

Prehistoric Investigations in Northeastern Thailand

Part ii

Charles Higham and
Amphan Kijngam

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Prehistoric Investigations in Northeast Thailand

Excavations at
Ban Na Di, Non Kao Noi, Ban Muang Phruk, Ban Chiang Hian,
Non Noi, Ban Kho Noi and site surveys in the Upper Songkhram and
Middle Chi Valleys

Charles Higham and
Amphan Kijngam

With contributions from
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CHAPTER FIVE

THE BURIAL POTTERY FROM BAN NA DI

All excavations in Northeast Thailand yielding prehistoric mortuary remains have revealed that the burial rite involved the placing of pottery vessels in the grave. This practice makes possible a range of analytical approaches not feasible if broken sherds alone were available. Moreover, since there are as yet no detailed reports available on prehistoric pottery from Northeast Thai sites, any comprehensive study must necessarily break new ground. The chapter which follows is itself restricted to certain aspects of the funerary vessels from Ban Na Di. This is due to the fact that the detailed analysis is too large an undertaking for one individual. The Ban Na Di ceramics and their external the subject of B.A. Vincent's doctoral dissertation, and some early findings are reported on below. He has already collected fifteen modern clay samples from the Sakon Nakhon Basin and Upper Chi Valley for comparative purposes, and now plans to create a file of about 1000 stained thin sections as the basis for analysis of clay sources, tempering materials, manufacturing techniques, and exchange patterns. Wichakana's analysis of non-burial pottery is set out above. A definitive typology therefore awaits the full petrographic and chemical analysis presently being undertaken by Vincent so as to enable the fabric component to be included among the typological variables concerned.

While this clearly circumscribes the nature and content of this section, a number of relevant issues will be considered. The principal aim is to employ the ceramic data for throwing light on sociocultural variables. It must be stressed that nearly all vessels were found in known association with inhumation burials. The relationship between different vessel forms and categories of grave is clearly important. Thus both Binford (1971) and Saxe (1971) have proposed that in egalitarian societies, burial goods frequently recognise the age and sex of the individual. Where goods cross-cut age and sex distinctions, there is a possibility that other variables, such as inherited or achieved status, are involved. Therefore it is necessary to devise a typological ordering of the complete vessels.

It is clear however, that the cemetery at Ban Na Di was in use for a considerable period of time. There is therefore, the need to find out whether the particular forms of vessel reveal style changes with time. It is also possible that the establishment of different forms of vessel in terms of form and style will make it possible to recognise unusual or chronologically restricted ones which were imported. Such vessels being rare, may come only from the graves of high status individuals.

The reader is reminded that there are three major burial phases at Ban Na Di, with the following level correlations and dates:

The burial pottery from Ban Na Di

TABLE 5-1 Ban Na Di: the three burial phases and their dates

Burial Phase	Layer Equivalent	Proposed Dates
1a	lower level 7	900-700 BC
1b	upper/mid 1.7	700-500 BC
1c	lower level 8	500-400 BC
2	level 4	200 AD +
3	level 3	500 AD +

Excavations at Ban Na Di, as has been shown, revealed the possibility that there are two different burial areas representing different social groups. The pottery vessels were approached bearing in mind the possibility that there may be subtle differences in style between analogous pots in each cemetery area. Such differences, if documented, would be of considerable interest in the analysis of social dimensions at Ban Na Di.

The availability of complete vessels, makes it possible to consider their possible uses. Such possible uses make such a study relevant to any review of prehistoric culture at Ban Na Di. Both the forms identified and their possible uses are bases for comparing Ban Na Di with other prehistoric sites which have been excavated in Northeast Thailand. Widespread similarities are as relevant as the discovery of marked local distinctiveness in style.

Although some pots were found complete, most had been broken during the prehistoric period and much time was devoted to reconstructing them. The contents of the complete pots were excavated in the laboratory in the hope that this would help in understanding their function. In approaching the establishment of typological groups of vessels, it must again be pointed out that there is little available comparative information in the Sakon Nakhon Basin. The nearest site for which there are comparable data is Non Nok Tha (Bayard 1971). There are as yet, no definitive reports on the pottery from Ban Chiang, which is only c. 25 km northeast of Ban Na Di.

There are two principal related ways of approaching the analysis of the complete vessels from Ban Na Di. Both have different objectives, and each has been undertaken. The first begins with the approach to the classification of vessel shape advocated by Shepard (1956). This paper is considered important, and is worth briefly summarising. The analysis of vessel shape should involve measuring from four different points on a pot's surface. These are known as end points, points of vertical tangency, inflection points and corner points. The first refers to the end of a vessel, such as the rim tip or basal part of a pedestal. A point of vertical tangency is where, for example, a spherical vessel has its maximum width, and begins its curve to the shoulder or the base. A point of inflection is where a contour turns from convex to concave, while a corner point is for example, the part of a vessel where a shoulder turns a sharp angle to become the rim. All measurements of Ban Na Di vessels have one of them as a point of origin.

It is when one begins an analysis of symmetry and structure that the two objectives under review integrate. While the former is concerned with the taking of measurements to define groups, the latter is concerned with the functional implications. In this respect Shepard defines three basic classes of vessel: those with a restricted orifice, those with an unrestricted aperture and those with a neck. The first named has an orifice diameter smaller than the vessel width. This is reversed in the second category. The angle of the tangent at the upper end point, disregarding the addition of a rim, is critical. Necked vessels are described as being independently restricted. Basic shapes, excluding rims and supports, are subdivided by Shepard into four groups: simple, composite, inflected and complex.

While Bayard's (1971) classification of the complete vessels from Non Nok Tha was impressionistic, MacDonald (1980) adopted an explicitly functional approach by emphasising the relevance of two variables, accessibility and stability. Measures of each are simply obtained by taking the ratio of maximum vessel width to the width at the base, and then to the width at the rim. The former reflects a pot's stability and the second, the degree of accessibility to the contents. In the case of a round-based vessel, he gave the basal width dimension of one unit of the measuring system employed. MacDonald has considered the resultant values in the light of comparable figures obtained by Calder (1972) for modern vessels from Ban Koeng, Mahasarakham Province. He concluded that the groups of vessels identified at Non Nok Tha were probably used for storage, serving and cooking.

THE MULTIVARIATE ANALYSIS OF ROUND-BASED POTS

At the commencement of the analysis of the Ban Na Di funerary wares, all complete or partially reconstructed vessels were measured using Shepard's reference points. These were then subjected to multivariate analysis in order to evaluate the possible presence of distinct forms, and to isolate changes in form through time.

There is an assemblage of complete vessels from Ban Na Di which have in common, a rounded base. Five measurements have been taken on each. Since these correspond to each other, it is possible to subject all vessels to the same series of statistical analyses. This option however, was not taken up because a consideration of each vessel in turn revealed that several specimens were clearly distinct from the majority both in terms of shape, technique of manufacture and surface finish. Consequently, these have been assigned form numbers and are described below after a review of the great majority of complete vessels.

An examination of these, the detailed results of which are set out below, suggested the presence of four groups. Nearly all specimens have some basic features in common. Most were made in three stages. First, the lower hemisphere was made by moulding the clay over an existing cord-marked pot. The evidence for this technique is clearly seen in the presence of positive cord marks on the lower half of the vessel's interior surface. The upper hemisphere was then added and finished by means of the paddle and anvil technique. Finally, the rim was put in place and finished by smoothing. Some vessels were embellished with a thin applied

strip of clay round the upper part. This was usually finger-pinched and the ends terminated in a curve or, in two cases, a round medallion. Any form of decoration by applying paint is extremely rare. In fact, only one vessel in the assemblage as a whole bears red painted decoration (no 62). There are also a few pots which were not mould-made. Details on individual vessels are set out below.

The impression gained from studying the range of pot forms and sizes, is that there are four groups. These are defined on the basis of size rather than shape, since all pots have a spherical contour. The first two groups comprise large vessels with a diameter varying between 27 and 44 cm. The two are distinguished by the fact that four specimens are generally less broad and have a particularly high rim. The third and fourth groups contain medium and small spherical vessels, the maximum breadth dimensions being respectively 15-24 cm and 11-14 cm. A tendency for early vessels to have taller, more flaring rims was noted during this stage of the analysis.

Bearing in mind the possibility that changes in shape occurred with time within the principal mortuary period at Ban Na Di, the computer was asked to seek eight clusters in the assemblage. In a perfect situation, one could expect there to be three clusters of the large vessels corresponding to mortuary phases 1 a-c. The same three groups should be present for the medium-sized vessels. Only 2 groups are expected for the small pots, because they are not present in phase 1a burials. Moreover, there are only two such small vessels from phase 1b graves.

The cluster analysis used was, then, requested to assign like vessels to one of eight groups. The results, details of which are set out in fig 5-2 were far closer to the expectation than one could reasonably hope for. Moreover, they added to and refined the morphological impressions briefly described above.

At the same time, a factor analysis was undertaken on the same data. The results of the factor analysis are set out graphically fig 5-1. The eight groups depicted in that figure by circles are those proposed by the cluster analysis. Factor 2 (Y axis) reflects the dimension rim height. Factor 1 reflects the other four dimensions taken.

Let us commence with clusters 1 and 4. These are the large vessels. The analysis grouped all four early specimens together. Those from mortuary phase 1b were assigned to group 7, together with 6 specimens from phase 1c. Group 4 contains only mortuary phase 1c specimens. As may be seen from fig 5-1, the distribution of these two groups is relatively discrete. It mustn't be overlooked that the program demanded eight groups of the data. Detailed inspection of the dimensions in question does, however, indicate the reason for splitting these large vessels into two groups, the early ones have narrower openings and are taller. Those in group 4 have broader openings and tend to be squatter. There are some hints that there is a chronological development between phase 1a and 1b large vessels, and a definite difference between the phase 1a large vessels and all later ones.

The medium-sized vessels were grouped into four clusters (fig 5-1). The first group comprises only one specimen (pot no 2). It comes from burial 47, one of the earliest in the site, and is distinguished by a very high, flared rim. Such enlarged rims also characterise the vessels in cluster 8. Six of the ten specimens in this group come from mortuary phase 1a burial contexts. Two of the balance are from burial 36, which

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comes from the phase 1a-b interface and could easily belong to later phase 1a. Pot 26 comes from TS burial 18. The remaining vessel derives from a phase 1c context (pot no 62 burial 29). It is alien to the Ban Na Di tradition because it was not mould-made and bears red-painted decoration. Petrographic analyses now underway should clarify whether or not this vessel is exotic.

Cluster 3 contains twelve specimens, five from phase 1b, six from phase 1c and one from a doubtful chronological provenance. Relative to cluster 8, these vessels are slightly smaller overall, but have markedly reduced rim height (the average is 23.8 mm in cluster 8 and 14.2 mm in cluster 3).

Cluster 5 is the last to come from the medium sized vessels. It includes 6 vessels from phase 1b and 5 from phase 1c. There is thus no chronological distinction between clusters 3 and 5. Both include vessels from phases 1b and 1c, but none from phase 1a. The vessels in cluster 5 are rather larger in all dimensions than those in cluster 3, except for the rim height which was smaller (average 7.3 mm against 15.2 mm). The smaller round-based pots were all placed within cluster 6. All but two derive from phase 1c contexts.

The possibility that these clusters of vessels, which are derived solely from the dimensions taken, are also set apart by distinct ornamentation must be considered. The most distinctive such ornament is the applique band found on the upper part of the pot's body. Two phase 1a pots have such applique ornament (pot nos 3 and 32). In the former, the band is completed in the form of a medallion which is paralleled only in pot 108. The latter also comes from a phase 1a context. The form of decoration applied to pot no 32 is also distinct as it comprises a series of clear slashes not found in later contexts. Twelve of the 23 pots which comprise clusters 3 and 5 have applique bands, which were usually finger pinched. The details are as follows:

Cluster	3	5
With applique band	4	8
Without applique band	7*	3

* The figure is reduced by one to account for an unprovenanced specimen.

A χ^2 test run on these figures suggests that cluster 5 has a significantly higher incidence of applique bands. In terms of chronology, the following facts are relevant:

Phase	1b	1c
with applique band	6	6
without applique band	5	5

Clearly there is no change in the incidence of the applique band with time. There are four early large vessels (cluster 1). One has an applique band which matches that from pot no 3, in that it ends in a medallion. The rest have no such decoration.

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Only one of the large vessels which make up clusters 4 and 7 has an applique band (pot no 58). It is noted however, that several fragmentary specimens not included in the statistical analyses do have such a decoration. Certainly such bands were more common on the medium sized vessels. Eight of the eleven small bowls in cluster 5 have an applied band.

Such decoration is thus encountered throughout the mortuary phases, but there is some evidence for a morphological change from a band which was cut or jabbed after application, to one raised and finger-pinched. Smaller vessels of form 3 seem to have decorated more often than the large ones of group 2, while pots in cluster 5 were more often treated in this way than were those in cluster 3.

Before turning to the rare vessels which were not incorporated in the factor or cluster analyses, it is necessary to consider the establishment of a morphological code to encompass the specimens first described. In so doing, it is stressed that there is no comparable study for any similar assemblage in Northeast Thailand. The closest is that for Non Nok Tha by Bayard (1971). His survey however, was of a preliminary and tentative nature and is not sufficiently detailed to be of use in relating the Ban Na Di vessels to Non Nok Tha types other than in a general way.

The principal objective of this morphological study is to seek structure in the development of styles with time, to allow us to relate different forms and consider possible functions for each form identified. In consequence, it is proposed initially to subdivide the vessels on the basis of the presence or absence of a pedestalled support. Those provided with such a base are considered later.

Having set aside vessels which, for one reason or another, stand out as being unusual, all round-based pots were subjected to multivariate cluster and factor analyses, the impression being that there are three forms with chronological variants. The following forms are proposed on the basis of these analyses.

FORM 1

These are spherical vessels with a constricted orifice and everted rim. They were usually made in three stages; moulding the lower half on an existing cord-marked vessel, joining the upper half and then affixing the rim. Vessels vary in width between 15-25 cm and between 14 and 22 cm in height. While the size of this form remained similar throughout the mortuary phase, there was a clear decrease in the height of the rim with time. The cluster analysis has proposed four groups for this sample of vessels (fig 5-2). In the present state of our knowledge, conservatism is advocated rather than too much splitting into different sub-groups. Consequently, three subforms are proposed.

FORM 1A: vessels 1-5, 16, 25, 26, 32, 36 and 62.

(figs 5-3, 4)

This subform includes vessels in clusters 2 and 8. These are

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distinguished by relatively tall and pronounced rims. All but three belong to the earliest of the three mortuary phases. Two of the remainder are very early in phase 1b if not from phase 1a itself. The third stands out as unusual on two grounds: it is not mould made, and was decorated with red paint on the rim and along the upper part of the body. If the analysis of the clay used suggests a foreign source for this vessel, it would be removed from this group.

Form 1B: vessels 8, 9, 10, 15, 27, 28, 33, 63, 64, 100, 101, 102, 105.

(figs 5-5, 6)

This subform includes all vessels located in cluster 3. These have in common a smaller rim than in cluster 8 and a spherical, cord-marked body. All but three of the vessels were definitely mould-made. One of the remainder was too fragmentary to indicate the manufacturing technique. Specimens 63 and 64 have no evidence for moulding. They are also unusual in that the application of the cord-marks was carefully undertaken in a nearly vertical direction. A detailed analysis of the clay used may reveal that these vessels were imported to Ban Na Di.

Form 1C: vessels 6, 7, 11, 12, 13, 14, 18, 21, 23, 28, 29 and 36.

(figs 5-7, 8, 9)

These vessels come from mortuary phases 1b and c. The rim is now much reduced compared with 1a and 1b forms. All were mould-made.

FORM 2: vessels 17, 19, 20, 22, 24, 30, 31, 34, 65 and 133.

(figs 5-10, 11, 12)

This form includes all the small round based bowls with a slightly constricted opening and small, everted rim. All but one vessel were mould-made. The exception is no 65 which, like nos 63 and 64, bears carefully applied vertical cord-marking. The maximum width of vessels in this group varies between 12 and 14 cm and the maximum height varies between 10 and 13 cm.

FORM 3: vessels 107, 108, 110 and 111.

(figs 5-13, 14)

The four vessels in this group (cluster 1) are all derived from the mortuary phase 1a to 1b contexts at Ban Na Di. These are large, deep bodied pots between 28 and 36 cm broad and 27-36 cm tall. Three were mould-made. All have large, sharply everted rims. One contained the interred remains of an infant (pot no 107, mortuary phase 1b).

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FORM 4: vessels 57-60, 78-83, 106, 112, 120, 121, 124 and 130.

(figs 5-15 to 21)

This form comprises all vessels in clusters 4 and 7. These are large, ovoid cord-marked vessels. The breadth varies between 28-45 cm and the height from 25-37 cm. All were mould-made. Again, it could be argued that we should define two subgroups based on each cluster. Given the similarities in chronological contexts for these clusters, and the similar sizes, finish and manufacturing techniques involved, it seems at present unnecessary to split the vessels into two subgroups. A large sample however, could well lead to the establishment of more than one group to encompass these large mid-late phase 1 mortuary vessels.

OTHER ROUND-BASED VESSELS

Several vessels were not included in the sample subjected to multivariate analysis because they are clearly distinct and can readily be ascribed to a particular form, as follows:

FORM 5: vessels 94 and 95 (fig 5-21)

These two vessels come from graves 35 and 12 respectively (mortuary phases 1c and 1b). They are extremely thin, almost spherical in shape and decorated with red paint over most of the body. Each has three concentric painted lines at and just below the body-neck junction. The edge of the rim is also painted red. They are quite distinct from the Ban Na Di earthenware vessels belonging to forms 1-4.

FORM 6: vessels 97, 98 and 109 (fig 5-22)

There are three vessels which bear the distinctive "Om Kaeo" style of decoration. These come from graves 18 (mortuary phase 1c), 21 (mortuary phase 1b) and square F6 level 1 (the equivalent of mortuary phase 1c). The vessels are large (the width varying between 41-46 cm), and sharply carinated. For vessels of such size, they are thin-walled (c. 4 mm). The Om Kaeo decorative style involves first cord-marking the vessel, then incising decorative designs which are infilled with red paint. At Ban Chiang, this style belongs to early period d, and occurred at about the same period as the first evidence for iron and the domestic water buffalo. All three vessels at Ban Na Di bear an identical pattern comprising three parallel bands which describe a flowing series of curves on the upper part of each vessel. A three-dimensional effect is created by turning each band into two, and vice versa, at the head of each curve.

FORM 7: Vessel 96 (fig 5-23)

This pot is very similar in size and shape to those belonging to form 8,

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except that it is cord-marked all over, it was not further incised and painted. It comes from burial 35 (mortuary phase 1c).

