces that no doubt produced significant amounts of atmospheric pollutants. These furnaces, well documented by Hauptmann and his team, appear to be large-scale operations with multiple installations being operated in close proximity to one another, possibly by natural draft as they are constructed on the windward side of high hills in the region. The best-preserved example of these furnaces is at the site of Faynan 9, where multiple furnaces were excavated indicating continued rebuilding on the same locality with furnaces superimposed one on another (Hauptmann 2000: 74-77, fig. 49).

In addition to these changes in smelting technology, there is also associated evidence for significant new developments in mining, with the introduction of shaft and gallery mines. Vertical shafts, which were dug down several metres to the DLS ore horizon, were then expanded into galleries following the narrow ore bodies often 1–1.5 metres in height. The excavation along the ore bodies, constructing a chamber and pillar system to ensure roof support, allowed the miners to dig very extensive galleries. It is clear from the available evidence that primary beneficiation took place within the mines themselves, and that the surplus mining waste was used to backfill the workings to ensure roof support (Hauptmann 2000, figs 54 and 55). The size and number of these mines documented by the DBM (in the Wadi Khaled, a total of 56 mines were found) suggest a dramatic increase in the scale of mining activities during Early Bronze Age II. The increasing sophistication of the mine construction suggests that mining activity may have been carried out by specialists. The primary reason for the shift away from open gallery mining in the MBS formation towards the much more difficult to mine ore deposits in the DLS is probably due to the fact that the copper ore was of a higher quality and more plentiful in the DLS deposits.

These changes in the mining and smelting of copper are only the visible remains of the developing complexity of copper production at Faynan during Early Bronze Age II. In order to support this level of activity, the transport of the ores to the smelting sites, and the production and transport of the large amounts of fuel now required for the expanded smelting activity would have required a significant amount of organisation and manpower. Analysis of the wood species used in the smelting operation suggests that much of the fuel used in these early periods most likely came from the Mediterranean forest, still in existence at this time on the Jordanian plateau (Engle and Frey 1996). Lastly, Hauptmann's (2000: 153) smelting experiments in replica furnaces suggest that the furnace contents once smelted would have to be crushed and processed to extract the copper metal from the slag. This is supported by evidence from the smelting site at Ras en-Naqb, a site very similar to Faynan 9, which is in close proximity to an extensive series of rock-cut mortars for the crushing of furnace slag (Hauptmann 2000, 85-86, figs 59 and 60).

The picture that we can see developing from all of the above is one of increasing sophistication and innovation in the technical processes, and a dramatic shift in the scale and intensity of copper production. The development of these operations required a significant amount of organisation of both labour and resources in order to support the production activities. In order to organise both the labour and resources needed, a degree of centralisation of control as well as manipulation of the labour base would have been required. The shift from small-scale 'community specialisation' in

EBA I to this highly-sophisticated and extensive production process in early EBA II seems to have occurred in a relatively short span of time, perhaps no more than a few hundred years.

Social Change at Faynan during the Early Bronze Age II period

The changes that occurred in the copper production processes at Faynan take place at a point when we can identify significant changes in cultural markers in the this region. Excavations at the site of Barqa el-Hetiye only a few kilometeres south of the Wadi Faynan have revealed a large rectilinear structure destroyed by fire and dated to the beginning of the Early Bronze Age II period on the basis of both radiocarbon and ceramic evidence. This structure, an isolated building on a prominent ridge near to one of the major smelting sites in the region, was partially constructed of dressed stone and surrounded by a stone wall which formed a courtyard for the building. The excavator has suggested it was a domestic structure of a 'unique' kind (Fritz 1994), but it has been proposed elsewhere that specific aspects of its construction and its similarities to other known cult structures of the EBA II period may identify it as a cultic building (Adams 1999, Chapter 6). The peculiarities of the building aside, its primary importance lies in the ceramic evidence from the site which shows that the EBA I indigenous ceramic style has now been replaced by what can be described as a normative EBA II style, broadly similar to the western Levantine styles, with no trace of the indigenous EBA I forms known from Wadi Fidan 4. Petrological study indicates that the ceramics found on site were both imported from the western Levant and produced locally. There is little difference in styles or wares, suggesting external influence on developments in Faynan at this time (Adams in prep).

