

EXCAVATING MINES, WITH EXAMPLES FROM CWMYSTWYTH, CHINFLON AND KESTEL

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Abstract: Archaeological excavation within mines has become an important component in the multi-disciplinary approach to the study of early mining and extractive metallurgy. Investigations of an open cast, a trench mine, and an extensive system of underground workings are discussed, with particular reference to the strategy and methods of excavation adopted in each case. A brief summary of the results is provided in order to illustrate the range of information which can be gained.

During the past 25 years or so there has been an increasing interest in ancient metal mines and metallurgy. Before this, discoveries of archaeological interest in mines were usually the result of the clearing out of "Old Man's" workings during subsequent mining activity. Discoveries at Rio Tinto received widespread attention (Palmer 1927), but elsewhere many finds of less obvious significance are likely to have been destroyed or discarded without recognition. Tools including stone hammers were sometimes recorded, but prior to the introduction of radiocarbon dating it was generally impossible to date many of the workings. In Britain it was sometimes assumed, quite reasonably, that they were the work of the Romans or Ancient Britons (Davies 1937), but evidence for prehistoric mining was thought unlikely to have survived. Modern techniques of investigating ancient mines and metallurgical sites pioneered by Prof. Beno Rothenberg in the Sinai and Arabah regions of Israel have led to a revolution in this aspect of archaeology (Rothenberg 1972). Today, the investigation and recording of metal mines is much more widespread.

In many ways the approaches to the excavation of mines, whether open cast or underground, are similar to those employed on more conventional sites on the surface. However, constraints particularly of light, space and accessibility, as well as the nature of the deposits, present problems rarely encountered on the surface. Furthermore, adherence to health and safety guidelines, an important, and, in this country statutory, requirement on excavations, may pose additional constraints.

It is important, especially in mines which may have early, possibly prehistoric origins, that the excavation and recording should be meticulously carried out for the sequence of activity may be equally as complex as on many surface sites; the wealth of information that can be gained from the excavation of mines often comes as a surprise both to archaeologists and those interested in the history of mines. Careful excavation may reveal evidence not only for dating the mine, but also for periods of activity and disuse, methods of working, and even for what was being mined. This may have significant ramifications which go far beyond simply understanding the history of a particular mine.

Three projects carried out during the past 15 years are summarised, two of which are still in progress. They all involve work on mines which are principally of prehistoric date, though all have evidence of later activity, and which because of their nature have necessitated different approaches to their excavation and recording. It should be emphasised that in each case excavation of the mine forms part of a larger interdisciplinary project involving surface, underground and geological surveys, excavation of associated settlements and processing sites, and related archaeo-metallurgical work. All are research rather than rescue projects carried out by small teams in 2-4 week seasons spread over several years.

COFA HILL, CWMYSTWYTH (MID-WALES)

A fuller description and discussion of this site excavated by the Early Mines

Research Group under the direction of Simon Timberlake is presented elsewhere (Timberlake 1990a and b). This paper will concentrate on some of the archaeological approaches adopted to its excavation.

Initial excavation in 1986 on waste tips below an open cast working on Copa Hill suggested that the mine was worked for copper in the Early/Middle Bronze Age (Timberlake and Switsur 1988). It was therefore decided to carry out an excavation within the open cast in order to obtain more evidence for the date and methods of working.

The problem presented by an open cast mine is that it is necessary to examine the floor and adjacent rockface in order to recover *in situ* evidence for working. Such evidence may lie beneath several metres of later infill, and perhaps include tools and timberwork which have been discarded or abandoned, and waste tips which may contain charcoal from firesetting for radiocarbon dating.

At Copa Hill the open cast working is of a relatively modest size, and selecting an area for excavation was not the problem it might be in a larger working (Fig. 1). A small area in the corner adjacent to the probable entrance was chosen as it was considered that the working might be shallower there, and solid rock would provide two edges to the excavation thereby increasing safety and reducing the quantity of shoring required. The latter was of some importance as the site lies on the brow of a hill and is not approachable other than by tracked vehicle, and then, only by exercising considerable caution. All shoring, comprising scaffolding tubes and joints, corrugated steel sheets and timber had therefore to be brought by hand across a bog from the nearest point on a farm track some 750 m away. This ruled out using any form of sheet-steel shoring which might normally be preferred on a small excavation several metres deep, but would have been too heavy to transport easily to the site.

The excavation carried out between 1989 and 1991 was essentially a trial trench designed to establish the sequence and nature of deposits, obtain dating evidence, and recover and record any finds. All excavation was done by hand, and spoil removed using a manually operated winch and stored nearby. This approach was particularly appropriate here for the site including much of the surrounding hillside is a Scheduled Ancient Monument; permission to excavate, what can be excavated and reinstatement conditions are more rigorously controlled than on unscheduled sites, particularly where excavation is a research rather than rescue project. A