FORM 8: vessel 131 (burial 48, mortuary phase 1c)

Only a body fragment of this vessel was found, but its contour, finish and presence of "Om Kaeo" decoration in one corner all recall the large, sharply carinated vessels found in 1d contexts at Ban Chiang.

FORM 9: vessels 87-91, 93, 119 and 140. (figs 5-23, 24)

This group comprises miniature vessels with a spherical shape, constricted neck and everted rim. Most have a smoothed exterior finish with no traces of any further decoration. One however (pot no 90), was painted on the exterior with a red slip. No 119 is placed in this group only because of its size. It is distinguished by its tiny size (4.5 cm at its widest) and the crudeness of its manufacturing technique. It looks like a child's first effort at pottery. These seven vessels come from mortuary phases 1b-c. There is in addition, one specimen (pot no 140) from level 7. The basal half was moulded, and then three coils were added. It is extremely crude in finish. No attempt was made to smooth over the coils once put in place.

FORM 10: vessel 99, burial 18, mortuary phase 1c. (fig 5-25)

This is also a small vessel, but is distinguished from those comprising form 9 because it is open in form, and has a rather carefully cord-marked exterior surface. It closely resembles pots 85 and 86 (form 15, below), except that it lacks a pedestal.

FORM 11: vessel 125, square F6, level 1, feature 1. (fig 5-25)

This vessel has a spherical shape, constricted neck and sharply everted rim. The interior and exterior surfaces bear marks made by a smoothing instrument. It dates to the equivalent of mortuary phase 1c.

FORM 12: vessel 122, burial 19, mortuary phase 1c. (fig 5-25)

This vessel is unique in the mortuary complex at Ban Na Di. It has a flat base, and straight, outward sloping walls and an incurved rim. the exterior surface is badly pitted, so it is not possible to describe the original surface finish.

FORM 13: vessel 127, burial 18, mortuary phase 1c. (fig 5-25)

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This vessel is shaped like a shallow dish, but could conceivably have been a lid. Its maximum width is 32 cm, but it only stands 9 cm high. The surface was smoothed.

THE MULTIVARIATE ANALYSIS OF THE PEDESTALLED VESSELS

All but three of the 28 complete pedestalled vessels were subjected to three multivariate analyses. The three remaining pots were excluded because their rim shape was sufficiently complex to exclude taking measurements which are matched on the other specimens. These vessels (pot nos 42, 123 and 128) are also clearly different in shape from all others. There are two principal reasons why these statistical manipulations were undertaken. A simple impressionistic review of the sample suggested the presence of a number of sub-forms, based both on size and shape. It was felt desirable to test whether multivariate analyses confirmed such impressions. Secondly, given the time span during which these vessels were made, it was felt necessary to determine whether changes in shape correlate with the passage of time.

At the outset, it was felt that the pots in the sample fall into three groups. The first is easily recognised as comprising small vessels with a rim and stemmed pedestal. The larger vessels were subdivided first into those with an open, or constricted orifice standing on a broad rather short pedestal. These contrasted with a group in which the orifice was increasingly constricted, and the junction between the pedestal and the container, relatively slender.

The results of a factor analysis in fact, confirmed these impressions. 90.4% of the variations in question derives from the first two factors. The dimensions contributing to the two factors are as follows:

TABLE 5-2

Ban Na Di: factor scores for the analysis of pedestalled vessels

	Factor 1	Factor 2
1. Rim diameter	0.383	0.831
2. Maximum width of body	0.854	0.444
3. Total body height	0.963	0.088
4. Diameter at base	0.860	0.445
5. Diameter at foot-body junction	0.148	0.924
6. Foot height	0.913	0.270

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Clearly the rim diameter and diameter at the foot-body junction contribute most to the values obtained for factor 2. Factor 1 reflects the other dimensions 2, 3, 4 and 6 above. The values of these factors for individual pots are set out in fig 5-26, in which the X-axis gives values for Factor 1 and the Y axis for Factor 2. Each vessel is given a symbol depending on whether it comes from phase 1a, b or c. The two vessels (nos 52, 53) with higher values on the Y axis are the earliest recovered, and have the broad pedestal and unrestricted form referred to above. The three specimens to the bottom left (84-86) are the miniature vessels. Numbers 30-40 are intermediate between those with restricted and unrestricted orifices. One comes from burial 38, the other was probably associated with that burial. Stratigraphically, burial 38 lies at the phase 1a-1b interface, and has conservatively been ascribed to phase 1b.

The remaining vessels appear to fall into two or three groups depending on the degree of discrimination employed. This situation is best seen by comparing figs 5-26 and 5-27. The former sets out a set of relationships which result from a cluster analysis. The coherence of the group comprising vessels 44, 47 and 48 is clear. This group is also seen clearly in fig 5-26, which sets out graphically the results of a factor analysis. These three vessels are of a size intermediate between the miniatures and the rest of the sample. All three come from mortuary phase 1c graves, two from the double burial (B.10-11) and the other from the adjacent burial (B.48).

Turning again to fig 5-26, it is possible that vessels 37 and 54 are distinctively different from the 12 pots to the left of them. They are also peripheral to the larger group. Inspection of the vessels themselves suggests that they are set apart because of the shape of the pedestal. These are distinctively different from the 12 pots to the left of them. They are particularly tall, with a narrow point of junction with the body and relatively broad base. One belongs to phase 1b, the other to phase 1c. A larger sample would allow the possibility that these two specimens represent a distinct group. At present, given the small number of two, it is felt more appropriate to assign them to the group comprising phase 1b and 1c large vessels.

There are two further vessels from the major burial complexes at Ban Na Di, both being clearly distinct in terms of shape, finish and size. The first is pot no 92. For all intents and purposes, this vessel is akin to form 2 (the medium sized bowl, see above), except that it has been provided with a pedestal. This pot was probably made on a mould and was finished with a cord wrapped paddle. A narrow band of clay was then applied round the upper part of the body to form an applique band.

The second unique form is pot no 128. It comprises a small cord-marked bowl on top of a pedestal. The bowl has a sharply everted rim, and the lower half was made on a mould. The portion above the mid point was attached after removal from the mould. This vessel comes from burial 50 (mortuary phase 1b).

There is one further form of pedestalled vessel (pot no 123). It comes from a level 6 context and does not belong to the mortuary assemblage described above. This vessel is malformed, having an irregular junction between the body and the rim. The pedestal itself has not survived. The pot has a plain, smoothed exterior.

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On the basis of these multivariate analyses, pedestalled vessels have been subdivided into the following forms-

FORM 14A: vessels 39, 40, 52, 53. (fig 5-28)

This class has the characteristic of a broad junction between body and pedestal. The orifice of vessel 52 is open but in the three other specimens it is slightly closed. Vessel 52 was entirely mould-made apart from the pedestal itself. Numbers 39, 40 and 53 were also moulded, but the inward curving upper portion of the body was, in each case, added after moulding was complete. These vessels belong to mortuary phase 1a and very early phase 1b. The exterior surface of the body was cord-marked, and the pedestals are smoothed inside and out.

FORM 14B: vessels 37, 38, 41, 42, 43, 45, 46, 49, 50, 51, 54, 55, 56, and 71 (figs 5-29 to 34)

These vessels were also mould-made. The lower exterior part of the moulded portion was shaped with a cord-wrapped paddle. The added part, however, markedly restricted the orifice size. The pedestals themselves were in general taller and far more waisted than in the form 14A examples. Form 14B vessels were found in mortuary phases 1b-c.

FORM 14C: vessels 44, 47 and 48 (fig 5-34)

These three pedestalled vessels stand out as being smaller than the form 14B variant. Again, the body-bases were mould-made, and the pedestals and upper parts of the bodies were added later. The exterior part of the body in pot no 47 is completely cord-marked. The others were smoothed on the upper part of the body although the cord-marks are still visible in places there.

FORM 15: Vessels 84, 85, and 86 (fig 5-35)

Form 15 comprises the three miniature pedestalled vessels. These have a body with generally vertical cord-marking, small-stemmed pedestals and everted rims crudely or even carelessly fashioned. There is no evidence to suggest that any was made on a mould. All three come from mortuary phase 1c burials.

FORM 16: vessel 128 (fig 5-36)

This unique vessel is relatively small. The lower half of the body was mould-made and the exterior cord-marked. The upper part of the body was also cord-marked, but then smoothed so that only traces of it remain. The pedestal/body junction is thin and the pedestal itself, markedly convex.

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FORM 17: vessel 92 (fig 5-35)

This curious vessel is shaped and constructed like pots of form 1 except that it has a pedestal. Unfortunately the support is broken, and its form cannot be determined.

FORM 18: vessel 123 (fig 5-36)

The last footed form does not derive from the site's principal mortuary context, but was found in level 6. In shape, it is quite distinct from all other pedestalled forms although the support itself is fragmentary. It has a plain, globular body, and a rim which rises vertically from it.

FORMS 19-21: vessels 113-117 (figs 37-41)

All three of these forms come from the mortuary phase 2 burials. They contained the remains of infants, and each form comprises a wide-bellied vessel with the constricted opening, everted rim and a fitted lid. In terms of manufacturing technique and fabric, they represent a distinct tradition from all the vessels from mortuary phases 1a-c.

ACCESSIBILITY AND STABILITY

The analysis proceeded with a consideration of accessibility and stability. Stability reflects the ratio of the pot's support to its maximum width. The values for these ratios for each complete pot have been calculated and are plotted in figs 5-42 and 43. Figure 5-42 is concerned with pots which having round bases, are by themselves extremely unstable. It should nevertheless be stressed that the modern Thai villager, who today uses similarly shaped vessels, would not regard them as unstable. Thus, the modern large round based water jar is set down on a rope base. Being flexible and therefore more resistant to accidental knocks, the base makes such vessels extremely stable. Again, round-based cooking vessels are balanced on metal supports or even a ring of stones in the hearth and are therefore unlikely to tip.

The distribution of the "stability" index in fig 5-43 suggests the presence of three clusters. In fact, since the method of obtaining this value is to divide an arbitrary figure of 1.0 cm by the vessels maximum width, the three clusters are distinguished by size rather than differences in stability.

The vessels vary little in terms of accessibility. They are without exception distinguished by a closed mouth relative to the maximum diameter of the body.

Values for the vessels with pedestalled bases are set out in fig 5-43. There is a fair degree of variation in terms of accessibility, though all could be described as being very stable. The variation in accessibility is, on inspection, a reflection of chronological change. Early goblets were relatively open vessels on broad bases. Later ones had a constricted

junction between base and body, and an incurving rim which restricted access.

MacDonald (1980) has suggested that degrees of accessibility and stability reflect the use to which vessel forms were put. Taken to extremes, one does not store meat in a milk bottle or water on a plate. Calder (1972) has described vessel use in the Thai village on Ban Khoeng. It is important to note that many vessels have both primary and secondary functions. As might be expected however, the majority of forms are concerned with cooking, storing and serving. Two of the most widespread forms currently seen in modern villages throughout the Ban Na Di area, are the large water storage jar and the smaller round-based vessels used for cooking rice or spiced meats. It is interesting that the dimensions and shape of the former match those for the vessels of form 4. The dimensions and shapes of form 1 also conform with the modern cooking vessels. The possibility that they were in fact used for cooking is supported by the recovery from the complete vessels, of the remains of small fish bone, fragments of rice and in one case, the entire forelimb of a young pig. No vessels of form 14A or B have been recovered undamaged, so it is not possible to evaluate the contents of such vessels, if any, at the time of burial. The form 14 vessels are not matched in the modern contexts. These vessels were made for stability. Two possible uses were the serving of food or of liquids.

MANUFACTURING TECHNIQUE

The majority of the mortuary vessels were made in three stages. Firstly, the basal hemisphere was shaped on a mould. The mould itself was clearly an existing, cord-marked vessel because the interior bore positive cord-marks which could only have been obtained by beating the soft clay over an existing cord-marked vessel. The hemisphere of clay was then cut from the mould. In the case of forms 1, 2, 3 and 4, the upper part was then added, and shaped with a cord-wrapped paddle and clay anvil. Several such anvils have been recovered from Ban Na Di, and their shape parallels those still in use in the area. The final stage in the manufacture of forms 1-4 was the addition of the rim, which was put in place over the cord impressed upper part of the vessel and smoothed. Painting on such moulded vessels is never found. The principal surface embellishment takes the form of cord impressions. Certain form 1, 2, 3 and 4 vessels were also decorated with an applied band of clay which was itself finger-pinchd or slashed at regular intervals with a sharp implement. These applied bands were never placed continuously round the vessel. Each end was usually curved to form what Gorman and Charoenwongsa called the "curvilinear applique" style at Ban Chiang. In two cases however, the end point formed an oval medallion. Such applique bands were found on some but not all, pots of forms 1, 2, 3 and 4.

In the case of the pedestalled vessels, the basal hemisphere was likewise mould-made. The upper portion and the pedestal were then added. The upper part of the vessel and the pedestal were usually smoothed inside and out, while the lower hemisphere was cord-impressed.

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There are some exceptions to these general principles of moulding followed by shaping with the paddle and anvil. Some form 1 vessels appear to have been shaped entirely with the paddle and anvil. In certain vessels, the pattern of positive cord-impressions formed during the moulding process is clearly visible. Now, since each mould bore a unique pattern of cord impressions, an analysis of size and mould pattern allows the investigator to fingerprint individual vessels back to the same mould. The possibility thus exists for the recognition of relationships between specific graves. Thus, it might be the case that vessels from individual potters are restricted to certain areas of the cemetery. This situation would strengthen the proposition that each area contains the bodies from members of a particular lineage. On the other hand, the presence of vessels from the same mould in different areas of a cemetery, would support the notion that there were specialised potters who supplied the community as a whole.

The mortuary sample at Ban Na Di is unfortunately too small to investigate these fascinating areas further. Extensive excavations would surely make available the necessary data for the exploration of such details of such social variables.

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TABLE 5-3

The dimensions of the complete pots
from Ban Na Di

Pot No.	Prov.	Mort. Phase	Rim Dia. (cm)	Rim/body Dia. (cm)	Rim Ht. (mm)	Max. Br. body (cm)	Max. Ht. body (cm)
FORM 1a							
1	A2 B.22	1a	14.0	11.0	30.0	17.0	19.0
2	F6 B.47	1a	21.0	16.0	38.0	20.0	22.0
3	A1 B.34	1a	19.0	13.0	30.0	17.0	19.0
4	A3 B.26	1a	19.0	16.0	22.0	19.0	17.0
5	A3 B.28	1a	16.0	12.0	26.0	17.0	17.0
16	F6 B.36	1b	19.0	15.0	22.0	21.0	18.0
25	F5 BTS.21	1a	17.0	14.0	23.0	17.0	15.0
26	F5 BTS.16	1b	16.0	14.0	23.0	18.0	15.0
32	A2/3 L.8	-	19.0	15.0	24.0	17.0	16.0
35	F6 B.36	1b	21.0	18.0	19.0	23.0	19.0
62	A4 B.29	1c	18.0	15.0	20.0	18.0	16.0
129	F6 B.40	1a	-	-	-	19.0	-
FORM 1b							
8	F6 B.42	1b	16.0	14.0	12.0	16.0	15.0
9	F6 B.38	1b	15.0	12.0	18.0	14.0	15.0
10	F6 B.38	1b	17.0	14.0	19.0	18.0	17.0
15	F6 B.36	1b	20.0	15.0	16.0	17.0	16.0
27	F5 BTS.15	1b	17.0	14.0	16.0	20.0	18.0
33	A2 L.5	-	15.0	13.0	15.0	17.0	14.0
63	A4 B.29	1c	19.0	15.0	18.0	19.0	17.0
64	A4 B.50	1b	14.0	13.0	16.0	15.0	13.0
100	A4 B.20	1c	16.0	14.0	15.0	18.0	19.0
101	F5 BTS.3	1c	16.0	15.0	11.0	17.0	(16.0)
102	F5 BTS.12	1c	14.0	12.0	13.0	19.0	16.0
105	F6 L.7	-	16.0	13.0	14.0	18.0	15.0
FORM 1c							
6	A1 B.14	1b	17.0	16.0	4.0	20.0	18.0
7	A1 B.14	1b	18.0	16.0	6.0	19.0	16.0
11	A1 B.15	1b	16.0	15.0	10.0	19.0	16.0
12	A1 B.15	1b	18.0	16.0	7.0	20.0	18.0
13	A3 B.12	1b	16.0	15.0	9.0	16.0	17.0
14	A3 B.12	1b	16.0	14.0	7.0	18.0	16.0
18	A4 B.48	1c	27.0	24.0	7.0	25.0	18.0
21	F6 B.32	1c	20.0	18.0	9.0	24.0	19.0
23	A4 B.50	1b	18.0	16.0	10.0	23.0	21.0
28	F5 BTS.12	1c	17.0	15.0	9.0	19.0	14.0
29	F5 BTS.12	1c	17.0	16.0	6.0	20.0	17.0
36	A4 B.18	1c	16.0	15.0	6.0	18.0	16.0

FORM 2

The burial pottery from Ban Na Di

17 A4 B.48	1c	12.0	11.0	6.0	14.0	12.0
19 A4 B.48	1c	11.0	10.0	5.0	12.0	10.0
20 F6 B.32	1c	11.0	10.0	7.0	13.0	11.0
22 A4 B.50	1b	11.0	9.0	8.0	12.0	10.0
24 F6 B.19	1b	12.0	10.0	8.0	13.0	11.0
30 F5 BTS.12	1c	17.0	11.0	7.0	14.0	12.0
31 F5 L.7	-	11.0	10.0	13.0	14.0	13.0
34 F5 BTS.5	1c	12.0	11.0	10.0	13.0	12.0
85 A4 B.18	1c	14.0	12.0	11.0	13.0	11.0
133 F6 B.31	1c	12.0	10.0	11.0	15.0	(10.0)

FORM 3

107 A3 B0.25	1b	32.0	25.0	35.0	36.0	35.0
108 A2/3 L.8	-	27.0	18.0	37.0	33.0	36.0
110 F6 B.48	1a	24.0	19.0	23.0	28.0	28.0
111 A2 L.8	-	30.0	25.0	27.0	35.0	27.0
118 F6 B.44	1a	30.0	22.0	32.0	34.0	-