Specialised Copper Production at Faynan during the Early Bronze Age III period

The evidence for the changes in mining and smelting activities that were documented by the DBM team can also be supplemented by material from the excavations at the site of Khirbat Hamra Ifdan (hereafter KHI). Excavations at this site in 1990 and 1992 (and subsequently in 1999 and 2000) revealed a portion of a well-built structure containing significant amounts of copper production debris, including numerous casting moulds and other evidence for the production of copper ingots and objects. The site is dated to EBA III on the basis of the ceramics and two radiocarbon dates that place it in the period 2600 – 2300 cal BC. The evidence from the site for extensive copper manufacturing suggests that the trend toward specialisation and an increased scale of production continued to the end of the main phase of the Early Bronze Age and into Early Bronze Age IV, a period often referred to as the end of the urban phase and one of societal collapse. The very extensive evidence for the final production of ingots and copper objects from this site suggests that this was a highly specialised operation for the final treatment of copper, prior to distribution. The evidence is of such an industrialised scale of production that it has been suggested that this site be termed a manufactory installation (Adams 1999; Levy *et al.* 2002).

The evidence from KHI is an important link for understanding the nature of copper production and trade in the later Early Bronze Age. While Hauptmann (2000) was successful in identifying various copper objects from Levantine Early Bronze Age contexts as having come from the Faynan copper sources, the evidence from KHI provided the first significant linkage in this distribution chain. During the excavations at KHI, significant numbers of clay casting moulds for the production of a copper objects (axes, pins, chisels) as well as a special type of bar ingot were found along with pieces of copper ingots (Levy *et al.* 2002). These ingots were already known from hoards at several excavations in the western Levant (Dever and Tadmor 1976; Maddin and Stech Wheeler 1976), principally from sites in the Negev. The discovery of casting moulds at KHI confirmed that these ingots had originated from Faynan. Although the Negev sites were dated to the Early Bronze Age IV period, the shallow stratigraphy and the fact that most of the finds from these sites were of 'ingot hoards' may suggest that the exact dating of these ingots is in dispute, and that they may in fact be EBA III in date. Despite the problems over the exact date, the correspondence of the ingots from the Negev sites with the casting moulds from KHI suggests that, by the end of the Early Bronze Age, copper was being produced in large quantities and exported as a commodity to the western Levant and perhaps beyond.

Scales of copper production at Faynan

At Faynan, the changes in technology and organisation during the Early Bronze Age II–III periods greatly increased the scale of copper production. Hauptmann estimated that in Early Bronze Age I copper production was probably in the range of a few hundred kilograms, although it was of such limited extent that it is difficult to quantify (Hauptmann and Weisgerber 1992; Weisgerber and Hauptmann 1988). Despite the difficulties in establishing estimates for Early Bronze Age II–III, Hauptmann estimated that between 300 and 500 metric tons of copper metal were produced (Hauptmann and Weisgerber 1992). This figure was based on his quantification of *visible* slags of the period although the true tonnage may in fact be much higher. The increase in scales of production is of such an order of magnitude that it requires a serious appraisal of the conditions under which such an increase might take place, and the factors that may have contributed to the increased demand for copper at this time.

Specialisation and control of resources during the Early Bronze Age II–III period

The intensification of copper production which can be seen in the archaeological record at Faynan can also be seen in other developments elsewhere in the southern Levant, including the extensive evidence of expansion in horticulture and viticulture (Miller Rosen 1997), trade in standardised flint tools (Rosen 1997), and the development of specialised and standardised pottery industries (Esse 1989, 1991). All of these developments had at their heart one key feature, and this seems to have been the centralisation and control of labour and resources.