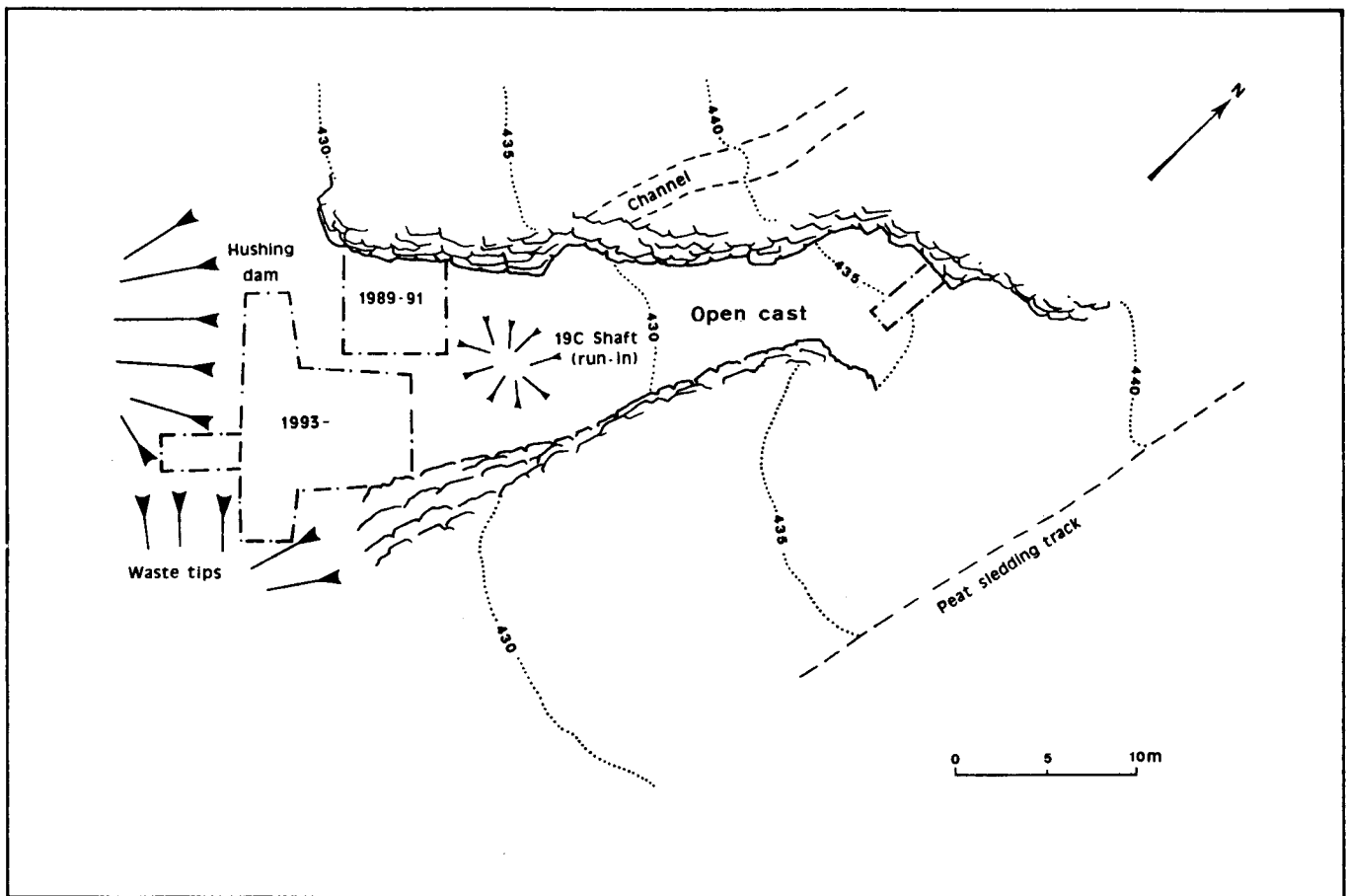


Fig. 1. Copa Hill. Plan of opencast showing location of excavations 1989-91 and 1993 (contours in metres).

mechanical excavator could have been used, but is a relatively 'blunt tool' for this purpose, particularly in the loose deposits anticipated. Furthermore, it would not be able to reach the depth required without removing a large volume of material in a series of ramps and steps, thereby destroying deposits without investigation. During the three seasons of work a trench measuring 6 m by 5 m at the surface and 7 m deep was excavated (Plate 1). The sides sloped inwards as it proved impossible to install vertical shoring in the loose shale which comprised much of the upper deposits. The insertion of shoring meant that it was not possible to view a complete section through the deposits, and so running sections were maintained. Before each level of shoring was installed at 1 - 2 m intervals, the exposed section was photographed and drawn so that a composite section could eventually be constructed. The shoring comprised several scaffold-tube 'boxes', each slightly smaller than the one above, with corrugated tin sheet and timber driven down behind the 'boxes' to hold back the loose rock and soil (Plate 2).

The careful hand excavation approach was soon vindicated for it became clear that the deposits represented a complex series of events. At the bottom were dumps of fire-set rock debris containing

charcoal, damaged or broken stone hammers, several pieces of discarded galena suggesting that copper rather than lead or silver was mined, and fragments of wood preserved in the permanently damp conditions; a more recent shaft driven through the bottom of the open cast had drained it so that trapped water requiring pumping-out was not a problem on this excavation. Subsequent deposits derived largely from weathering and erosion of the open cast sides rather than mining activity. These were sometimes separated by layers of peat, and in one instance by a substantial ponded deposit of clays which had accumulated when a hushing dam was later built across the front of the largely infilled open cast. Environmental sampling of these peats and clays for pollen, plant macrofossils and insect remains is providing much evidence about the vegetation sequence in the vicinity (Mighall 1990). The only evidence for post-Bronze Age mining activity within the open cast was provided by two infilled shafts, both of post-medieval/early "modern" date, the earlier of which appears to have been a trial working, the latter a shaft linking with a deeper system of underground workings. The former was very difficult to detect and its position was only confirmed by plans drawn at intervals as excavation progressed downwards, tied into a grid established on the surface. Its recognition was particularly important for