FORM 4

57 A4 B.10/11	1c	27.0	25.0	9.0	37.0	34.0
58 F5 BTS.5	1c	25.0	23.0	14.0	38.0	35.0
59 A4 B.48	1c	32.0	30.0	7.0	43.0	37.0
60 A4 B.18	1c	34.0	32.0	9.0	45.0	35.0
61 F6 B.32	1c	30.0	28.0	9.0	47.0	-
74 A4 B.30	1b	21.0	18.0	-	37.0	-
75 A1 B.14	1b	19.0	17.0	12.0	34.0	-
76 F5 BTS.12	1c	30.0	29.0	11.0	39.0	-
77 F5 BTS.3	1c	-	-	-	38.0	-
78 F6 B.31	1c	32.0	29.0	11.0	-	-
79 F6 B.31	1c	32.0	29.0	12.0	37.0	25.0
80 F5 BTS.12	1c	28.0	25.0	12.0	38.0	32.0
81 A4 B.48	1c	26.0	23.0	14.0	40.0	38.0
82 A4 B.12	1b	35.0	32.0	11.0	-	-
83 F5 BTS.12	1c	38.0	36.0	12.0	43.0	25.0
103 F5 BTS.7	1c	32.0	31.0	10.0	42.0	-
104 F5 BTS.7	1c	30.0	27.0	9.0	-	-
106 F6 B.19	1b	29.0	27.0	8.0	39.0	-
112 A4 B.48	1c	38.0	36.0	9.0	41.0	(28.0)
120 A3 B.12	1b	28.0	26.0	19.0	41.0	33.0
121 F6 B.21	1b	30.0	27.0	11.0	40.0	(30.0)
124 F6 L.7	-	28.0	26.0	12.0	-	(38.0)
126 F6 B.19	1b	28.0	26.0	7.0	38.0	-
130 F6 B.19	1b	28.0	26.0	10.0	41.0	(38.0)
132 F6 B.32	1c	-	-	-	-	-
134 F6 B.31	1c	44.0	40.0	10.0	-	-
135 A4 B.10/11	1c	36.0	32.0	11.0	-	-
136 F5 BTS.6	1c	28.0	25.0	9.0	-	-
138 F5 BTS.12	1c	28.0	24.0	11.0	-	-

FORM 5

84 F6 B.35	1c	12.0	10.0	30.0	17.0	17.0
95 A3 B.12	1b	14.0	12.0	31.0	-	-

The burial pottery from Ban Na Di

FORM 6						
97 F8 B.21	1b	33.0	31.0	20.0	46.0	29.0
98 A4 B.18	1c	29.0	27.0	22.0	41.0	26.0
109 F8 L.7	-	31.0	29.0	17.0	43.0	(30.0)

FORM 7						
96 F8 B.35	1c	30.0	5. 22.0	34.0	23.0	

FORM 8						
131 A3/4 B.48	1c	-	-	-	-	-

FORM 9						
87 A3 B.12	1b	6.0	5.0	11.0	-	-
88 A4 B.48	1c	4.0	4.0	9.0	5.0	6.0
89 A4 B.48	1c	6.0	5.0	7.0	6.0	6.0
90 A4 B.50	1b	8.0	7.0	6.0	9.0	8.0
91 F5 BTS.6	1c	4.0	4.0	5.0	6.0	6.0
93 F8 B.19	1b	7.0	5.0	16.0	9.0	10.0
119 A3/4 B.12	1b	4.0	4.0	9.0	-	-

FORM 10						
99 A3 B.18	1c	11.0	10.0	7.0	11.0	7.0

FORM 11						
125 F8 L.7	-	10.0	8.0	24.0	12.0	13.0

FORM 12						
122 F8 B.19	1b	26.0	-	-	28.0	12.0

FORM 13						
127 A4 B.18	1c	32.0	-	-	32.0	9.0

Pot No.	Prov.	Mort. Phase	Rim Dia. (cm)	Max.Width body (cm)	Tot.Ht.of body (cm)	Base Dia. (cm)	Foot Ht. (cm)
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FORM 14a							
39 F8 B.36	1b	19.0	21.0	20.0	16.0	10.0	
40 F8 B.36	1b	15.0	16.0	15.0	15.0	7.0	
52 F5 BTS19	1a	19.0	20.0	18.0	16.0	7.0	
53 A3 B.26	1a	17.0	18.0	16.0	16.0	8.0	

FORM 14b							
37 A1 B.14	1b	17.0	20.0	27.0	18.0	14.0	
38 A2 B.12	1b	12.0	20.0	26.0	16.0	10.0	
41 A1 B.15	1b	14.0	19.0	20.0	17.0	10.0	
42 A4 B.18	1c	14.0	22.0	26.0	15.0	9.0	
43 F8 B.31	1c	13.0	22.0	26.0	17.0	10.0	
45 F8 B.32	1c	13.0	21.0	23.0	15.0	8.0	
46 A4 B.50	1b	12.0	20.0	25.0	18.0	12.0	
49 F8 B.19	1b	12.0	22.0	25.0	15.0	7.0	
50 F5 BTS5	1c	12.0	19.0	22.0	16.0	10.0	
51 F5 BTS12	1c	12.0	20.0	24.0	17.0	9.0	
54 F5 BTS13	1c	19.0	23.0	24.0	20.0	12.0	

The burial pottery from Ban Na Di

55	F5	BTS5	1c	14.0	19.0	24.0	19.0	9.0
56	F5	L.7	-	13.0	21.0	23.0	14.0	8.0
66	F6	B.37/39	1b	-	-	-	-	10.0
67	F6	B.37/39	1b	-	-	-	16.0	8.0
68	A4	B.13	1b	12.0	19.0	27.0	18.0	12.0
69	F5	BTS15	1c	-	-	-	17.0	10.0
70	A4	B.29	1c	-	-	-	16.0	9.0
71	F5	BTS6	1c	13.0	20.0	27.0	17.0	9.0
72	A2	L.8	-	-	-	-	14.0	10.0
73	F5	BTS12	1c	12.0	19.0	-	-	-
137	F5	BTS6	1c	-	-	-	12.0	-

FORM 14c

44	A3	B.48	1c	12.0	15.0	19.0	12.0	6.0
47	A4	B.10/11	1c	11.0	13.0	14.0	11.0	4.0
48	A4	B.10/11	1c	11.0	15.0	17.0	11.0	5.0

Pot No.	Prov.	Mort. Phase	Rim Dia (cm)	Rim Ht. (cm)	Rim/Body Dia.(cm)	Max.Width body (cm)	Tot.Ht.of body (cm)	Base Dia. (cm)	Foot Ht. (cm)
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FORM 15

84	A4	B.12	1c	11.0	6.0	9.0	9.0	10.0	7.0	3.0
85	A4	B.48	1c	9.0	6.0	8.0	8.0	7.0	5.0	2.0
86	F6	B.19	1b	11.0	5.0	9.0	9.0	8.0	4.0	2.0

FORM 16

128	A4	B.50	1b	11.0	9.0	9.0	12.0	15.0	10.0	5.0
-----	----	------	----	------	-----	-----	------	------	------	-----

FORM 17

92	A4	B.48	1c	18.0	6.0	16.0	21.0	19.0	-	-
----	----	------	----	------	-----	------	------	------	---	---

FORM 18

123	A2	L.6	-	12.0	4.0	12.0	15.0	-	-	-
-----	----	-----	---	------	-----	------	------	---	---	---

Pot No.	Prov.	Mort. Phase	Rim Dia (cm)	Rim-body Dia.(cm)	Rim Ht. (mm)	Max.Br. body (cm)	Max.Ht. body (cm)
---------	-------	-------------	--------------	-------------------	--------------	-------------------	-------------------

FORM 19

113	A1	B.4	2	31.0	31.0	19.0	43.0	38.0
114	A1	B.5	2	31.0	31.0	18.0	41.0	37.0
115	A1	B.8	2	35.0	35.0	16.0	43.0	36.0

FORM 20

116	A2	B.7	2	41.0	43.0	20.0	55.0	32.0
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FORM 21

117	A2	B.6	2	49.0	41.0	16.0	-	18.0
-----	----	-----	---	------	------	------	---	------

Ban Na Di: illustrations of complete vessels

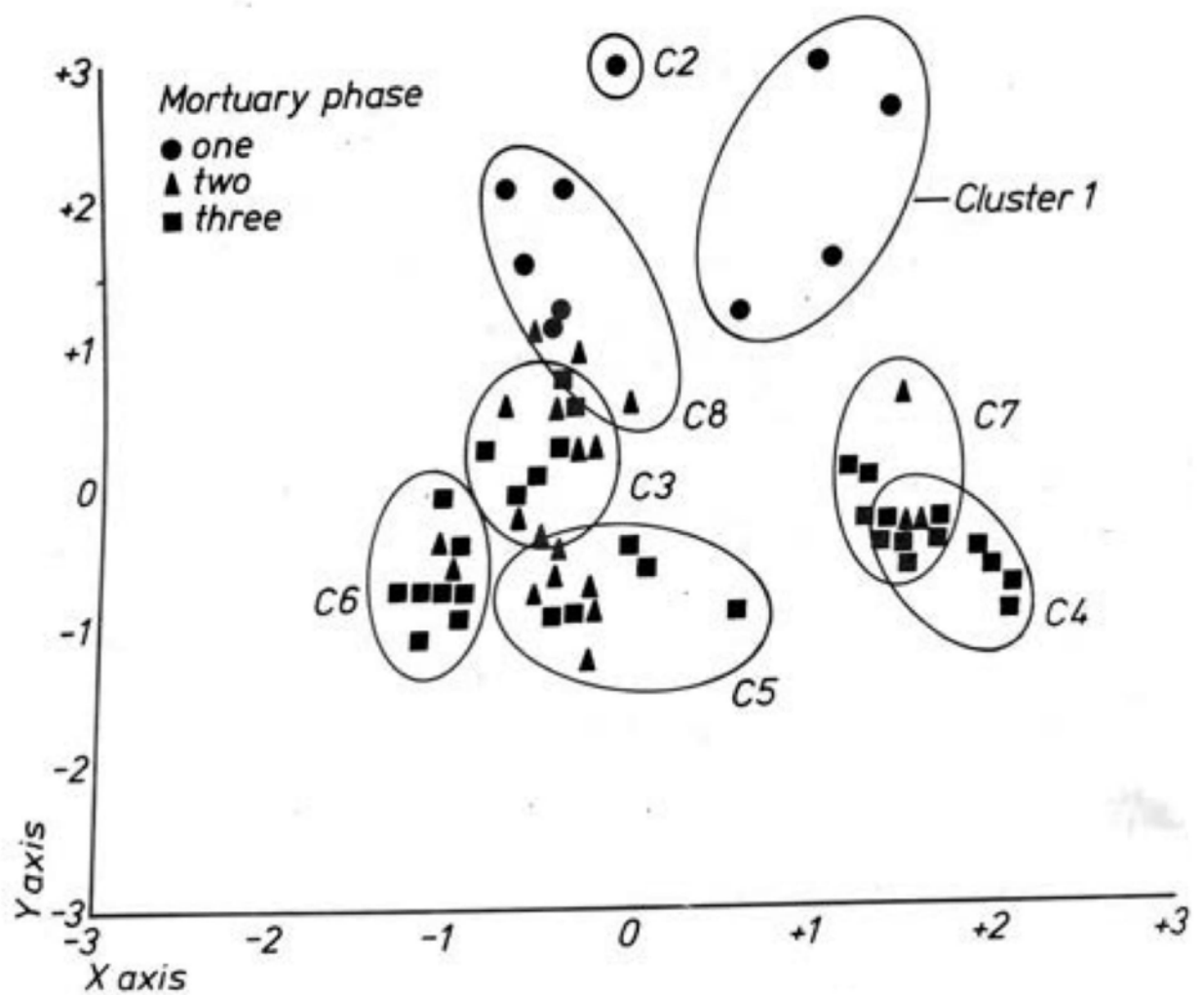


FIGURE 5-1

Factor Analysis of round based pots.
X axis is factor 1, Y axis is factor 2

Ban Na Di: illustrations of complete vessels

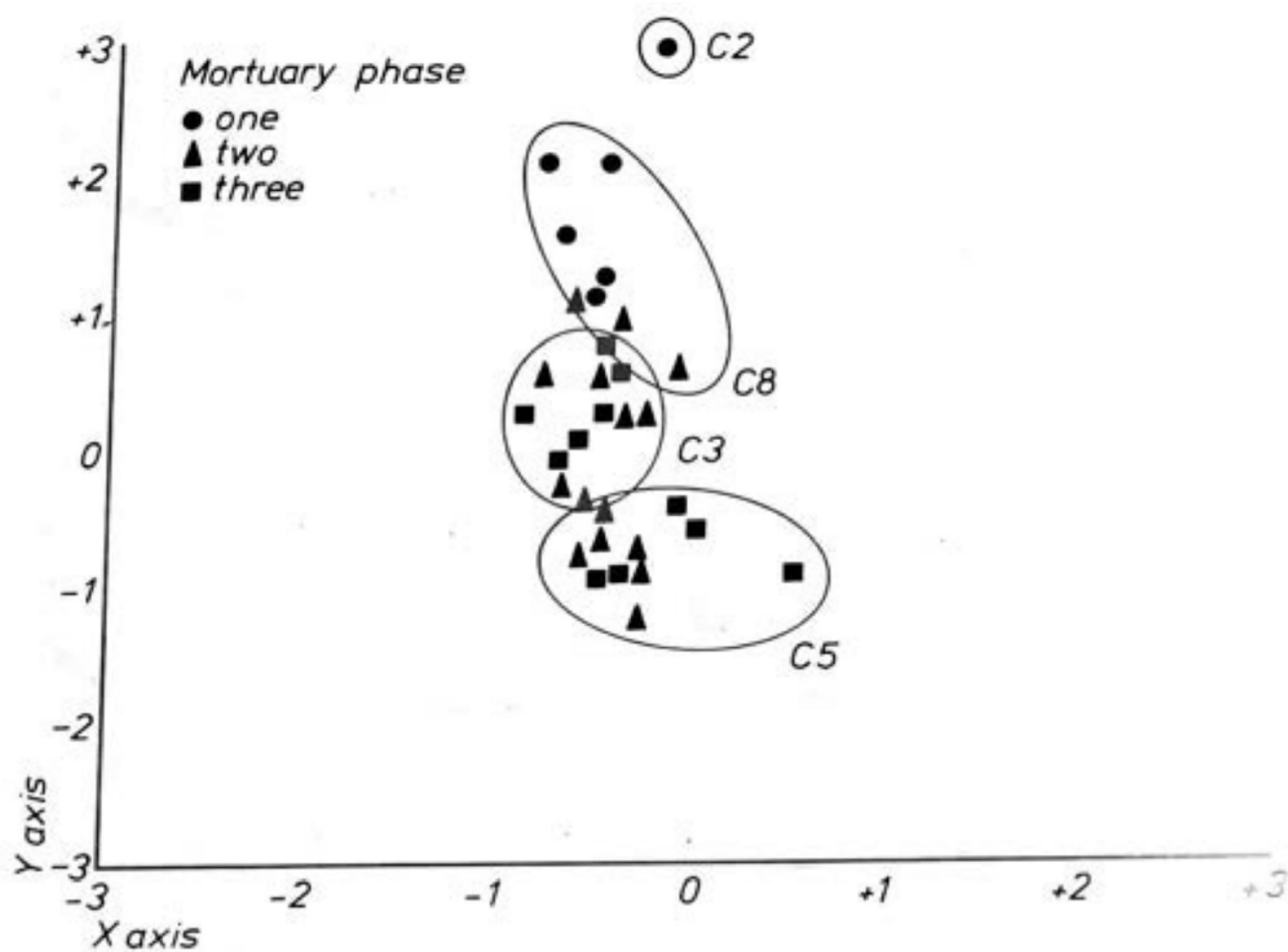


FIGURE 5-2

The clusters of round based vessels resulting from a factor analysis

Ban Na Di: illustrations of complete vessels

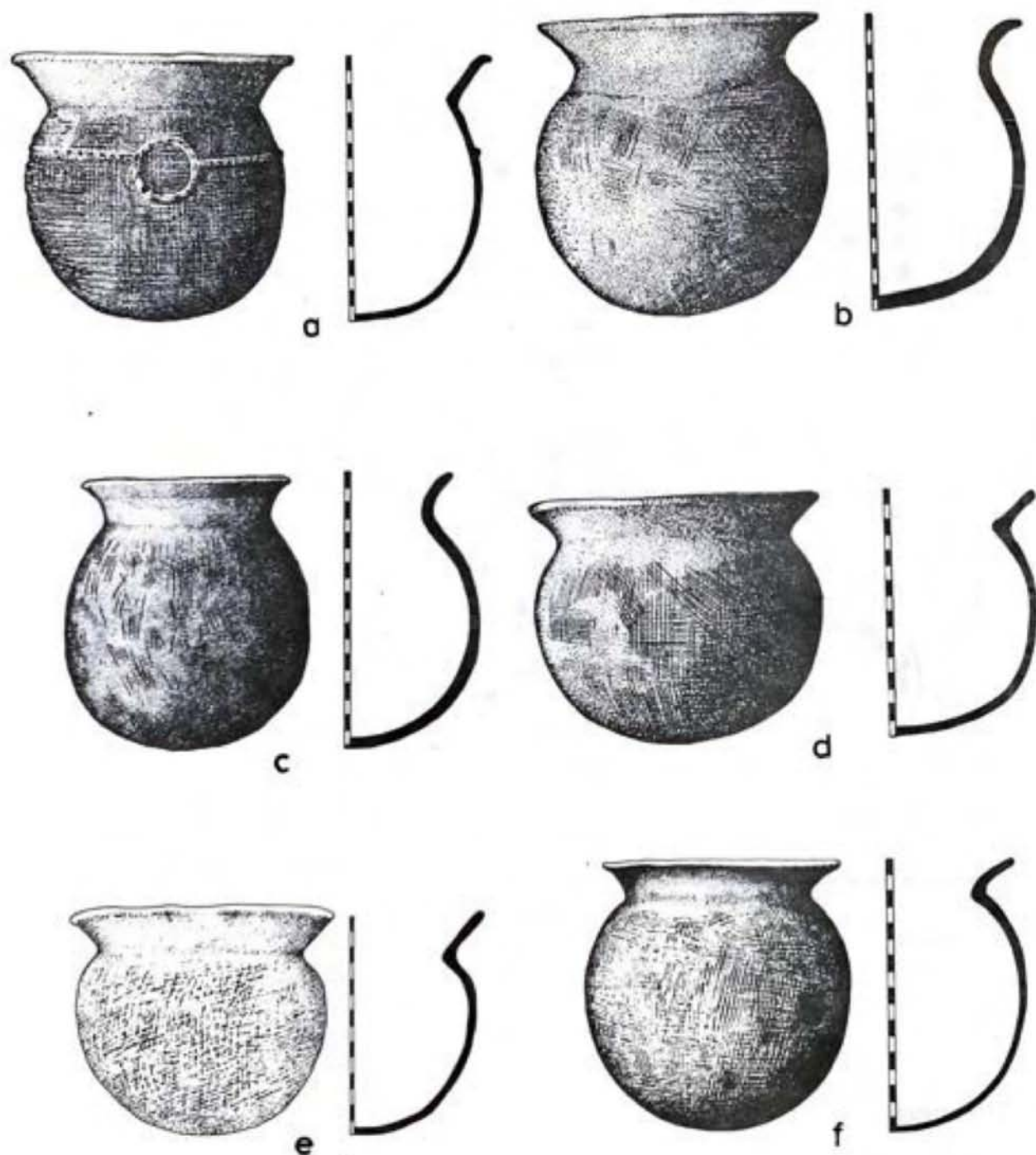


FIGURE 5-3 Ban Na Di: pot form 1a

- | | |
|---------------------------|------------------------|
| A. Pot no.3 B.34 MP 1a | B. Pot no.2 B.47 MP 1a |
| C. Pot no.1 B.22 MP 1a | D. Pot no.4 B.26 MP 1a |
| E. Pot no.25 B.TS21 MP 1a | F. Pot no.5 B.26 MP 1a |