In terms of the parallel developments in agriculture, Miller Rosen (1997) suggests that the agricultural intensification which takes place in western Palestine at this time developed on two levels, with production of 'cash crops' (both primary and secondary products, such as olives and olive oil, grapes and wine) for intra- and inter-regional trade, as well as 'subsistence crops' (wheat and other cereals). Miller Rosen also proposes that cash crops may have been regulated by elite segments of society, while cereal production was conducted on an exploitative basis by family units. Elites may have maintained control over agriculture through the extraction of cereals in the form of taxes or through religious motivation of the farmers, with storage of cereals for redistribution in times of drought or famine (see also Stein 1994). Another possible motivation may have been provided by allowing access to walled towns for defence against marauders (Miller Rosen 1997: 96). By means of these controls, the elites may also have gained control of the labour of the population for the production of cash crops, as well as for the building of fortifications, temples and other public construction projects. These elite 'managerial classes' may therefore have consolidated their control through the revenues from cash crops, control over staples and the trade of prestige items such as copper, as well as through controlling access to religious and defensive mechanisms.

This model for agriculture can also be used to support the development of metallurgy, with copper — like horticultural surpluses — being viewed as a specialised product requiring control and the manipulation of labour resources for the advancement of elites through trade.

Resources and organisation

The significant changes referred to here that were taking place throughout the southern Levant at the beginning of the Early Bronze Age II period should be seen against the changing situation in the region with respect to population demographics and increased international contact, which had begun at the beginning of the Early Bronze Age with the first contact with Egypt (Braun in press). It is important to place the transformation of copper production in the Faynan area against the background of these developments, since the rapid transformation of the copper industry and the scale of the developments in this period both point in the direction of major social changes. These were most likely of external origin, since the scale of development is difficult to account for on the grounds of indigenous factors alone. To summarise, the increase in the scale of copper production at the beginning of EBA II required several key innovations and developments:

- mining on an increased scale and now exclusively in the DLS copper deposits, which required new mining technology to build shaft and gallery mines;
- new smelting furnace technology to deal with the massively increased scale of production, and to smelt the ores more efficiently;
- increased procurement of fuels for smelting;
- increased manpower to work the mines, supply fuel for the smelting ovens and process the ores before smelting, and the slags after smelting;
- the organisation, co-ordination and control of these various activities.

When the evidence of extensive changes at Faynan are reviewed against the parameters put forward by Costin (1991) (Figure 2), it is clear that these modifications in the scale, concentration, intensity and context of production indicate that there were major transformations between Early Bronze Age I metallurgy as seen at Wadi Fidan 4 and the later Early Bronze Age II–III form of production.

Scale

In terms of the scale of production, the evidence is unambiguous in indicating a large increase in the absolute volume of copper produced. This can be seen in the occurrence of the residual slags from smelting that have been radiocarbon dated to this period, as well as from the evidence of the mine waste or 'tailings' which cover large portions of the landscape around the new shaft and gallery mines. Although this mine waste is difficult to date precisely, large amounts of these tailings can be dated to the Early Bronze Age II–III period on the basis of associated ceramics.

The increased scale of copper production is also clear from the evidence in the vicinity of the smelting installations, which include extensive furnace production areas and proof of the continuous refurbishment of smelters, as well as the proximity of numerous crushing installations. On the basis of this evidence, we must also assume a large increase in the amount of fuel required for smelting. This implies an increase in manpower required for the movement of the fuel, as well as of the ores from the mines to the smelting sites.

Concentration

The concentration of this smelting activity is equally clear from the archaeological evidence. In contrast to the evidence for the Chalcolithic and Early Bronze Age when production was dispersed in domestic village contexts either outside the mining zones or, as in the case of Wadi Fidan 4, somewhat removed from the mines, Early Bronze Age II–III smelting activities were near the mines, in the closest areas suitable for natural draft furnace smelting.

This concentration can also be seen in the occurrence of closely-arranged smelting installations at sites such as Faynan 9, where numerous furnaces are located in a small area, as well as from the evidence of spatially-concentrated crushing and processing installations near to the smelters, as at Ras en-Naqb. These sites were most likely used for the preparation of the smelting charge and the separation of copper metal from the slag after smelting. That this spatial distribution of activity is related to large-scale workshops rather than many nucleated individual producers is best evidenced by the tightly-packed nature of the smelting installations, which suggests workshop activity away from domestic habitations, in an area exclusively reserved for this activity.