it contained pieces of wood which produced a comparatively recent radiocarbon date. Had they not been recovered from a stratigraphically secure context then they would have thrown considerable doubt on the antiquity of the open cast workings. Having established and provisionally dated the sequence of deposits, it was decided in 1993 to open up a larger area adjacent to the trial trench in order to expose more of the earliest, Bronze Age, phase of mining. It was anticipated that this would include the entrance area, and provide a cross-section across the entire open cast. A small, tracked excavator was used to remove the uppermost deposits which had been shown to be derived from weathering and erosion of the open cast sides (Plate 3). A series of steps approximately 1 m high were left around the sides of the excavation to avoid the necessity for shoring, and care was taken not to disturb any *in situ* deposits of mining debris on the exposed rock surfaces. Machining unavoidably left a somewhat irregular hole in the ground which required straightening and clearing of all loose material before further, hand excavation was begun (Plate 4). Work has not been completed and will continue in 1994, but already two launders made from hollowed-out tree trunks possibly of Bronze Age date have been discovered, one apparently *in situ*. Their very soft condition will probably preclude them



Plate.1 Copa Hill 1989-91. Installing shoring.

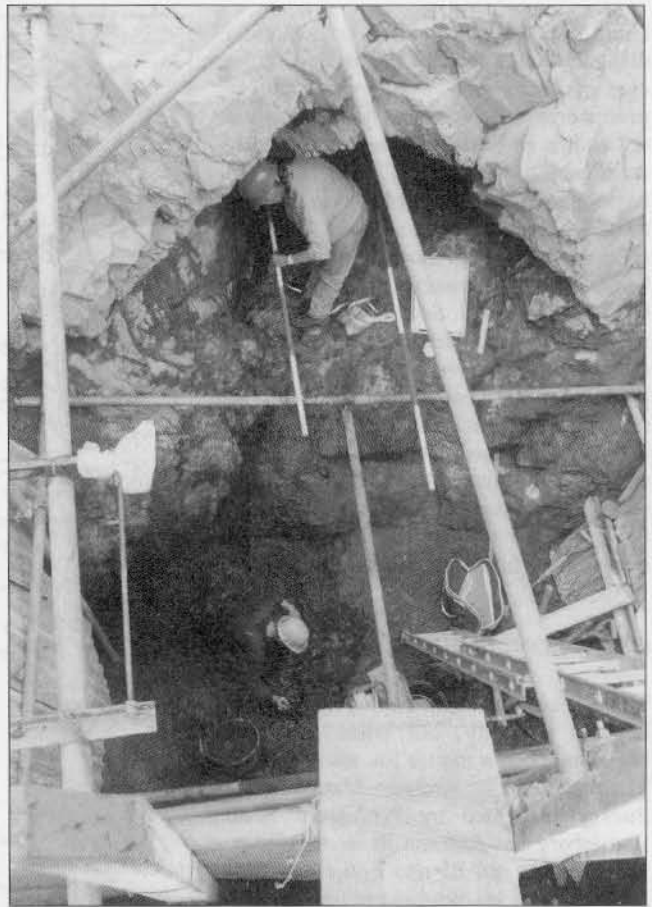


Plate 2. 1989-91. Excavation and recording in progress. In background a short fireset gallery with stone hammers.

Plate 3. 1993. Site during machining, view to west.



Plate 4. 1993. After cleaning - note battered surfaces with mining debris (centre), and ponded deposits (bottom left) overlain by layers of eroded rock. View north into opencast.



being lifted without considerable difficulty and expense. Furthermore, the cost of conserving wood, even that of prehistoric date, is rarely worthwhile unless it is of intrinsic interest and easily retrievable. At present, both laundries have been cocooned in plastic to prevent them drying out, and it is likely that only short sections of the more solid parts will be removed and conserved after they have been fully recorded. Several areas of rock showing clear evidence of battering by stone hammers have also been revealed, protected from weathering by burial, and the best examples of these will be drawn and photographed. After excavation is complete the site will be backfilled and reinstated, leaving a large proportion of the open cast undisturbed and available for possible future research.

CHINFLON, HUELVA (SW SPAIN)

There is no doubt that copper was mined here in antiquity, but when this first began has been a matter for some debate. The Huelva Archaeo-Metallurgical Survey instigated by Professors Beno Rothenberg and Antonio Blanco-Freijeiro (Rothenberg and Blanco-Freijeiro 1981) recorded a series of what are best termed 'trench mines', following malachite outcrops across hills in this fairly remote region of south-west Spain. The proximity of several mines to groups of megaliths raised the possibility that the earliest phase of mining was contemporary with these, and dated to the 4th millennium BC. In order to investigate this further, excavation of two of the mines and an associated occupation / smelting site was undertaken.

Between 1978 and 1980 one mine was fully excavated and another partly excavated (Rothenberg and Blanco-Freijeiro 1980). These provided evidence for having been worked in the Late Bronze Age, with no clear evidence for earlier exploitation. Both mines lay close together near to a hilltop, a short but steep climb from a forestry track, and had become almost totally infilled to within a metre or so of the surface. The fully excavated example (Mine B) will be discussed here. This was selected for investigation as it appeared to be undisturbed, whereas several others showed evidence of having been dug into or emptied at a later date, perhaps during prospecting. On the surface the mine is several metres long, but less than a metre wide making total excavation the most appropriate strategy; it was assumed that the mine was going to be between 10 m and 20 m deep (Plate 5).