Ban Na Di: illustrations of complete vessels

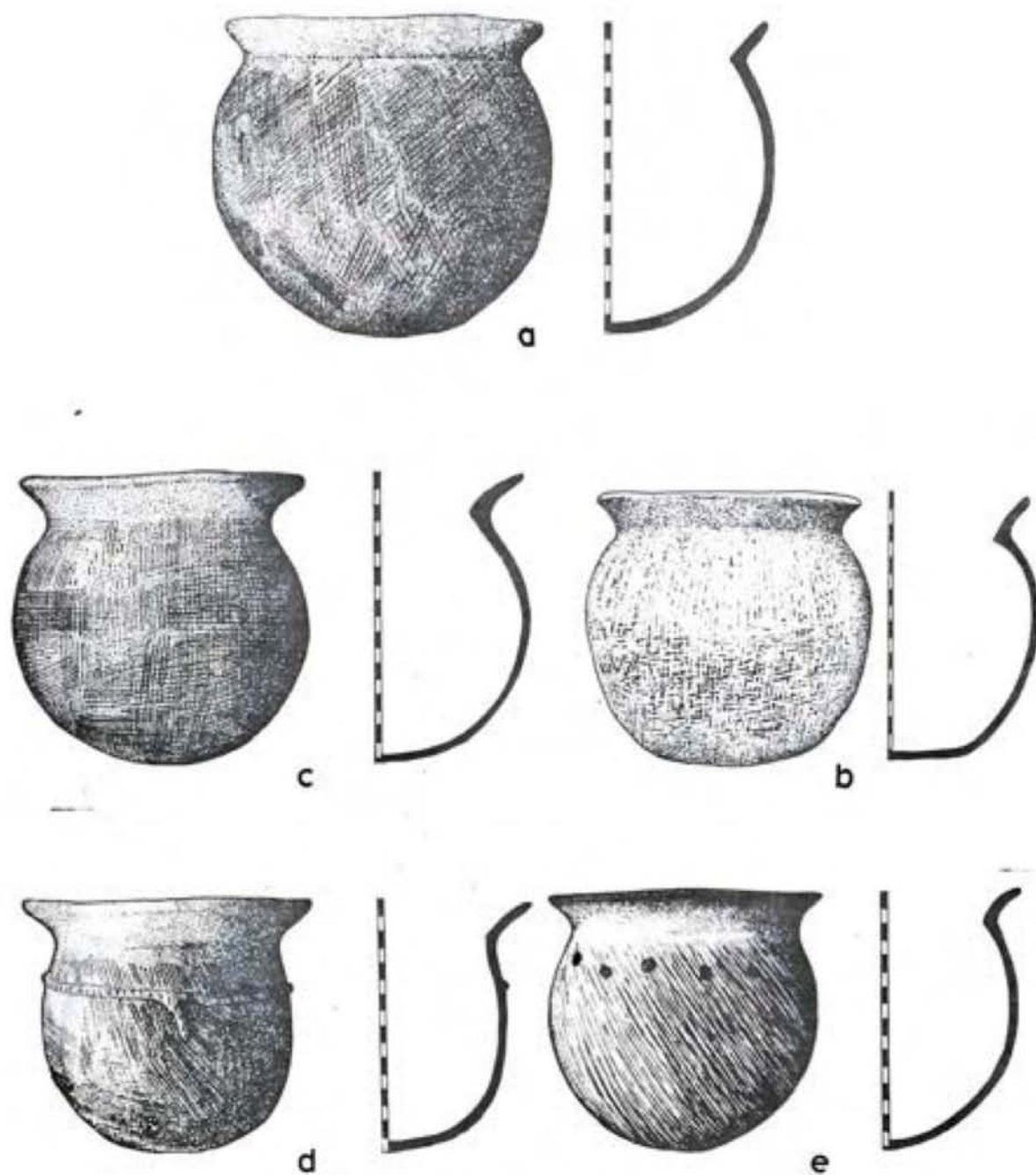


FIGURE 5-4 Ban Na Di: pot form 1a

- | | |
|-------------------------|---------------------------|
| A. Pot no.35 B.36 MP 1b | B. Pot no.26 B.TS16 MP 1b |
| C. Pot no.16 B.36 MP 1b | D. Pot no.32 Level 8 |
| E. Pot no.62 B.29 MP 1c | |

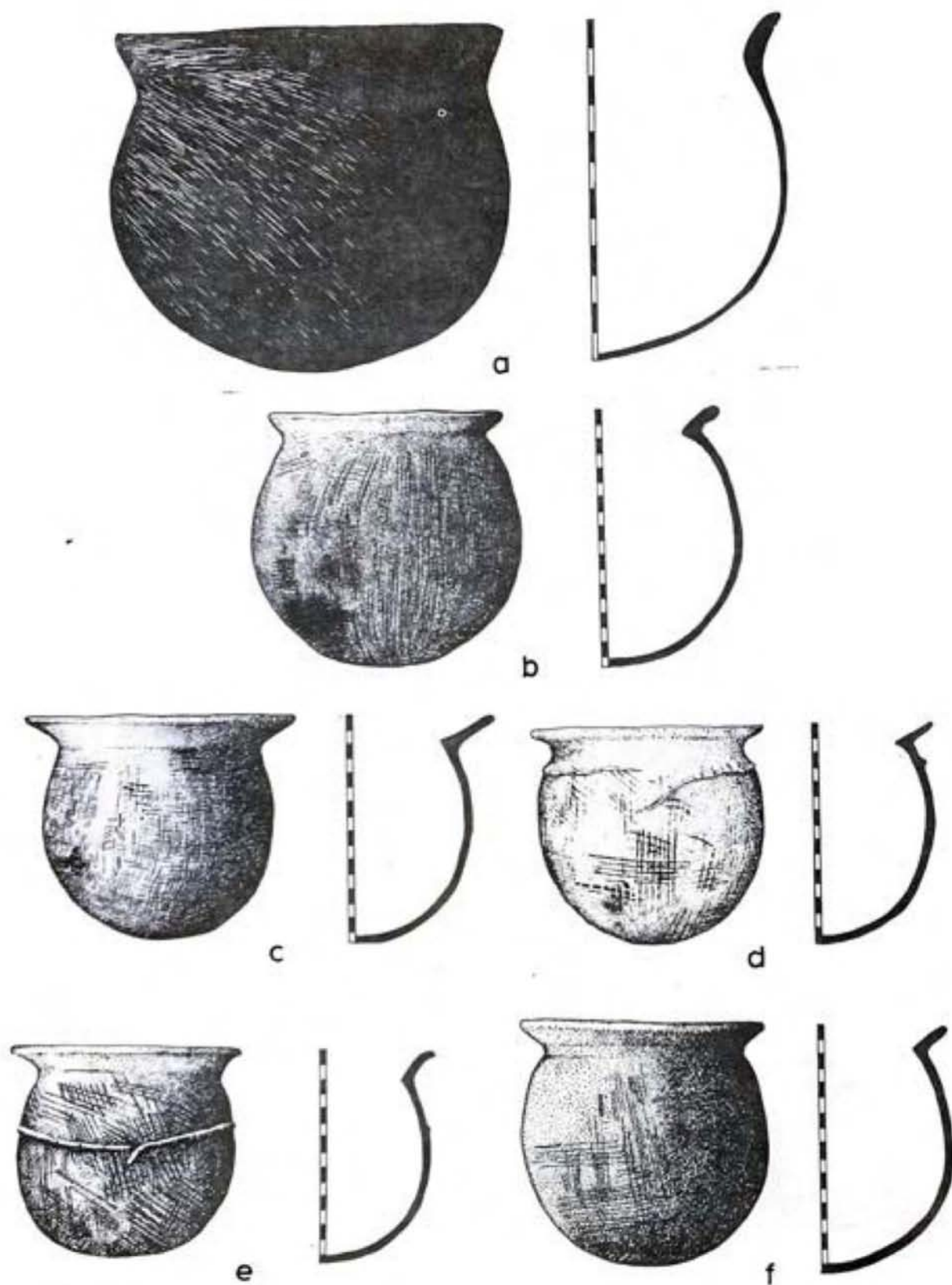


FIGURE 5-5 Ban Na Di: pot form 1b

- | | |
|-------------------------|---------------------------|
| A. Pot no.64 B.50 MP 1b | B. Pot no.27 B.TS15 MP 1b |
| C. Pot no.15 B.36 MP 1b | D. Pot no.8 B.42 MP 1b |
| E. Pot no.9 B.38 MP 1b | F. Pot no.10 B.38 MP 1b |

Ban Na Di: illustrations of complete vessels

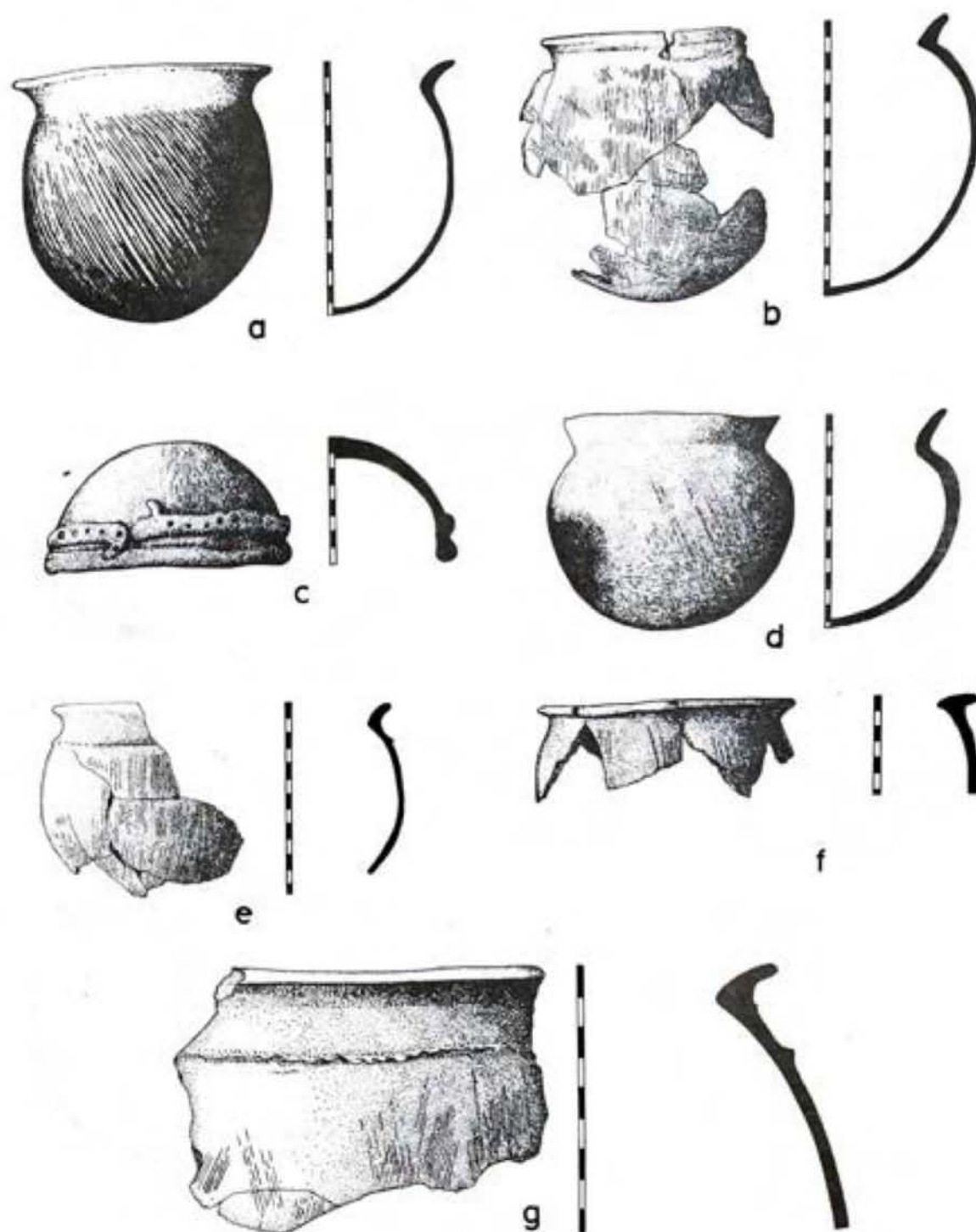


FIGURE 5-6 Ban Na Di: pot form 1b

- | | |
|---------------------------|----------------------------|
| A. Pot no.63 B.29 MP 1c | B. Pot no.100 B.20 MP 1c |
| C-D. Pot no.33 Level 5 | E. Pot no.105 Level 7 |
| F. Pot no.101 B.TS3 MP 1c | G. Pot no.102 B.TS12 MP 1c |

Ban Na Di: illustrations of complete vessels

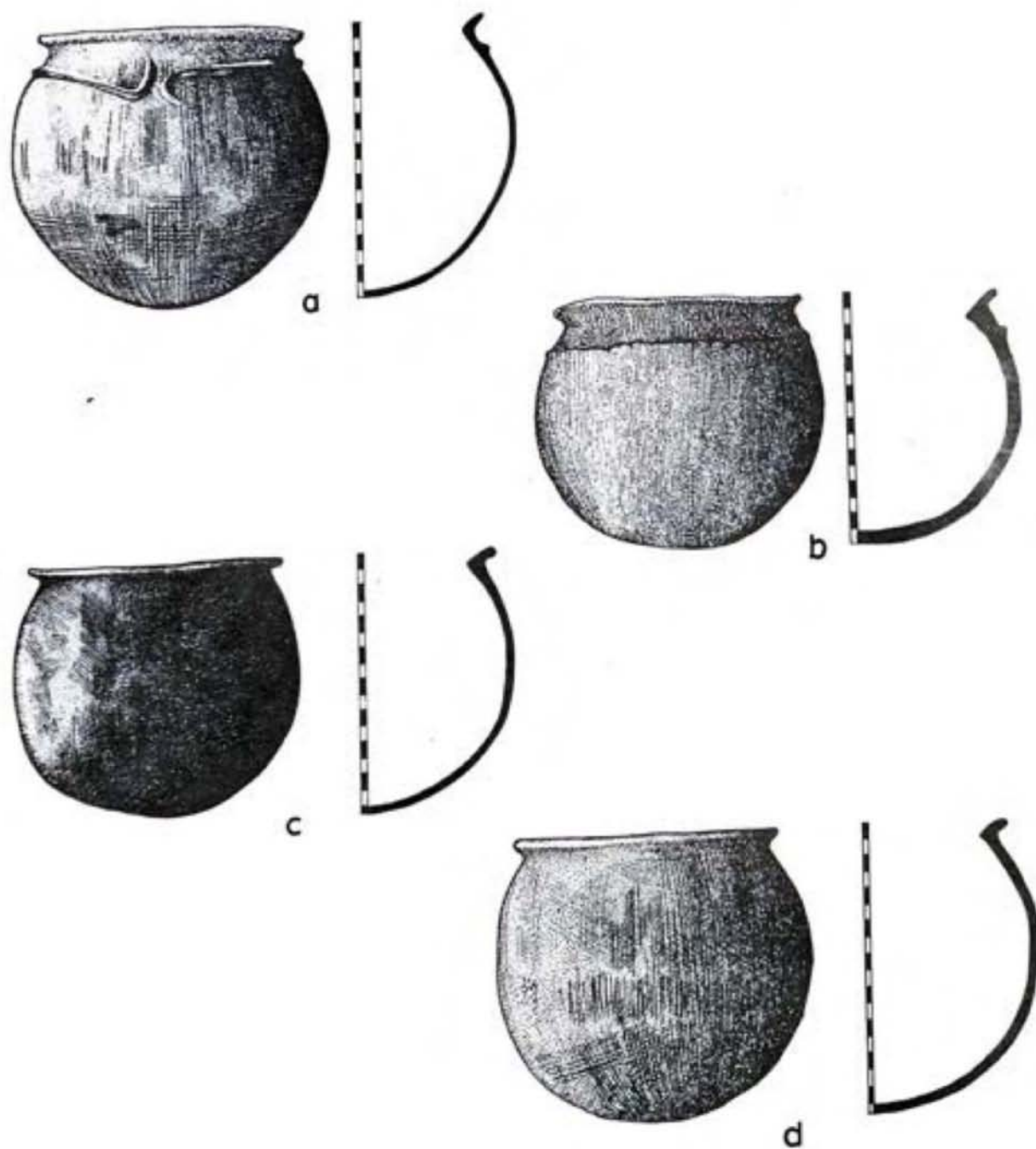


FIGURE 5-7 Ban Na Di: pot form 1c

- | | |
|-------------------------|-------------------------|
| A. Pot no.12 B.15 MP 1b | B. Pot no.11 B.15 MP 1b |
| C. Pot no.7 B.14 MP 1b | D. Pot no.6 B.14 MP 1b |