Intensity

Assessment of the intensity of copper production during the Early Bronze Age II–III periods at Faynan relies to a large degree on circumstantial evidence related to both its scale and concentration. It is difficult to say with absolute confidence that the production activities were being conducted by 'full-time' specialists, but there is evidence which may indicate this to be the case. Perhaps the best evidence for a shift to 'full-time' specialists is the dramatic increase in the number of different operations that are being carried out, many of which by this time had become quite 'specialised' in technological terms. Included in the latter is a very specialised type of mining activity that required careful and expert knowledge to ensure the creation of a stable mine with sufficient roof support and suitable circulation of air. Other 'specialised' activities probably included ore dressing, fuel procurement (the felling of trees and possibly charcoal production), transportation (of both ores and fuel), the manufacture as well as the operation of smelting furnaces, the crushing of slags and, most likely, recasting operations to form the primary smelted metal into ingots and objects. All of these activities suggest a degree of specialisation, and many are best attributed to 'full-time' specialists.

Context

All this evidence of large-scale, concentrated workshop activity by full-time specialists suggests that these activities were being carried out by attached specialists, rather than independent producers. This seems the most likely interpretation on the basis of both the archaeological data and an understanding of the rapid nature of the transition to large-scale production. It is unlikely that the scale of production and the rapidity of technological changes were driven by 'supply and demand' alone. It seems more likely that the high degree of organisation and co-ordination of the labour involved, as well as the large number of individuals required to carry out the copper production, were the result of some form of attached specialisation. Whether these attached specialists were working under the patronage of a major centre or, alternatively, some other interest group who provided the basic subsistence requirements of the production community remains an open question.

Changing Patterns of Consumption in the later Early Bronze Age

All of these developments and the general intensification of copper production point to a rapidly increased demand for copper as a specialised product. To understand fully the changing patterns of production at Faynan during Early Bronze Age II–III, it is necessary to understand the changing nature of consumption during this period that leads to this increased production.

Any discussion of consumption should be firmly rooted in an understanding of it as a social process, and in an acknowledgment of the role that materials (such as copper in this case) play in societies as reflections of prestige, social markers or wealth. The close association of metal objects as markers of prestige in burials has often been seen as a hallmark of the early periods of metal use throughout the Old World. That metal objects played a role in early society primarily as a display of personal social ranking, as a form of elite display, and also in creating and maintaining social networks of bonding and obligation, is now commonly accepted. Renfrew (1986), however, in his study of the Varna cemetery on the Black Sea, has stressed that it is important to note the circularity of these arguments regarding the association between rich burials with numerous metal objects and supposed ranking. He suggests, and then demonstrates with reference to Varna, that it is both necessary and possible to show a 'conjunction' between the perceived 'value' of metal and social ranking in early metal-using societies.

Indeed, a number of scholars analysing patterns of early copper metal utilisation in the Old World have suggested that the earliest use probably had little to do with the utilitarian aspects of the material, and that copper items were primarily seen as objects of high prestige and value for display, rather than as *useful* commodities (Renfrew 1986: 144, emphasis in original). Budd and Taylor (1995: 139) remark that the processes of copper *production* may have played a significant role in this prestige, in as much as "…the ability to put on a show of colourful, transmogrifying pyrotechnics may have commanded considerable respect". Both Renfrew, and Budd and Taylor argue (contra Childe 1944) that the introduction of metal-producing technologies, rather than being significant technological ‘stages’, were in fact not immediately significant events in their own right. Renfrew (1986: 146) also suggests that the ‘innovation’ of metallurgy was not in its discovery, but in the eventual ‘adoption’ of metals as useful commodities in considerably later times, when the technology had progressed to a stage where production promoted “…efficiency in a way that is adaptively advantageous”.

Nakou (1995) hints at just this scenario in the context of the development of the use of copper in the Aegean Bronze Age. There, the archaeological evidence for the use of metal in the Neolithic period is in such a stark contrast to the Early Bronze Age 2 period as to produce a ‘*Metallschock*’, with the ‘sudden’ appearance of increased amounts of copper and other metal objects as conspicuous consumption in the burials of elite males. Nakou attributes this largely to the changing social strategies and behavioural patterns in which metal objects, and especially weapons, are used as a means of identifying emergent (male) groups, and as markers of “…membership in a successful group…defined by participation in esoteric knowledge, of which metal was the material embodiment” (1995: 23).