The majority of the excavation was carried out by a team of three people, one excavating and two to haul the spoil out

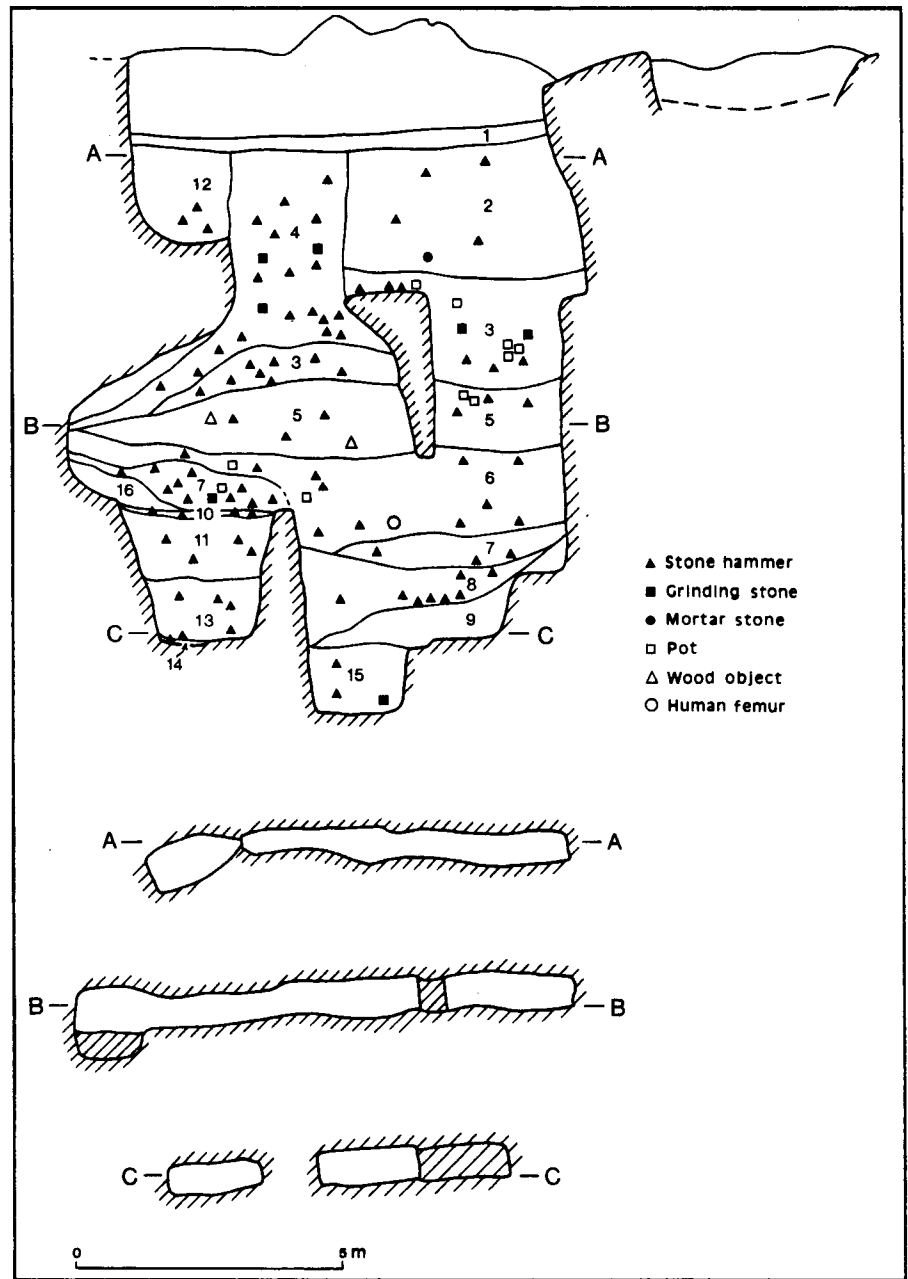


Fig. 2. Chinflon - reconstructed section through deposits in Mine 4B.

using a tripod, pulley block and bucket. Deposits were removed in a series of spits up to 0.5 m thick, recording in two dimensions (length and depth) the location of all finds in relation to two fixed points on the surface. Most finds were damaged or broken stone hammers, though some pottery, wood objects and a human femur were also recovered. As excavation progressed it became clear that the fill was not uniform, but comprised a series of quite different deposits derived from several sources representing both natural and deliberate infilling. These were recorded as part of a single running section.

One minor problem which developed as the excavation reached deeper levels was the lack of light. A battery-powered cap lamp augmented the available natural light, but this was not ideal for the recovery of finds and identifying changes

in the deposits. However, all spoil removed was checked at the surface to recover any finds overlooked below, and changes in the deposits could often be detected by recognising changes in texture. Some rainwater had become trapped in the workings, but the comparatively small volume was easily removed by bucket, and its presence had proved beneficial in the preservation of a considerable amount of wood, both worked and unworked. Heavy overwinter rain after the end of the first season resulted in the workings becoming flooded, but the water was easily removed using a small pump lowered into the workings.