Ban Na Di: illustrations of complete vessels

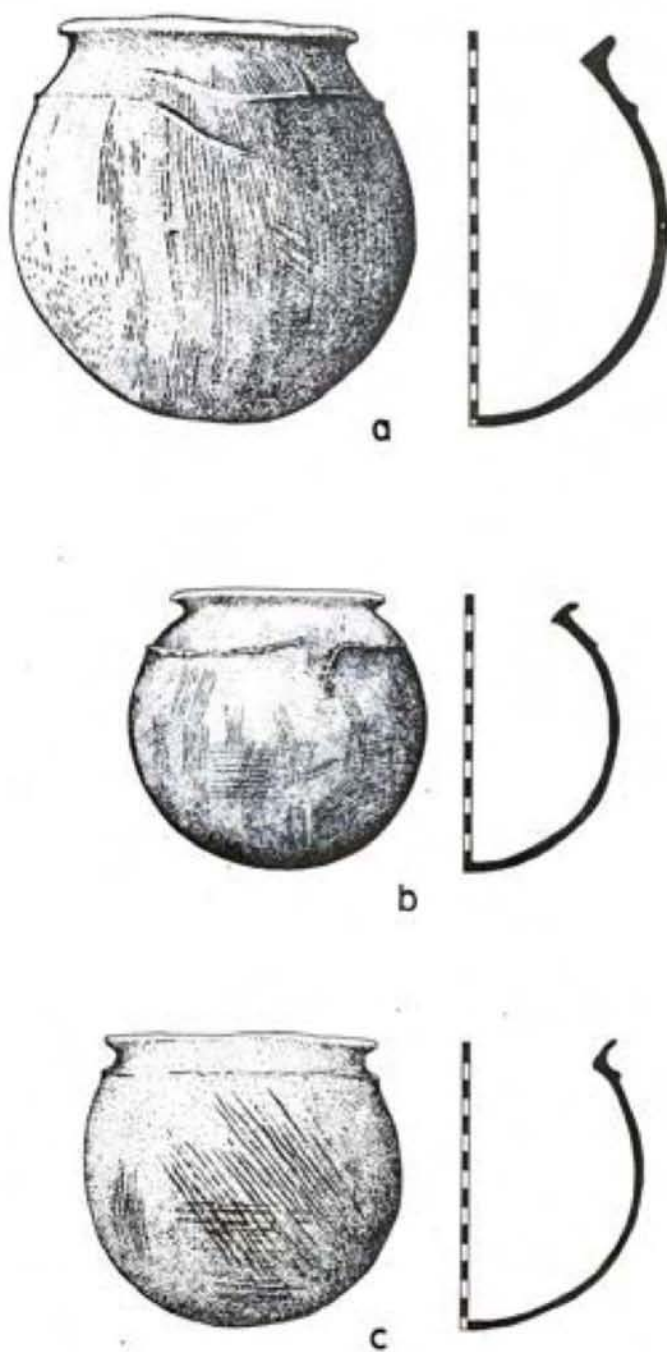


FIGURE 5-8 Ban Na Di: pot form 1c

- A. Pot no.23 B.50 MP 1b B. Pot no.13 B.12 MP 1b
C. Pot no.14 B.12 MP 1b

Ban Na Di: illustrations of complete vessels

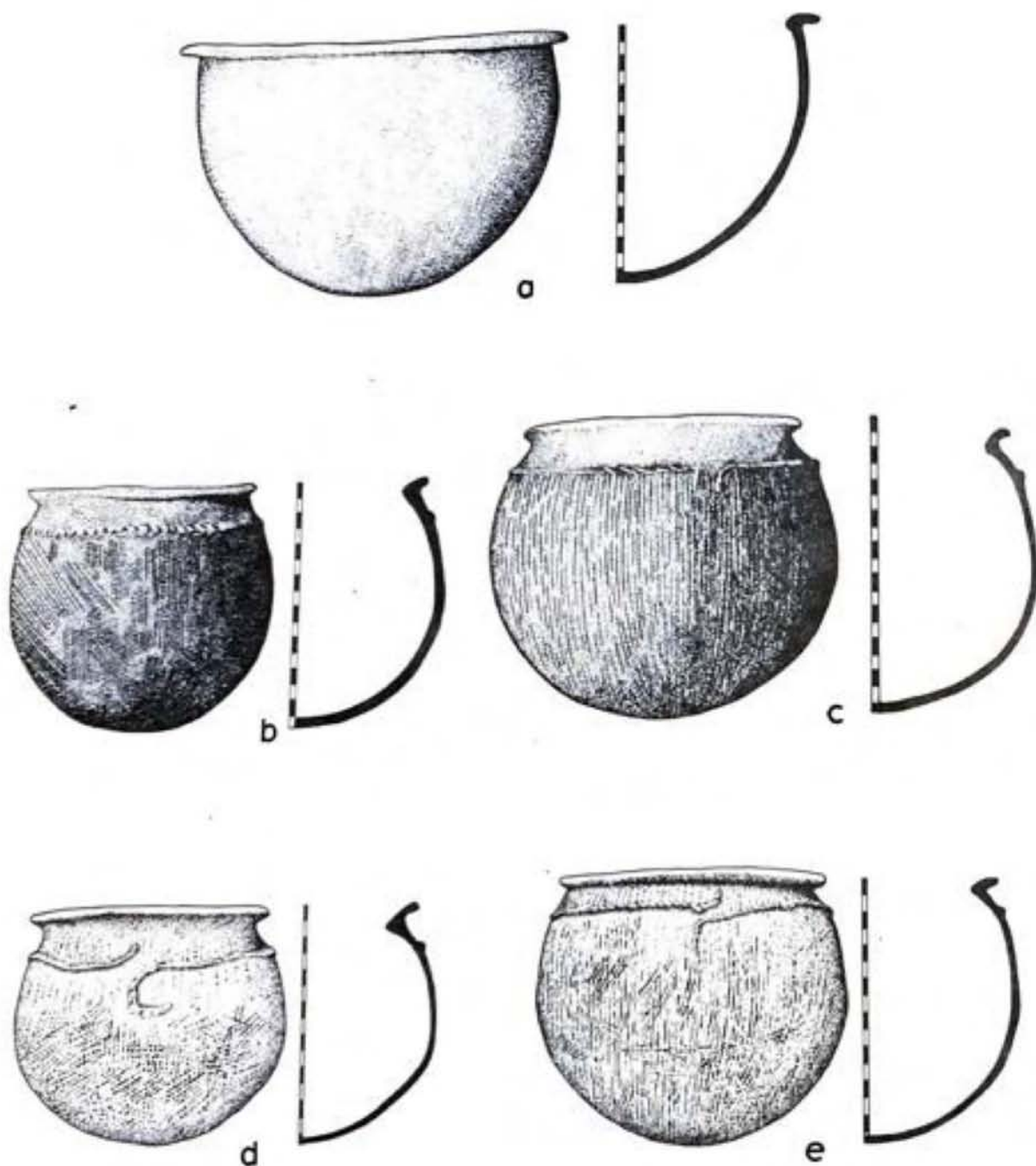


FIGURE 5-9 Ban Na Di: pot form 1c

- | | |
|---------------------------|---------------------------|
| A. Pot no.18 B.48 MP 1c | B. Pot no.36 B.18 MP 1c |
| C. Pot no.21 B.32 MP 1c | D. Pot no.28 B.TS12 MP 1c |
| E. Pot no.29 B.TS12 MP 1c | |