This evident change in the patterns of deposition of metal objects is also seen in other parts of the Mediterranean and notably in the Levant, where it is similarly visible in the context of changing patterns of burial that move from the collective to the individual (Joffe in prep). Likewise in Egypt, the development of an elite can be seen in the changing style and scale of the burial monuments themselves, as well as in the deposition of imported goods perceived to be ‘elite’ in nature, many of which are the products of ‘specialised’ production (Dreyer 1992).

This notion of the value and prestige of metal objects as *documenting* personal ranking, through individual ownership and the deposition of objects in burials, may in fact be viewed from a slightly different perspective. Following Hodder (1982), Renfrew (1986: 156) suggests that, rather than merely *reflecting* an expression of social ranking, the ownership and display of such valuable objects may have *contributed* to the establishment of prestige and rank and “…constituted an essential part of the prominence of the owner”. This of course lends an active role to material culture, rather than simply seeing artefacts as a material reflection of embedded social structures.

The shift from curation in the earlier stages of metallurgy to a tendency for conspicuous consumption through deposition (and hence loss from circulation) is an obvious example of the changing patterns of metal consumption during the Bronze Age. It can be argued, however, that there is a further step to the consumption trend, in that during the developed Bronze Age there was a tendency away from high quality objects that showed considerable input of labour in production to more mass-produced items (this trend is clearly visible in the numerous casting moulds for multiple copper objects found at KHI (Levy *et al.* 2002)). There is evidence of a change in pattern or a transition, when metal objects were no longer regarded as important in their own right as specific objects of production, rather as much for the value of the ‘material’ (in this case copper). This shift marks the move toward metal being perceived as a true commodity, and as having a value on the basis of the ‘material’ rather than as an individual crafted object. This tendency can be suggested to parallel the continued intensification of metal production, and at the same time marks a decline in the prestige aspect of objects and a shift towards the utilitarian characteristics of the material. In addition, this transformation most likely reflects a developing trend toward the accumulation of ‘wealth’ in the form of copper as a tradable ‘commodity’ for exchange in a semi-finished form, often in the shape of ingots.

Copper consumption during the later Early Bronze Age

It remains to explore the nature of this increased demand, and suggest the reasons for and probable end-users of this large supply of copper. It is unlikely on the basis of the current evidence from excavations that the majority of the copper produced at Faynan was for the direct use of the communities in the Levant. The sheer volume of copper produced during this period of expansion is not reflected in finds from the known excavated sites. It is more likely that intra-regional trade was simply one avenue of distribution, and that the largest demand for copper came from outside the Levant.

If we are to look for an alternative end-user of the copper being produced during the later Early Bronze Age, the most likely consumer is Egypt. The possible role of Egypt in providing an external stimulus to urban processes in the Levant is generally accepted (Brandl 1992; Braun in press; Levy *et al.* 1995, 1997), and the importation of specialised products such as wine, oil and bitumen into Egypt from at least the Pre-Dynastic period is well documented (Dreyer 1992, Oren 1973, 1989). Given that Egypt was a resource-poor society it is logical to assume that it was also eager to attain copper. Numerous scholars have over the years pointed to Egypt as an importer of Levantine copper (Ben Tor 1986; Gophna 1976; Kempinski 1989, 1992; Stager 1992), but little direct evidence has ever been presented in support of this theory. Marfoe (1987: 26) has suggested that this factor may have been a primary one in developing centralisation in Early Dynastic Egypt:

> "In Egypt a monopoly of this lucrative link — particularly in copper — may have contributed to the further centralisation of the state between Dynasties I and III, if not earlier. Impressionistically, at least, there seems to be a significant rise in copper found in Egyptian contexts from Nagada III onwards. In a tomb dating to the reign of Djer (Dynasty I: Emery 1949), 700 copper objects (including 75 'ingots') were found. By Dynasty II, a smaller but similar cache was deposited in the tomb of Kha'sekhemwi, suggesting perhaps that a control over this strategic resource was a royal and/or elite prerogative. By Dynasty V, copper was sufficiently common to be used for a long drainpipe in Sahure's funerary complex, indicating that the deployment of wealth that surely preceded the Old Kingdom was laid mainly in the late Pre-dynastic and Early Dynastic times."