The width of the workings remained fairly constant with some slight variations, but the bottom was comparatively irregular, presumably reflecting different depths of oxidation,

reaching a maximum depth of around 15 m. Access to the workings was facilitated by a pair of 15 m chain ladders. Very little *in situ* evidence of working survived, perhaps not surprising given the restricted confines of the bottom of the mine, but from the reconstructed section through the deposits it has been possible to interpret the sequence of mining activity and subsequent infilling (Fig. 2). This was more complex than anticipated, and could only have been deduced as a result of excavation.

The trench-like nature of the workings and the lack of charcoal indicated that mining was carried out by battering the rock rather than by firesetting. This was confirmed by the nature of several of the deposits which comprised finely crushed rock. The presence and distribution of this debris making-up a substantial proportion of the infill suggested that not only were abandoned parts of the mine backfilled, but the mine itself was largely infilled with mining debris after it was exhausted, presumably from an adjacent working. Scattered throughout this debris were a large number of grooved stone hammers, all damaged or broken and presumably discarded. Other finds included several wood objects amongst which were part of a notched ladder, a platter or shovel, and two or three



Plate 5. Chinflon - Mine 4B during excavation.

stemples. There was also a pottery bowl and a lamp, and a human femur - probably from a disturbed burial on the surface rather than a mining accident. All these objects are likely to have been deliberately or accidentally disposed of with the mining debris. The most unusual deposit in the infilled mine was a substantial layer of well-preserved brushwood and leaves from dwarf oak

trees (layer 8), probably derived from surface clearance. Such material can provide important environmental information and samples for radiocarbon dating - particularly useful here in the general absence of charcoal. Surprisingly, no wood haftings from the stone hammers were found. Samples of this brushwood and a similar deposit from an adjacent, largely emptied mine produced Late

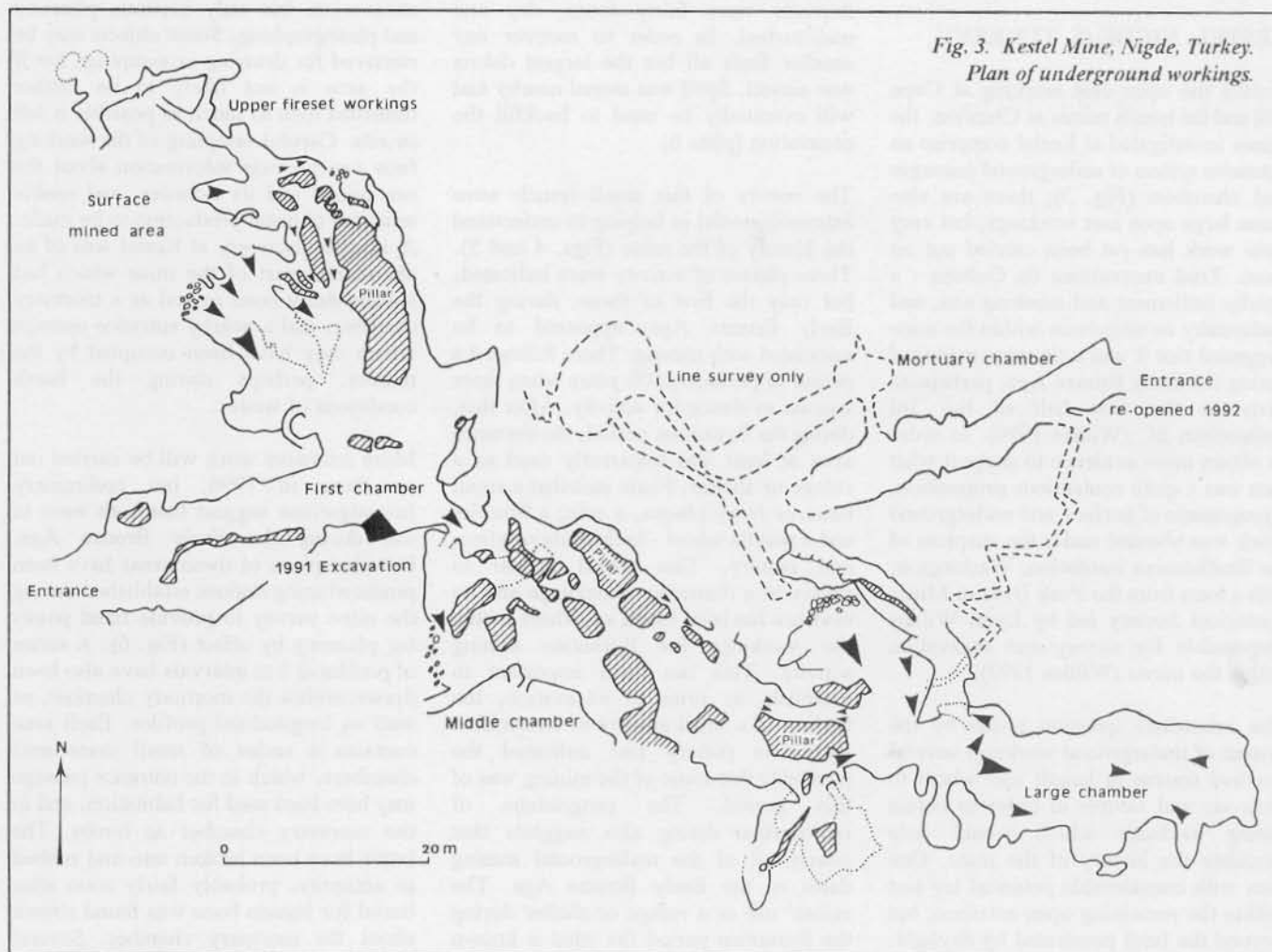


Fig. 3. Kestel Mine, Nigde, Turkey. Plan of underground workings.