Ban Na Di: illustrations of complete vessels

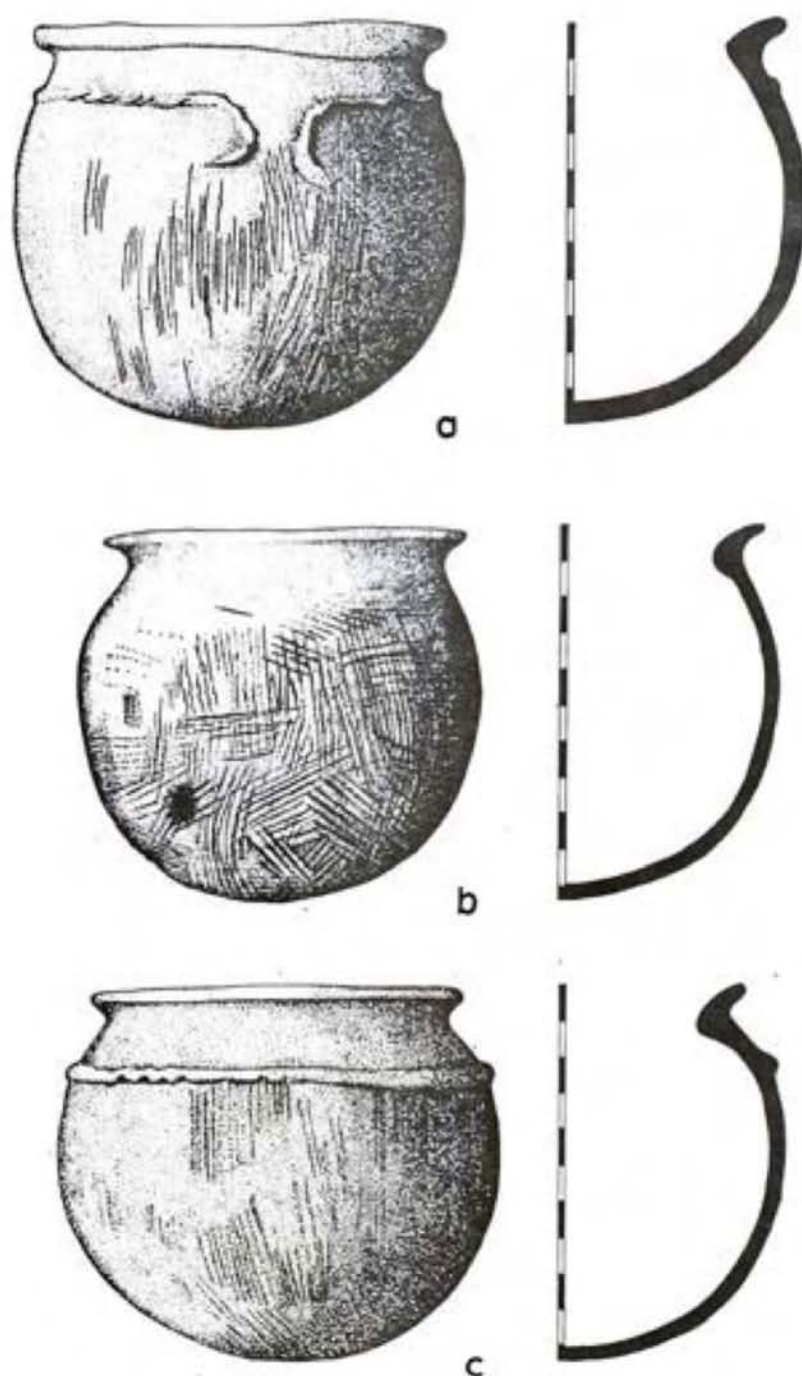


FIGURE 5-10 Ban Na Di: pot form 2

- A. Pot no.24 B.19 MP 1b B. Pot no.22 B.50 MP 1b
C. Pot no.20 B.32 MP 1c

Ban Na Di: illustrations of complete vessels

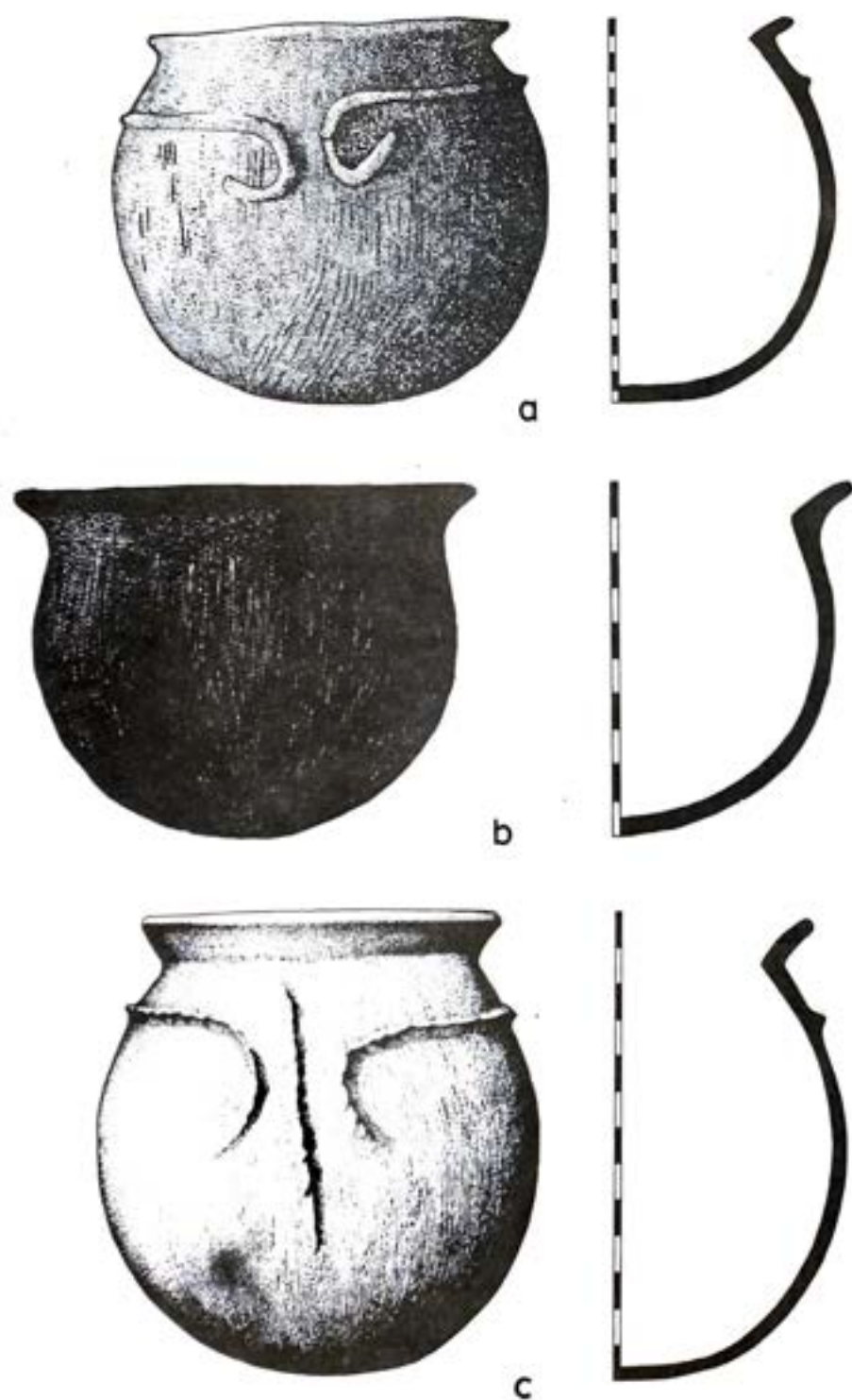


FIGURE 5-11 Ban Na Di: pot form 2

- A. Pot no.30 B.TS12 MP 1c B. Pot no.65 B.18 MP 1c
C. Pot no.31 Level 7

Ban Na Di: illustrations of complete vessels

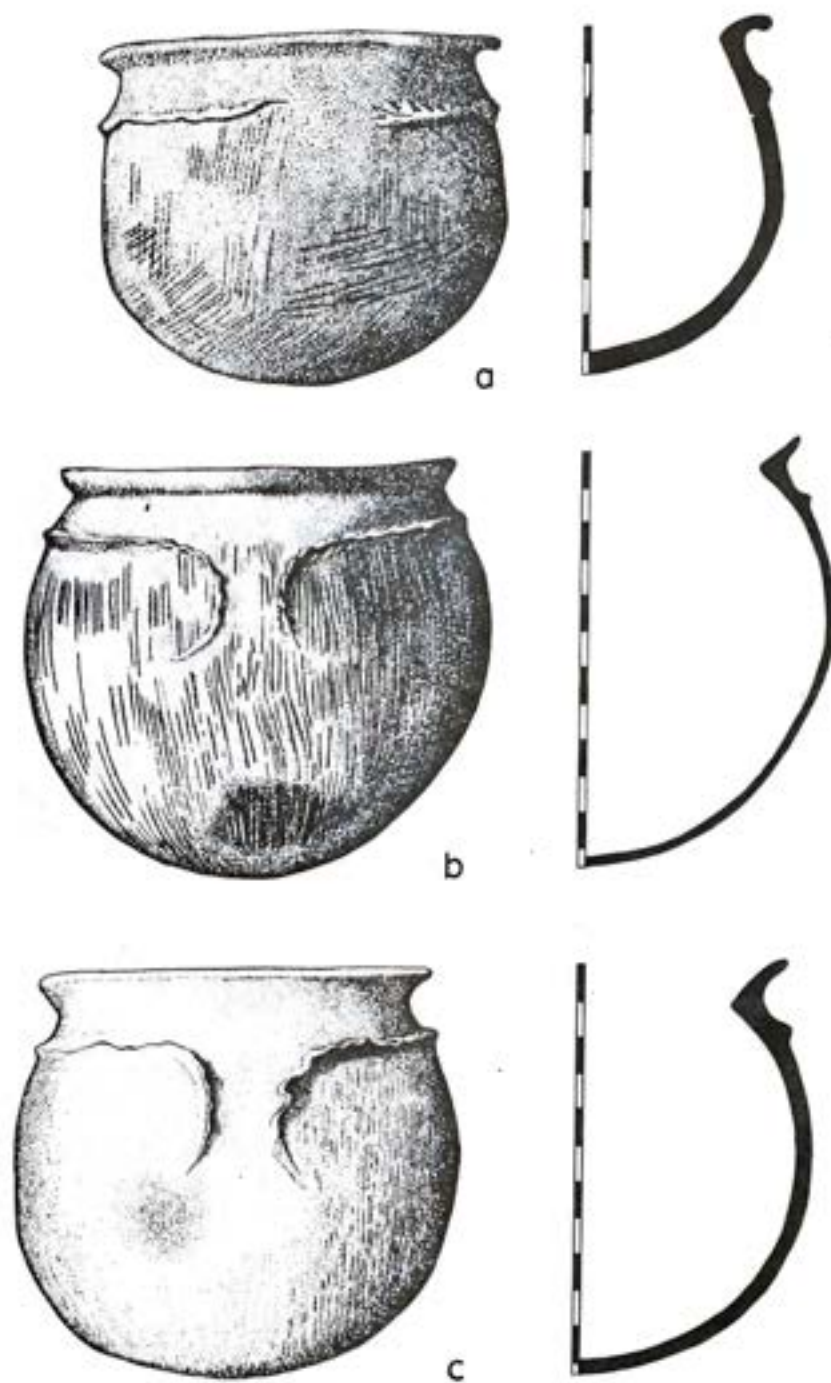


FIGURE 5-12 Ban Na Di: pot form 2

- A. Pot no.19 B.48 MP 1c B. Pot no.17 B.48 MP 1c
C. Pot no.34 B.TS5 MP 1c

Ban Na Di: illustrations of complete vessels

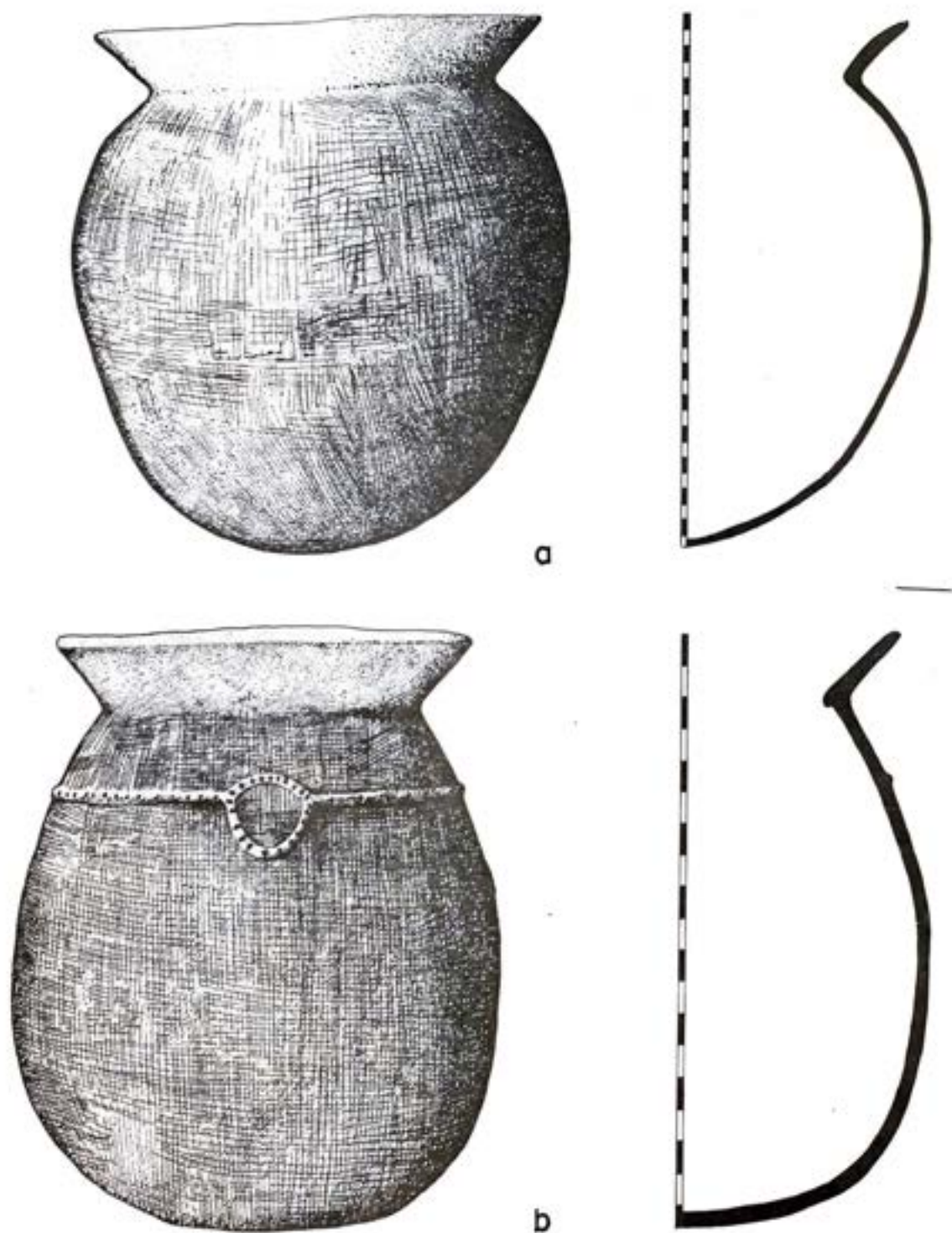


FIGURE 5-13 Ban Na Di: pot form 3

A. Pot no.107 B.25 MP 1b

B. Pot no.108 Level 8

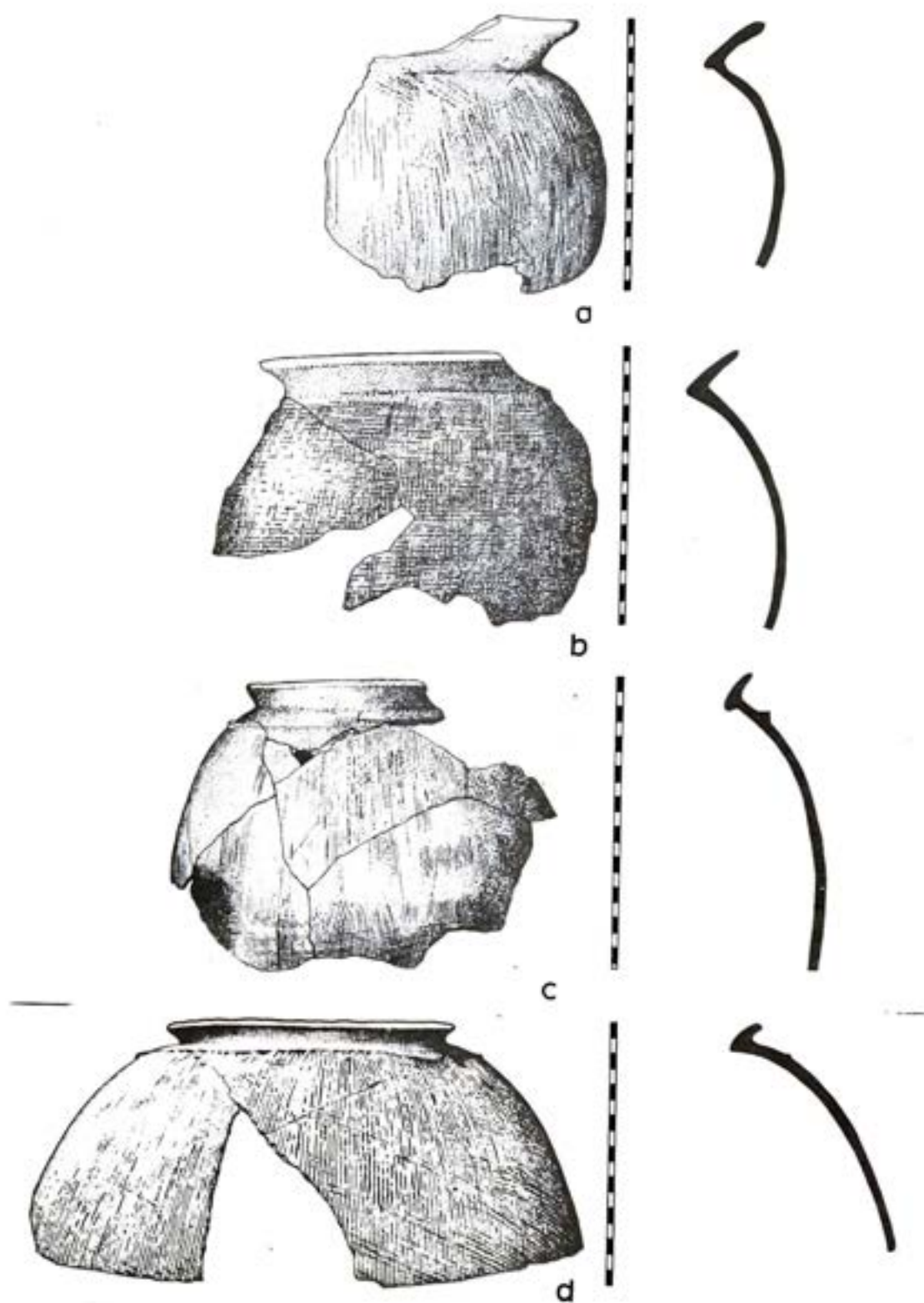


FIGURE 5-14 Ban Na Di: pot forms 3 (a-b) and 4 (c-d)

- | | |
|--------------------------|-------------------------|
| A. Pot no.110 B.46 MP 1a | B. Pot no.111 Level 8 |
| C. Pot no.74 B.30 MP 1b | D. Pot no.75 B.14 MP 1b |

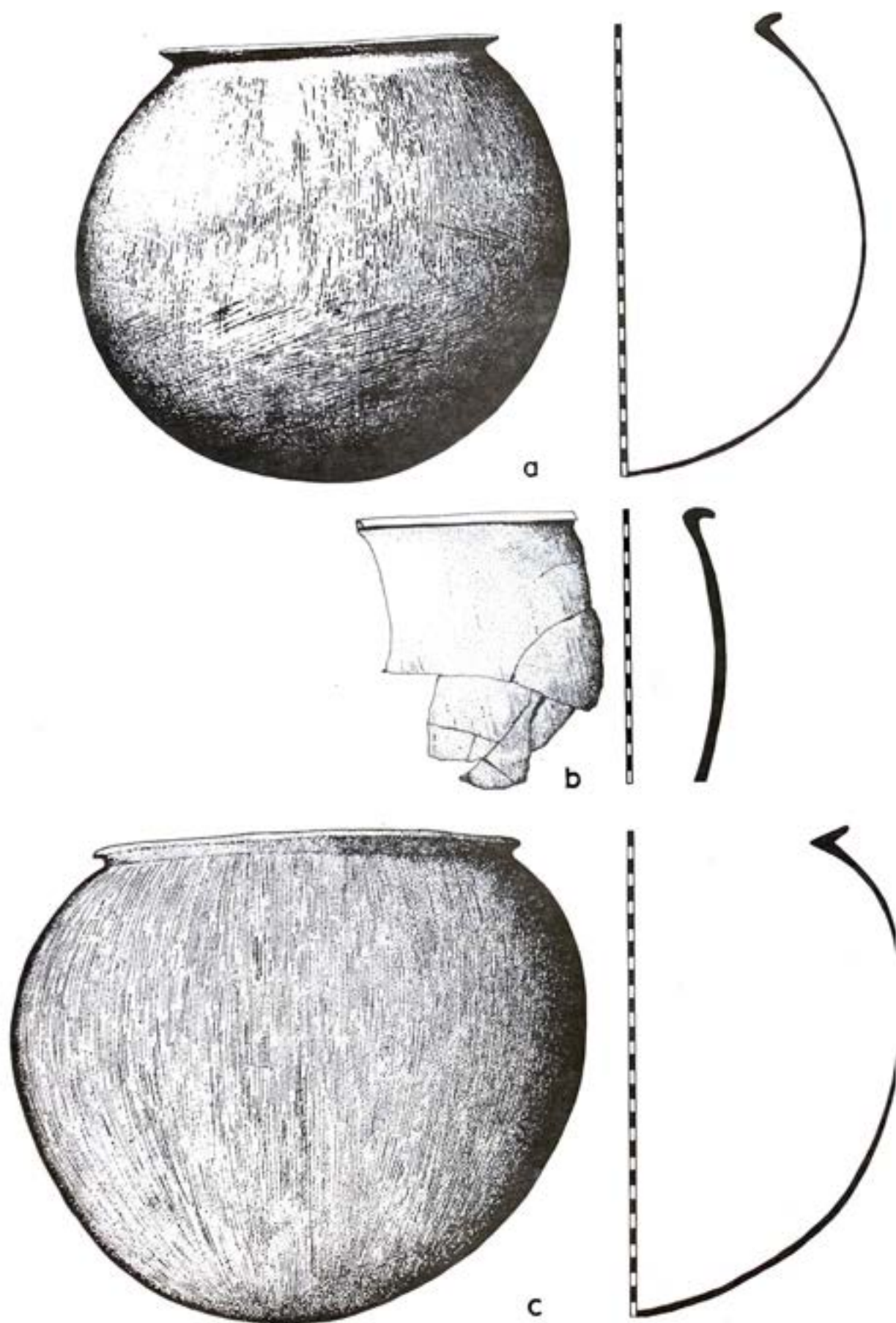


FIGURE 5-15 Ban Na Di: pot form 4. A. Pot no. 81 B.48 MP 1c. B. Pot no. 112 B.48 MP 1c. C. Pot no.59 B.48 MP 1c