This demand for copper, which provided a new and useful resource to the expanding elites in Egypt, may perhaps be the ultimate answer to the question of who were the primary end-users of this increasing copper production at Faynan. Marfoe (1987: 28) has suggested that copper may well have played a significant role in the creation and maintenance of Egyptian elites:

> "A state monopoly of an inflow of goods — especially metals — can be a factor in a state's capabilities to mobilise human energy, a phenomenon that was spectacularly successful in the Egyptian case. As durable, reputable, quality controllable resources with a degree of scarcity, metals have possessed a substantial potential for binding allegiances in later times…the early centralisation of the state structure may have been in part achieved by the deployment of capital through proscribed yet 'legitimate' channels that restricted the range of alternate modes of acquisition."

The evidence for the importation of copper into Egypt seems clear. There is evidence from at least the Nagada I (Late Chalcolithic) period at Maadi, which continued during Nagada II (Early Bronze Age Ia) when finds of over 50 copper objects, including fish hooks, chisels, axes and adzes, sheet metal and three ingots, point to the centre as a major importer of copper objects. The ingots (two of which are the same shape) are all within a very close weight range, which may be indicative of a degree of standardisation in ingots (Rizkana and Seeher 1989: 17). Hauptmann and Pernicka (1989: 137–141), analysing seven ore samples and five objects from Maadi, suggested, on the basis of texture, mineralogy and chemistry, that the majority of copper ores and objects are probably derived from the same source. This is most likely the DLS levels at Faynan, although Timna cannot be totally excluded as a possibility (Hauptmann 1989: 129).

The end-users of the copper produced at Faynan during the later Early Bronze Age cannot at present be proven conclusively, but the available evidence suggests that, in addition to the increasing level of demand for copper amongst the developing 'urban' polities of western Palestine, the emerging

Egyptian state perhaps provided the necessary large-scale endusers of copper. The changing patterns of consumption in Egypt, often in the form of conspicuous consumption by elites for burial and deposition, may have resulted in dramatic changes in demand for copper at this time and caused the increase in copper production at the beginning of the Early Bronze Age II period at Faynan.

Conclusion

To summarise, the evidence for copper production at Faynan outlined here suggests that the most significant changes in its organisation occurred in Early Bronze Age II–III. These changes can be seen as a transition in the 'type' of production occurring in these periods. There is a clear change from a dispersed, low-scale, low-intensity and independent form of production at Wadi Fidan 4, where there is possible evidence of a 'community specialisation' that exploited the nearby copper resources during Early Bronze Age I, to a large-scale, high-intensity, nucleated form of production that suggests attached specialisation during Early Bronze Age II–III. The evidence at Faynan suggests that these changes were probably in reaction to external factors, such as the increasing consumption of copper by other regions, including the emerging urban towns in the western Levant and Egypt. The social changes occurring at Faynan during the EBA also suggest that this region experienced change as a result of contact with the western Levantine, as evidenced through changes in regional ceramic styles. The effect of these contacts was most likely far reaching and long lasting, and resulted in significant reorganisation of both the copper industry and local cultural traditions. These developments should been seen in the context of similar changes in other aspects of social organisation and production throughout the Levant at this time, and must also be viewed against an overall changing pattern of consumption and trade networks both within the Levant and between the Levant and Egypt during the early third millennium BC.