Plate 6. Kestel. Entrance area: the site of the 1991 excavation lies to the right beyond the figure.

Bronze Age radiocarbon dates, thereby seeming to rule out any link between the construction of the megaliths and these trench mines. Nevertheless, the mine along with the adjacent occupation/smelting site represent a rare and comparatively well-preserved example of a Late Bronze Age copper mining complex.

KESTEL, NIGDE (S. TURKEY)

Unlike the open cast working at Copa Hill and the trench mines at Chinflon, the mines investigated at Kestel comprise an extensive system of underground passages and chambers (Fig. 3); there are also some large open cast workings, but very little work has yet been carried out on them. Trial excavations on Goltepe - a nearby settlement and smelting site, and preliminary investigations within the mine suggested that it was a tin mine exploited during the Early Bronze Age, perhaps as early as the first half of the 3rd millennium BC (Willies 1990). In order to obtain more evidence to support what then was a quite contentious proposition, a programme of surface and underground work was planned under the auspices of the Smithsonian Institution, Washington, with a team from the Peak District Mines Historical Society led by Lynn Willies responsible for survey and excavation within the mines (Willies 1992).

The immediate question posed by the system of underground workings several hundred metres in length was where to excavate and sample in order to obtain dating evidence which would help elucidate the history of the mine. One area with considerable potential lay just within the remaining open entrance, but beyond the limit penetrated by daylight.

Cap lamps provide insufficient light for excavation, and so a portable generator set up outside the mine powering two arc lights was used to provide illumination. The lamps were attached to the roof at a height of about 2 m, and proved suitable for excavation without any great problems from shadows. The area chosen for excavation was small, only 3 m by 3 m, against one side of the broad, high, gently sloping entrance chamber. The surface deposits were fairly loose, dry and undisturbed. In order to recover any smaller finds all but the largest debris was sieved. Spoil was stored nearby and will eventually be used to backfill the excavation (plate 6).

The results of this small trench were extremely useful in helping to understand the history of the mine (Figs. 4 and 5). Three phases of activity were indicated, but only the first of these, during the Early Bronze Age, appeared to be associated with mining. There followed a period of perhaps 2500 years when there was no evidence for activity. After this, during the Byzantine period, the entrance area at least was apparently used as a refuge or shelter. Finds included a small bone or ivory plaque, a coin, a bracelet and a spindle whorl - both made of glass, and pottery. This would appear to represent a domestic assemblage and no evidence has been found anywhere within the workings for Byzantine mining activity. This has been important to establish, as prior to excavation, the finding of a small amount of unstratified Byzantine pottery had indicated the possibility that some of the mining was of this period. The programme of radiocarbon dating also suggests that nearly all of the underground mining dates to the Early Bronze Age. The mines' use as a refuge or shelter during the Byzantine period fits what is known

of the history of this area, with the Christians taking refuge in remote sites to escape persecution - Kestel mine would have provided an ideal hiding place. Finally, a scatter of medieval Islamic pottery and a copper alloy bell indicates the mine's use again as a refuge or shelter, perhaps by shepherds. Several smaller excavations further into the workings produced only Early Bronze Age pottery dispersed amongst a considerable quantity of stacked 'deads' and smaller debris from firesetting.

In none of the areas excavated was there any evidence for post - Bronze Age mining activity. Although the space available to excavate and store spoil in most of the passages and chambers is restricted and the excavations necessarily small, these are generally of sufficient size in workings of this type, where there is little or no later infill, to produce adequate material for dating and sampling. Furthermore, in some places the workings remain virtually as they were when abandoned, with tools, small heaps of ore and waste, and perhaps lamps and other pottery vessels still *in situ*. Wood objects, timberwork and baskets may also be preserved in waterlogged or extremely dry environments, although at Kestel conditions were not suitable for their survival. Such areas required little or no excavation, but only accurate planning and photography. Some objects may be removed for drawing or sampling, but if the area is not likely to be further disturbed then as much as possible is left *in situ*. Careful sampling of the working face can provide information about the ore mined and its richness, and enable estimates of metal production to be made. A unique discovery at Kestel was of an abandoned part of the mine which had subsequently been reused as a mortuary chamber, and a nearby entrance passage which may have been occupied by the miners, perhaps during the harsh conditions of winter.

More intensive work will be carried out on these in 1996, but preliminary investigations suggest that both were in use during the Early Bronze Age. Detailed plans of these areas have been produced using stations established during the mine survey to provide fixed points for planning by offset (Fig. 6). A series of profiles at 2 m intervals have also been drawn within the mortuary chamber, as well as longitudinal profiles. Each area contains a series of small stone-lined chambers, which in the entrance passage may have been used for habitation, and in the mortuary chamber as tombs. The latter have been broken into and robbed in antiquity, probably fairly soon after burial for human bone was found strewn about the mortuary chamber. Several