Ban Na Di: illustrations of complete vessels

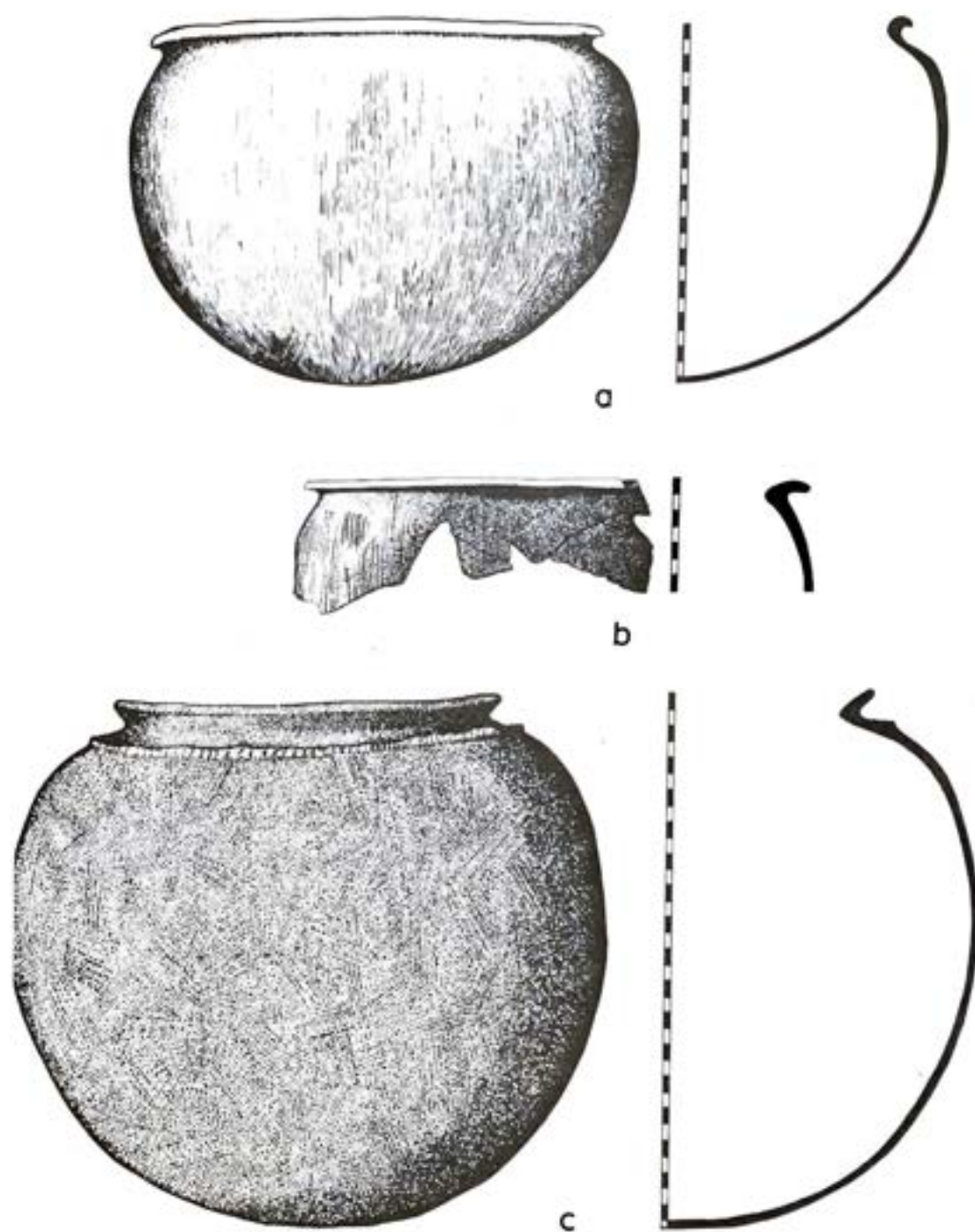


FIGURE 5-16 Ban Na Di: pot form 4

A. Pot no.79 B.31 MP 1c B. Pot no.134 B.31 MP 1c
 C. Pot no.58 B.TS5 MP 1c

Ban Na Di: illustrations of complete vessels

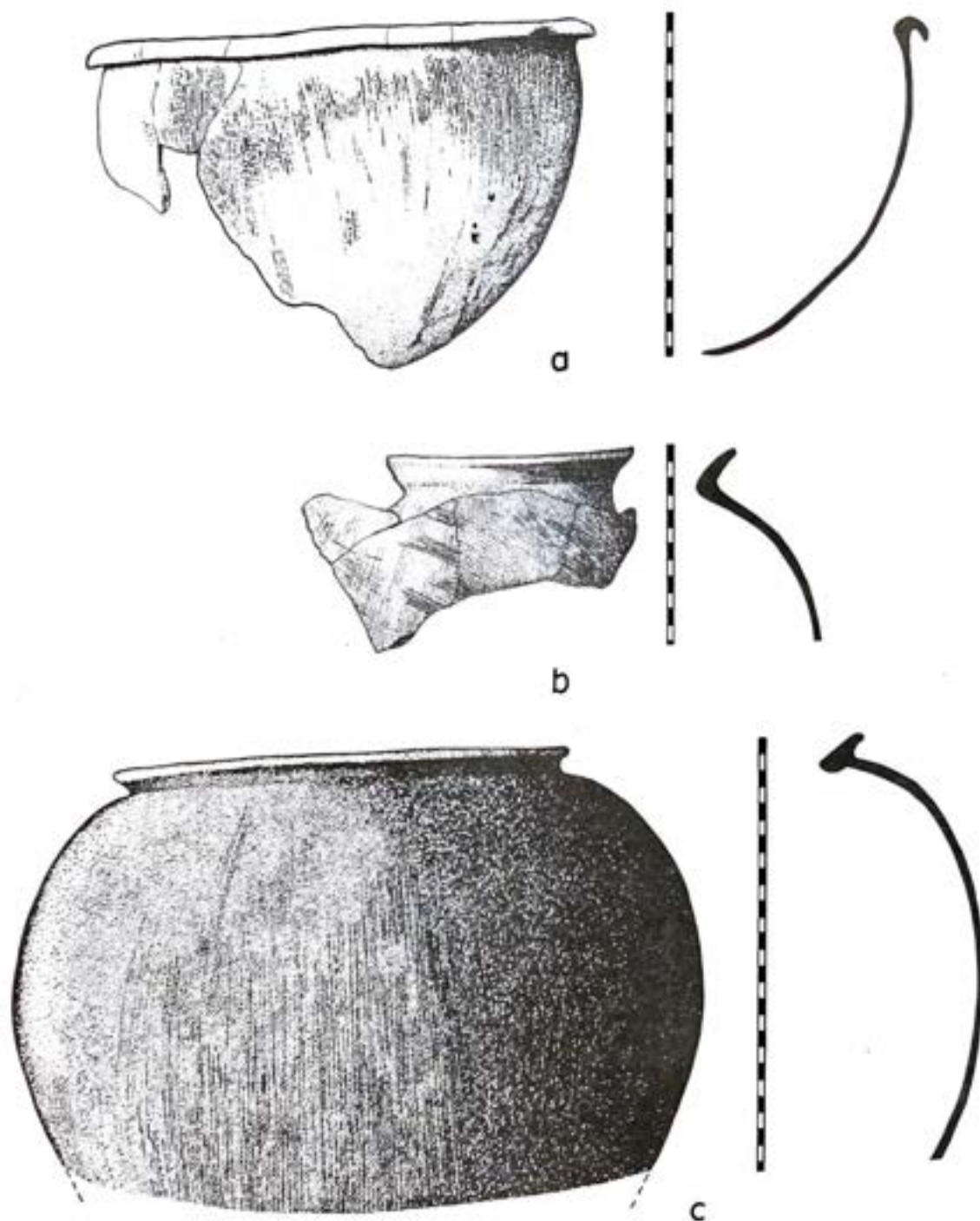


FIGURE 5-17 Ban Na Di: pot form 4

- A. Pot no.82 B.12 MP 1b B. Pot no.120 B.12 MP 1b
C. Pot no.61 B.32 MP 1c

Ban Na Di: illustrations of complete vessels

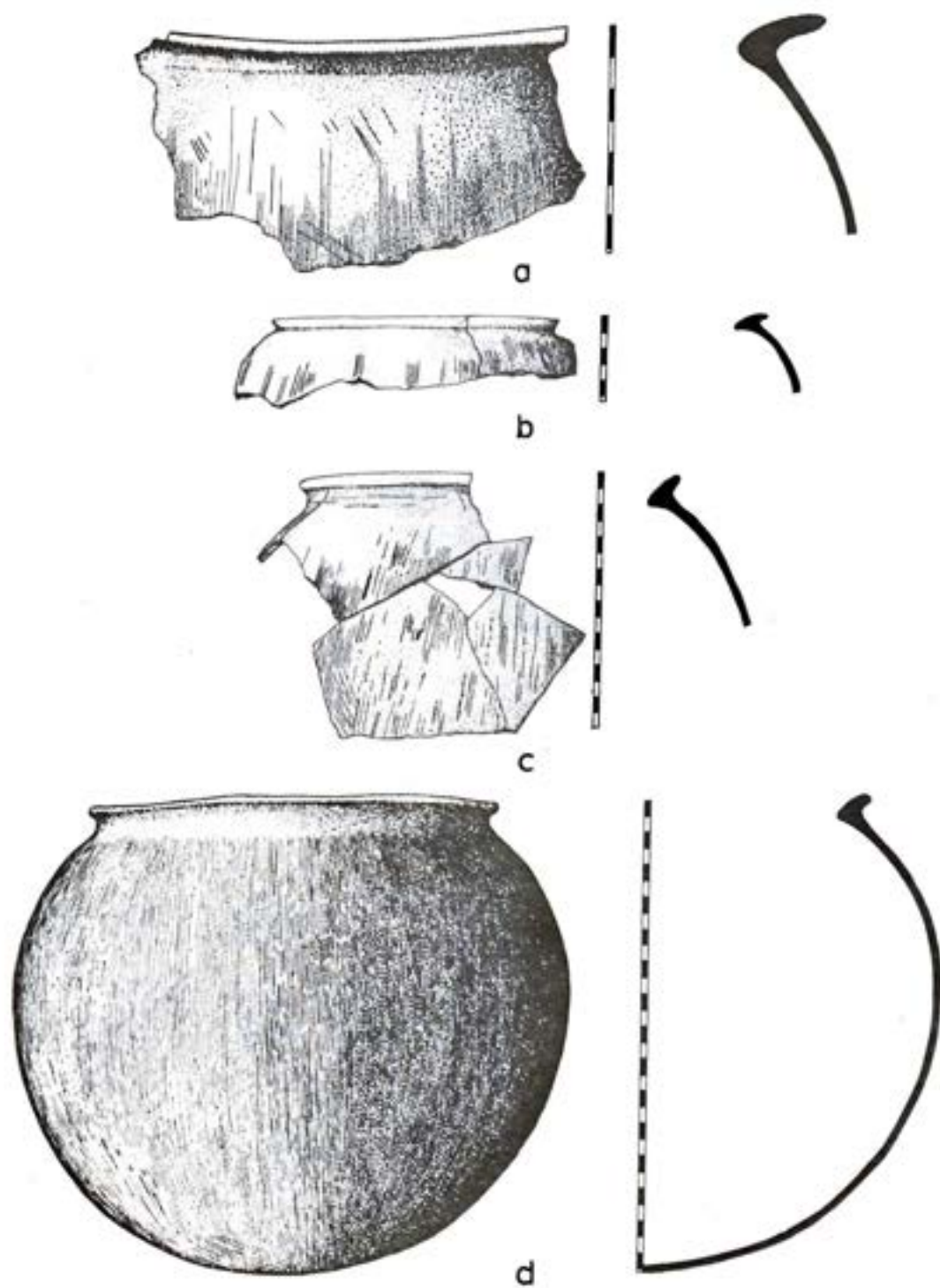


FIGURE 5-18 Ban Na Di: pot form 4

A. Pot no.104 B.TS7 MP 1c
C. Pot no.57 B.10/11 MP 1c

B. Pot no.103 B.TS7 MP 1c
D. Pot no.135 B.10/11 MP 1c

Ban Na Di: illustrations of complete vessels

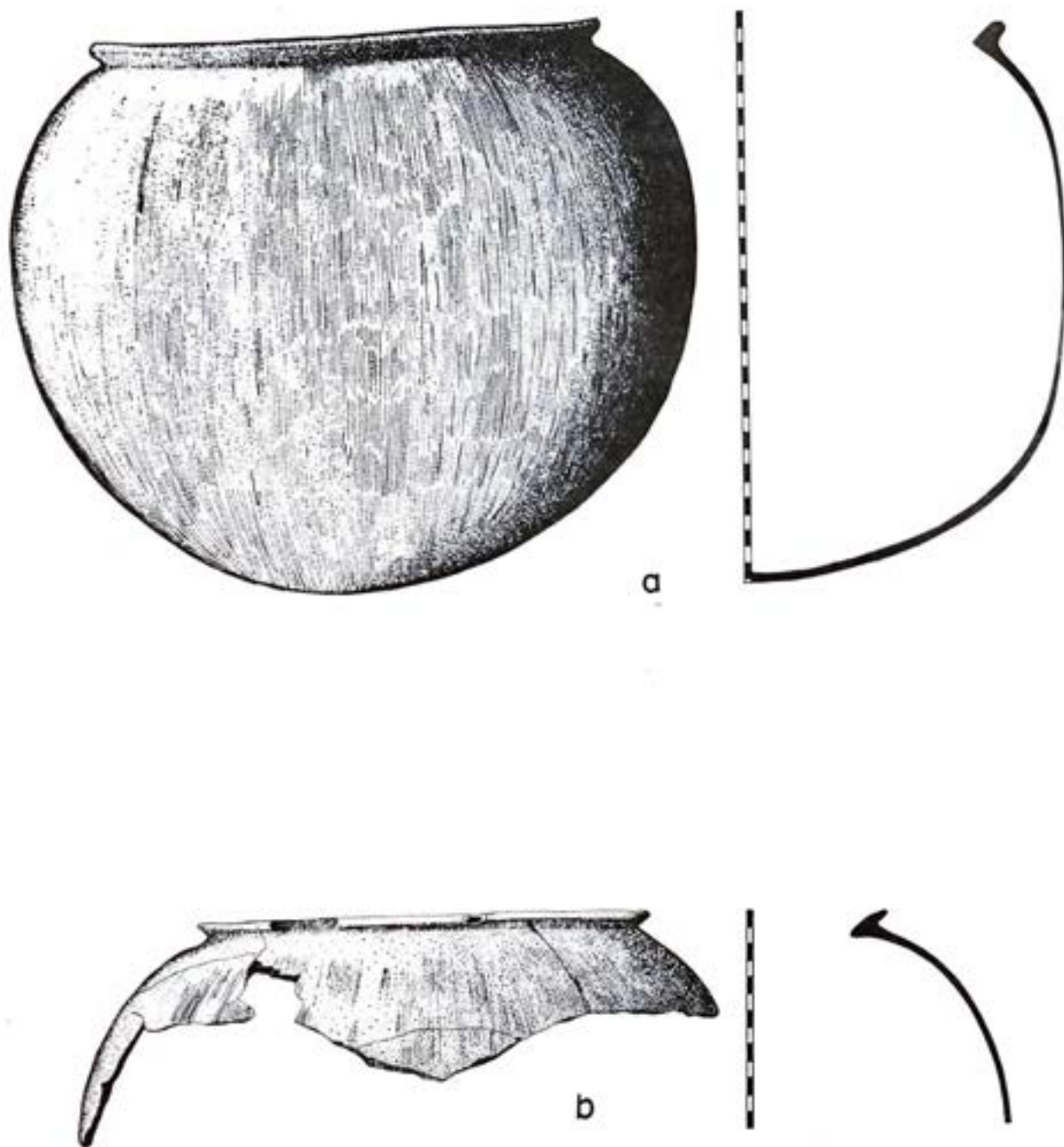


FIGURE 5-19 Ban Na Di: pot form 4

A. Pot no.60 B.18 MP 1c

B. Pot no.106 B.19 MP 1b

Ban Na Di: illustrations of complete vessels

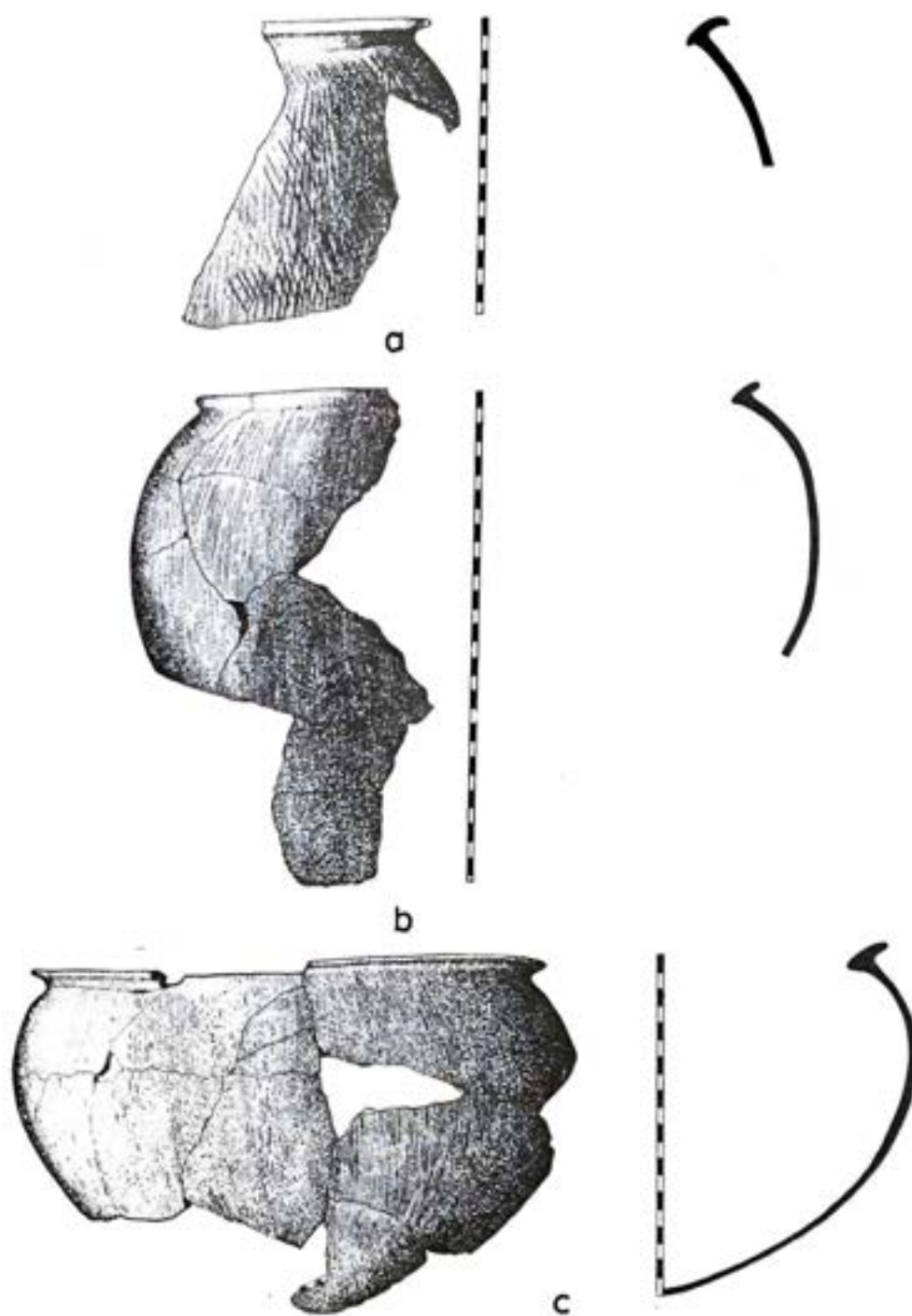


FIGURE 5-20 Ban Na Di: pot form 4

- A. Pot no.80 B.TS12 MP 1c B. Pot no.76 B.TS12 MP 1c
C. Pot no.83 B.TS12 MP 1c

Ban Na Di: illustrations of complete vessels

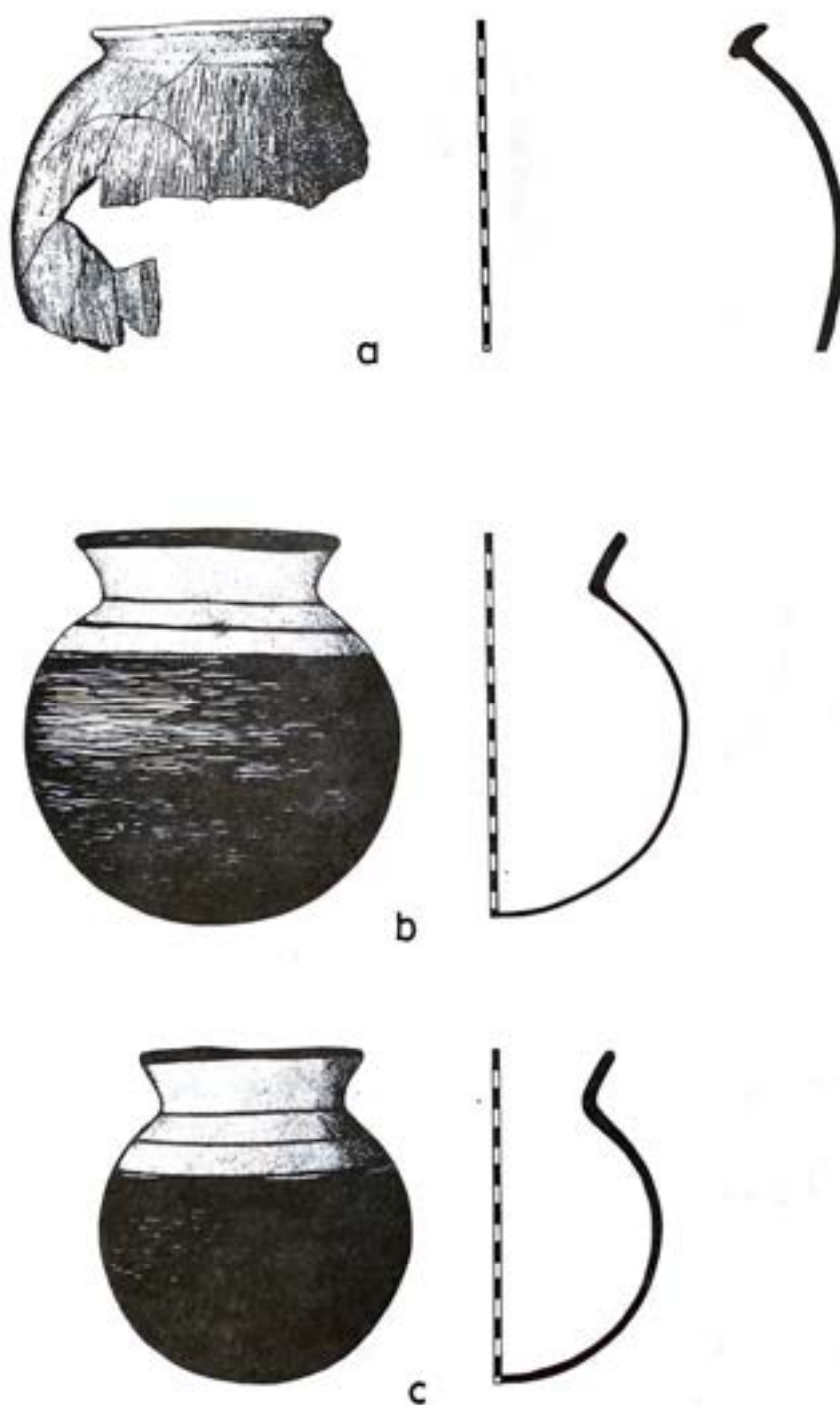


FIGURE 5-21 Ban Na Di: pot forms 4(a) and 5(b-c)