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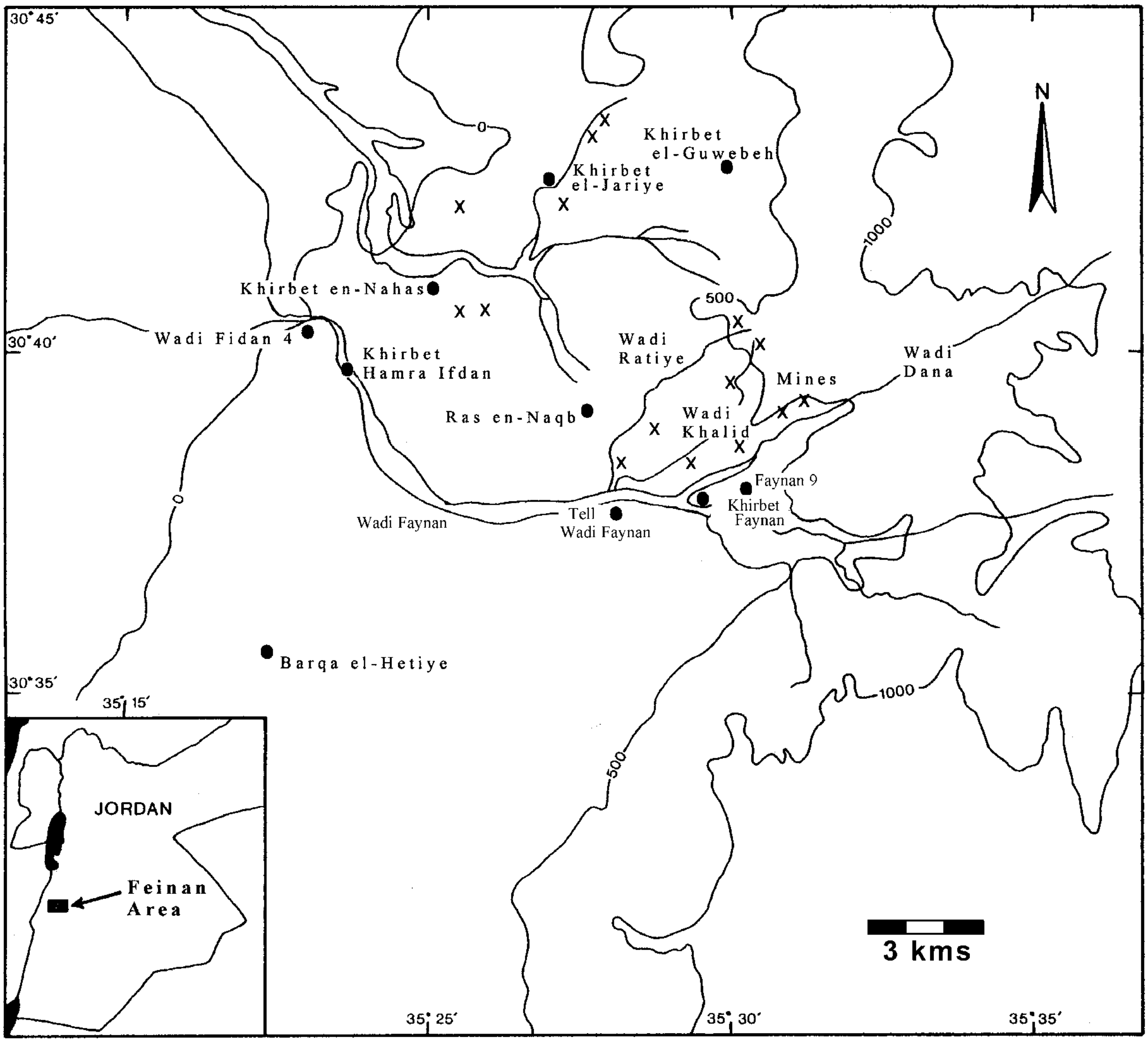

Figure 1 Sites mentioned in the text.

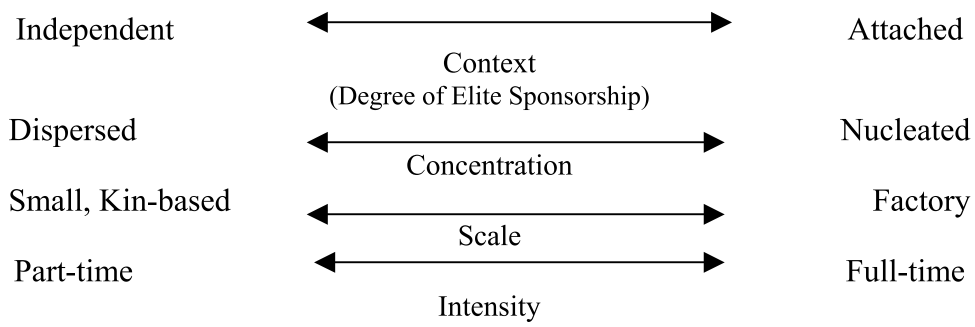

Figure 2. Primary parameters which characterise the organisation of production (after Costin 1991: 9).