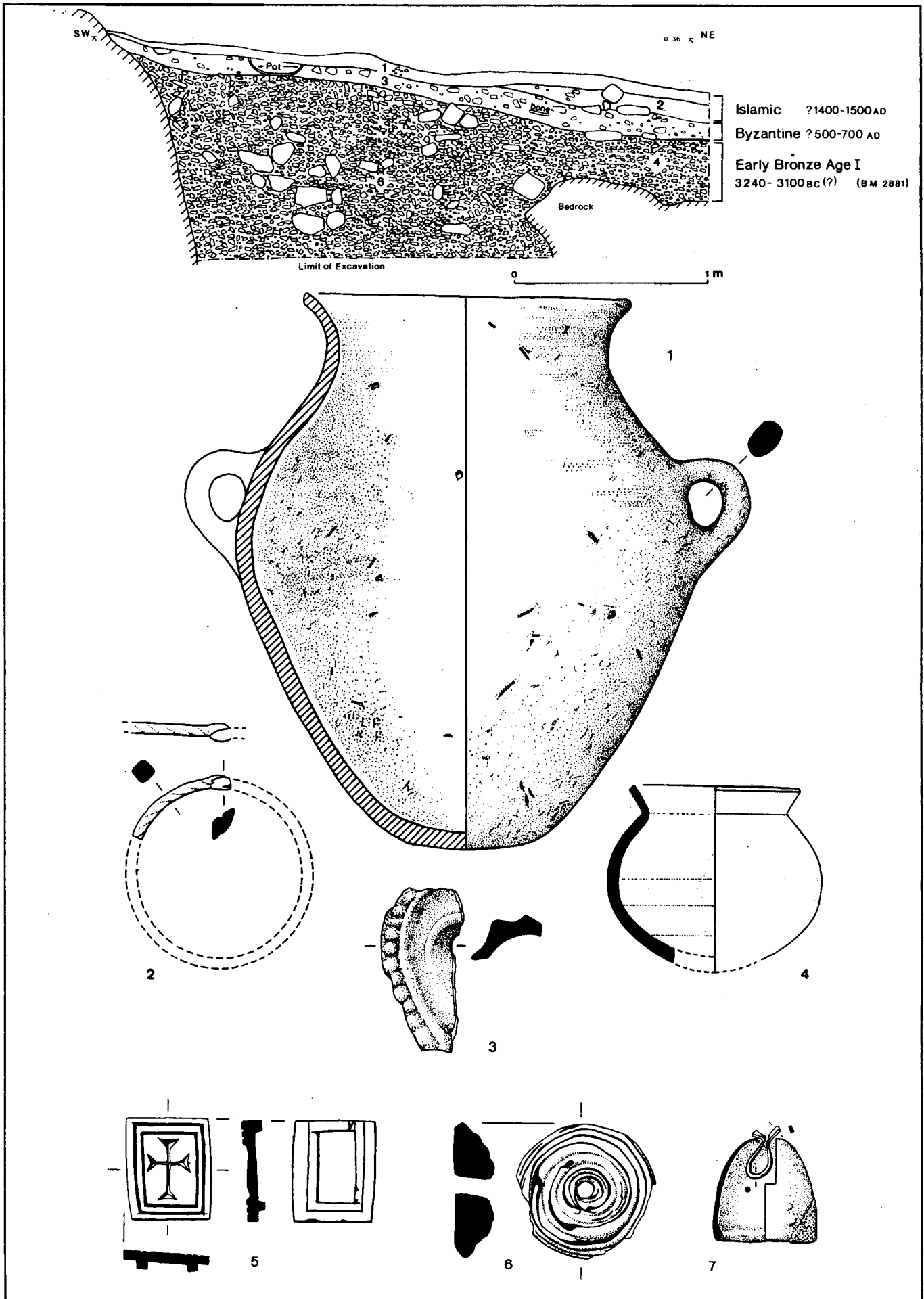


Fig. 4. (top). Kestel Mine. Section of 1991 excavation.

Fig. 5. Kestel: finds from excavation. Early Bronze Age - 1. Storage jar. Byzantine - 2. Glass bracelet; 3. Lamp fragment; 4. Small jar; 5. Glass spindle whorl; 6. Bone / Ivory plaque. Islamic - 7. Copper alloy bell. All at 1:2 except nos. 1 (1:4), 5 and 6 (1:1).

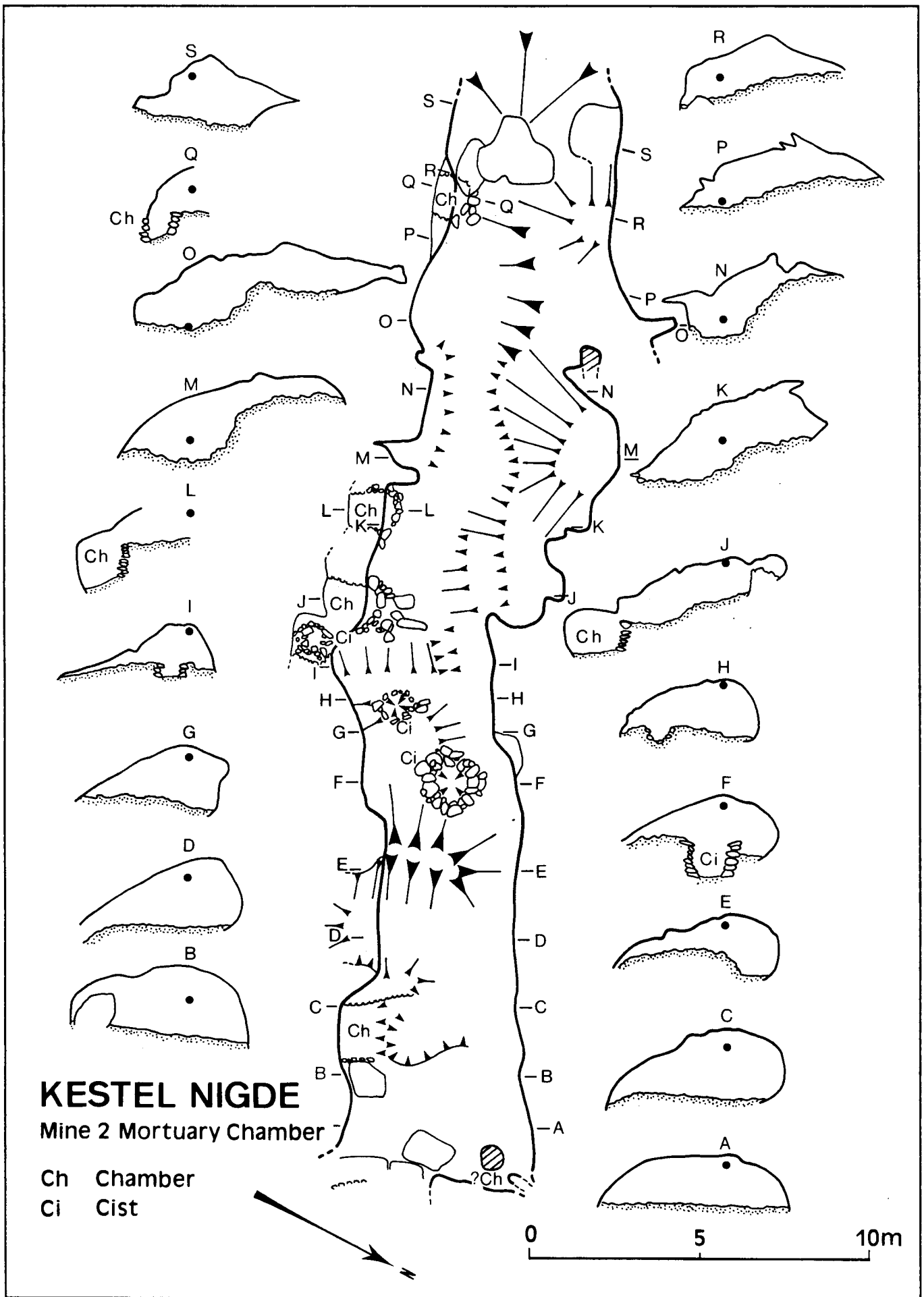


Fig. 6. Kestel Mine – Mine 2, Mortuary Chamber.

virtually complete pots and sherds of many others have been plotted and recovered, some perhaps grave goods.

Before 1992 the mortuary chamber and entrance passage were only accessible via a lengthy and narrow crawl for the nearest entrance had become blocked, and the area could only be reached by way of the single remaining open entrance. This would have made detailed recording and excavation a longer and more difficult task, and so in 1992 several days were spent reopening the blocked entrance. This has made access much easier, improved air circulation, and in the course of reopening provided further evidence for occupation of this entrance area which will be more fully investigated in 1996.

Plans for excavation have not yet been finalised, but extensive investigation of the mortuary chamber is envisaged. Initially it had been planned to lay a set of rails and take the spoil out of the newly opened entrance in a small wagon. However, a low and potentially dangerous part of the roof may preclude this, as the time and resources needed to create more headroom and make safe the roof may be too great. (These are important considerations when working abroad in often remote areas, for both time and the availability of equipment may be limited - generators and lamps, for example, are brought overland from Britain). Instead, a series of smaller areas will probably be excavated within the 30 m by 5 m mortuary chamber, and then backfilled, with all spoil being stored within the chamber. There may be between 1 m and 2 m of mine debris on the floor of the chamber, but it is hoped that a complete cross-section will be obtained, with more burials possibly lying concealed and undisturbed within the debris.

Besides the burials in small stone-lined chambers, other forms of burial in cists, pithoi (pots), and simply laid-out and covered are also present. No other burial sites contemporary with the mine and settlement have yet been found, and this group within the mine represents a particularly important and unusual survival. The possibility that this may represent an elite group of burials, with links to Mesopotamia and Syria suggested by some of the pottery has important implications for the study of trading networks and the development of tin metallurgy in the Near East during the Early Bronze Age.

CONCLUSION

The aim of this short paper has been to demonstrate, by way of three examples,

the different approaches to and the wealth of information which can be gained from the excavation of mines, in these cases prehistoric metal mines. More recent mines, particularly those of post-Roman date, may prove less worthwhile excavating for contentious matters of dating and what was mined may not be in question; a thorough survey of such workings may be sufficient to provide an adequate record. For mines suspected of having prehistoric beginnings, controlled archaeological excavation is the only method of obtaining reliable dating evidence. Indiscriminate collecting of samples from insecure or unstratified deposits should always be avoided, because they provide an extremely unreliable basis on which to make interpretations concerning the history of particular workings.

Besides dating evidence, mines often contain a range of well-preserved artefactual evidence which may survive less well at the surface, particularly organic material. Similarly, they may also contain important environmental information.

Excavation coupled with survey and a judicious sampling strategy can provide information which will enable an accurate history of the mine to be reconstructed: when, what, how and how much was mined, with this integrated with multi-disciplinary work on associated settlement / processing sites and the metallurgical remains. Sometimes, as with the mortuary chamber at Kestel, important discoveries may be made which are not directly related to the mining activity. In all of the examples discussed here, the dating of the mines has been of considerable importance in understanding the development of Bronze Age metallurgy and its wider economic implications,

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