- A. Pot no.121 B.21 MP 1b B. Pot no.95 B.12 MP 1b
 C. Pot no.94 B.35 MP 1c

Ban Na Di: illustrations of complete vessels

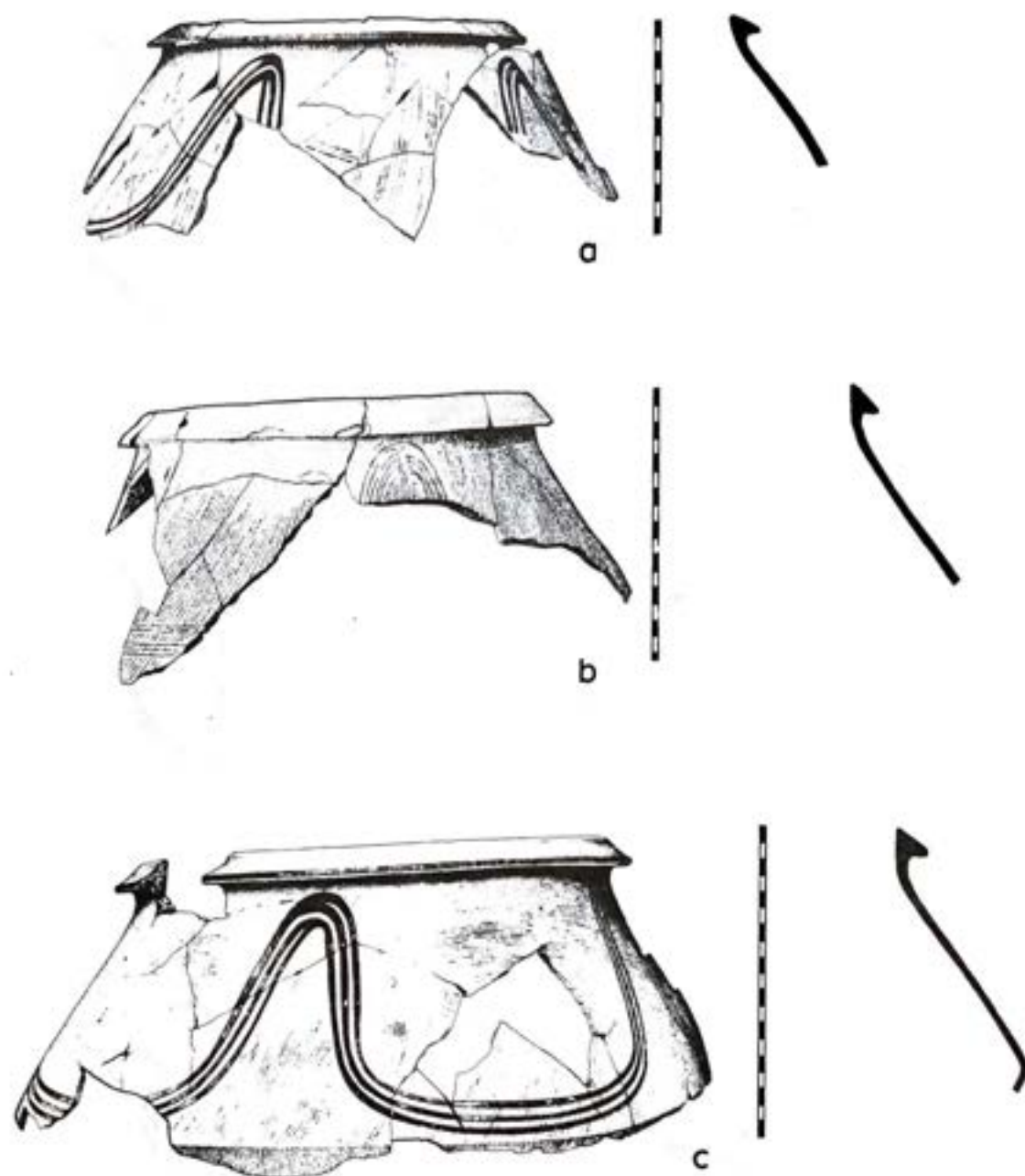


FIGURE 5-22 Ban Na Di: pot form 8

- A. Pot no.109 Level 7 B. Pot no.98 B.18 MP 1c
C. Pot no.97 B.35 MP 1c

Ban Na Di: illustrations of complete vessels

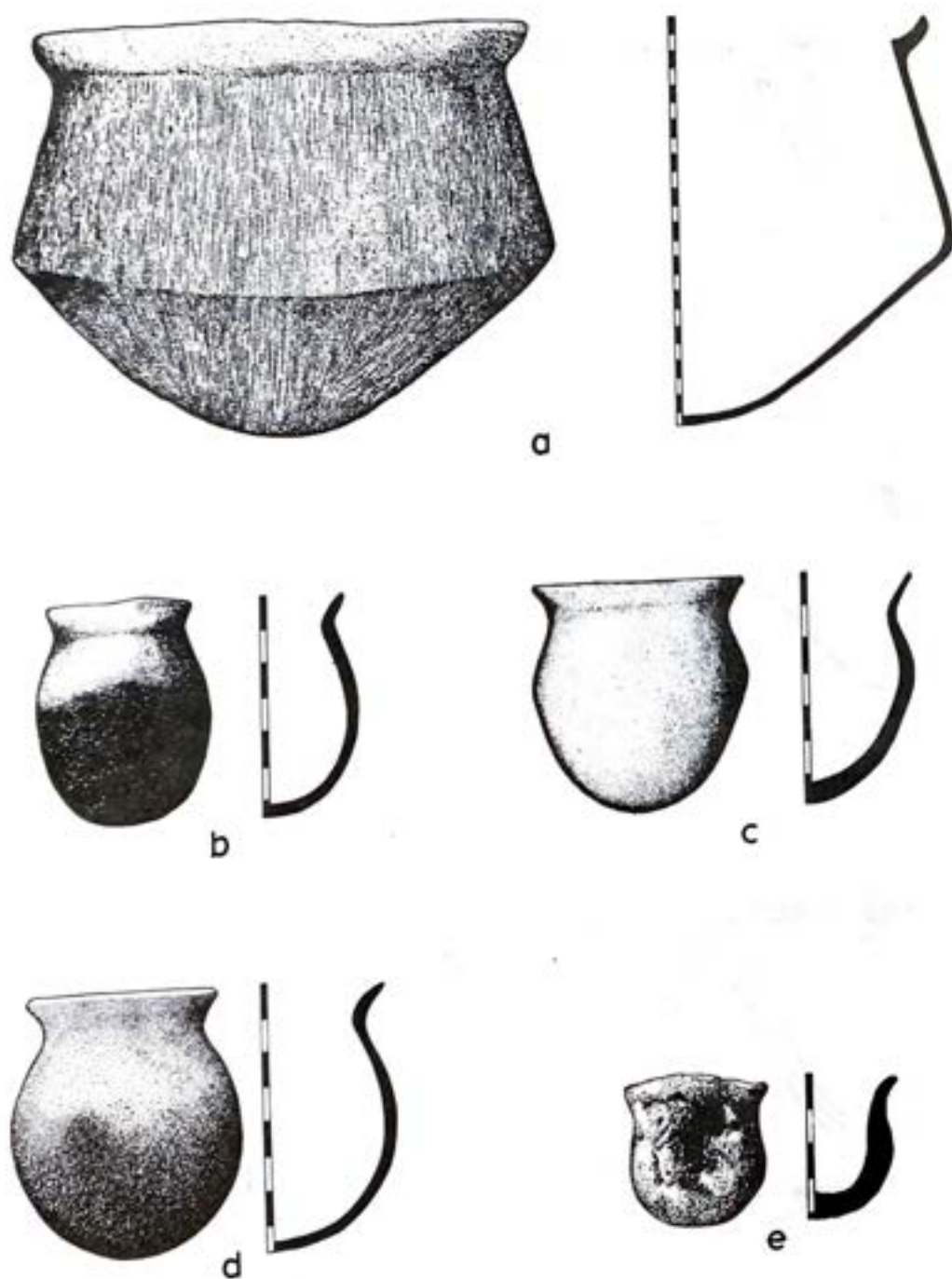


FIGURE 5-23 Ban Na Di: pot forms 7(a) and 9(b-e)

- | | |
|--------------------------|-------------------------|
| A. Pot no.98 B.35 MP 1c | B. Pot no.88 B.48 MP 1c |
| C. Pot no.89 B.48 MP 1c | D. Pot no.87 B.12 MP 1b |
| E. Pot no.119 B.12 MP 1b | |

Ban Na Di: illustrations of complete vessels

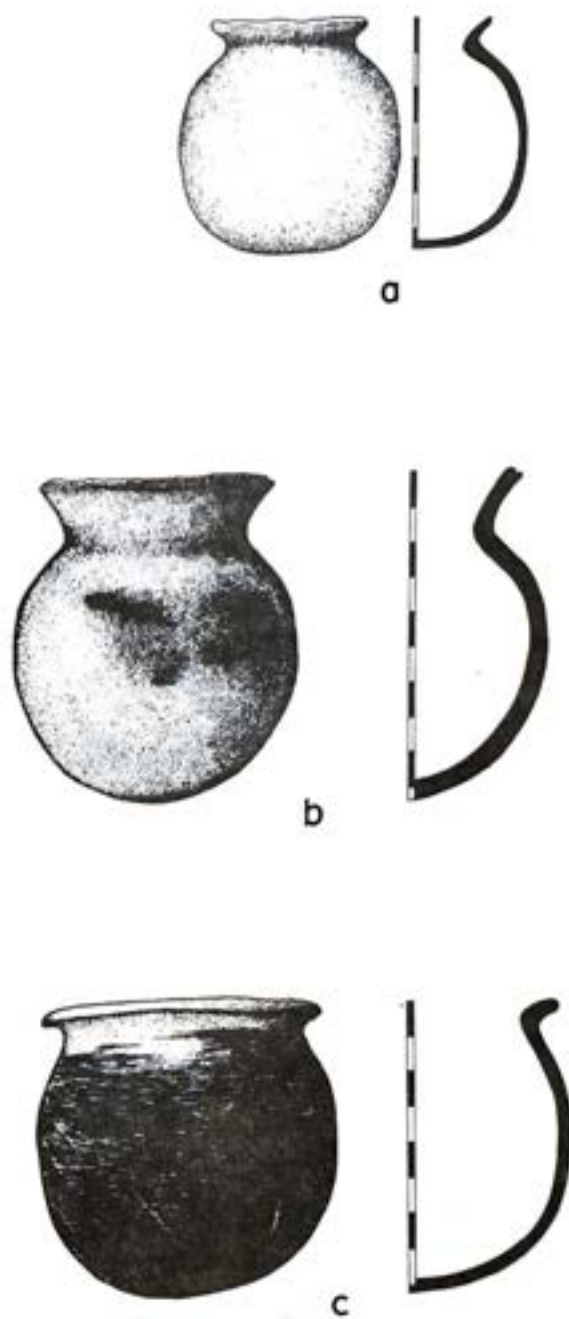


FIGURE 5-24 Ban Na Di: pot form 9

- A. Pot no.91 B.TS6 MP 1c B. Pot no.93 B.19 MP 1b
C. Pot no.90 B.50 MP 1b

Ban Na Di: illustrations of complete vessels

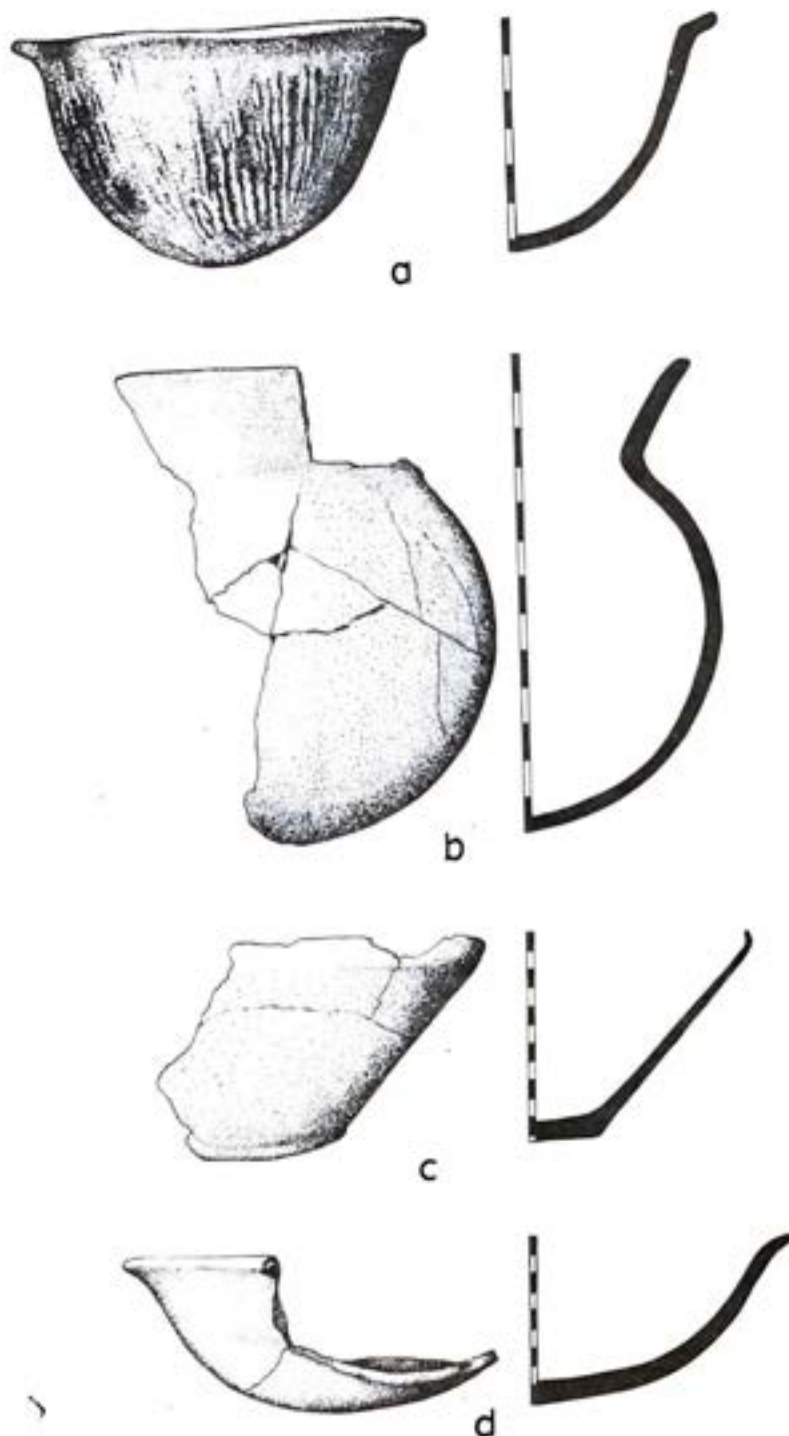


FIGURE 5-25 Ban Na Di: pot forms 10(a),11(b),12(c)and 13(d)

- | | |
|--------------------------|--------------------------|
| A. Pot no.99 B.18 MP 1c | B. Pot no.125 Level 7 |
| C. Pot no.122 B.19 MP 1b | D. Pot no.127 B.18 MP 1c |

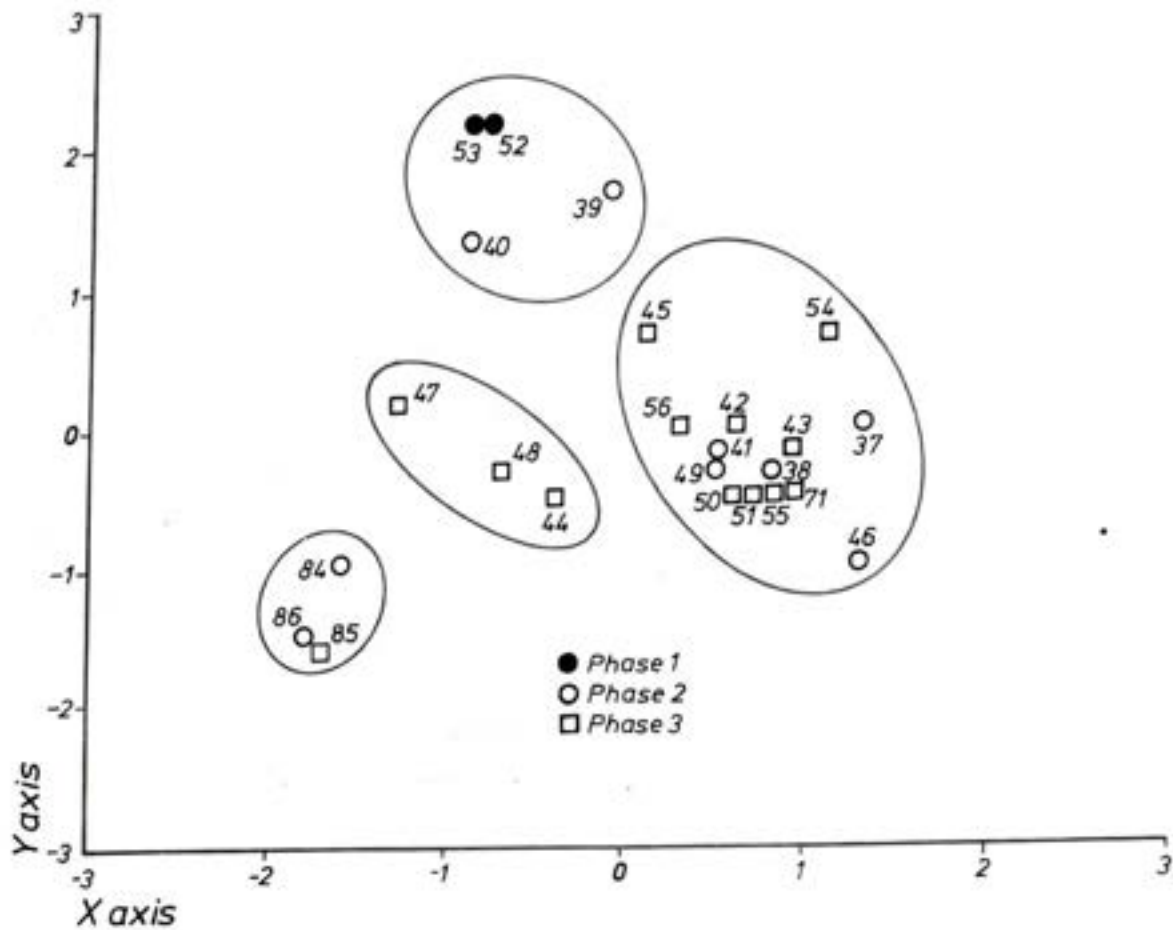


FIGURE 5-26

Factor analysis for pedestalled vessels.
Factor 1 is the x axis, factor 2 is the y axis.

Ban Na Di: illustrations of complete vessels

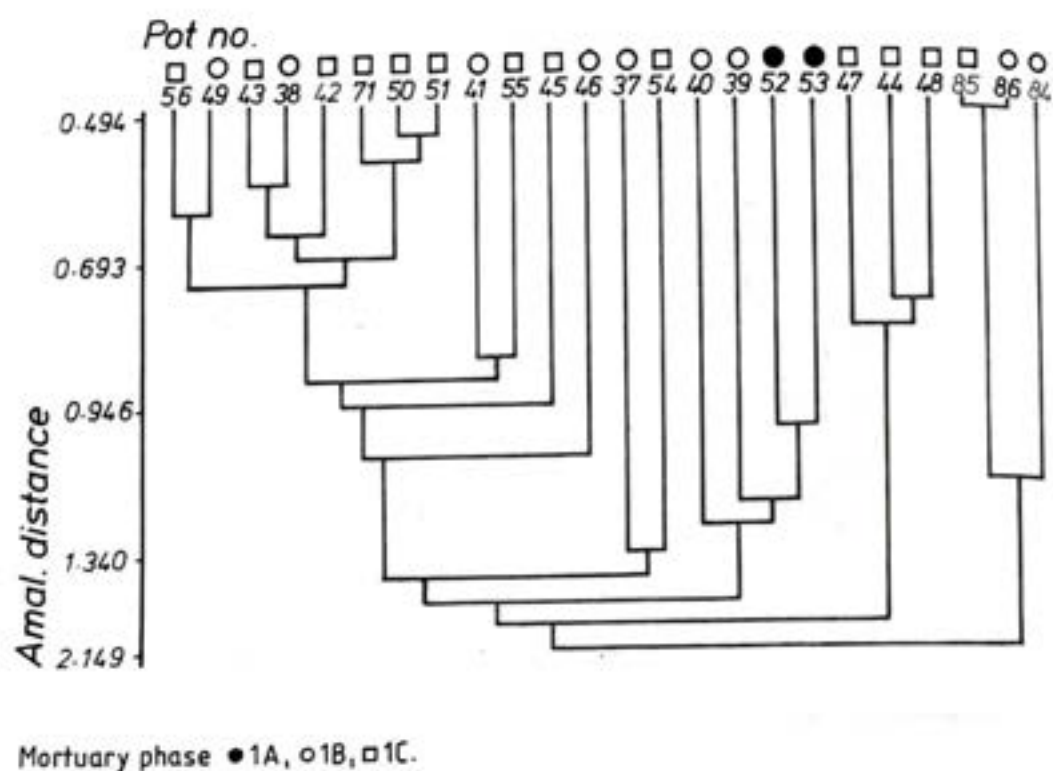


FIGURE 5-27

Results of a cluster analysis for the pedestalled vessels from Ban Na Di.

Ban Na Di: illustrations of complete vessels

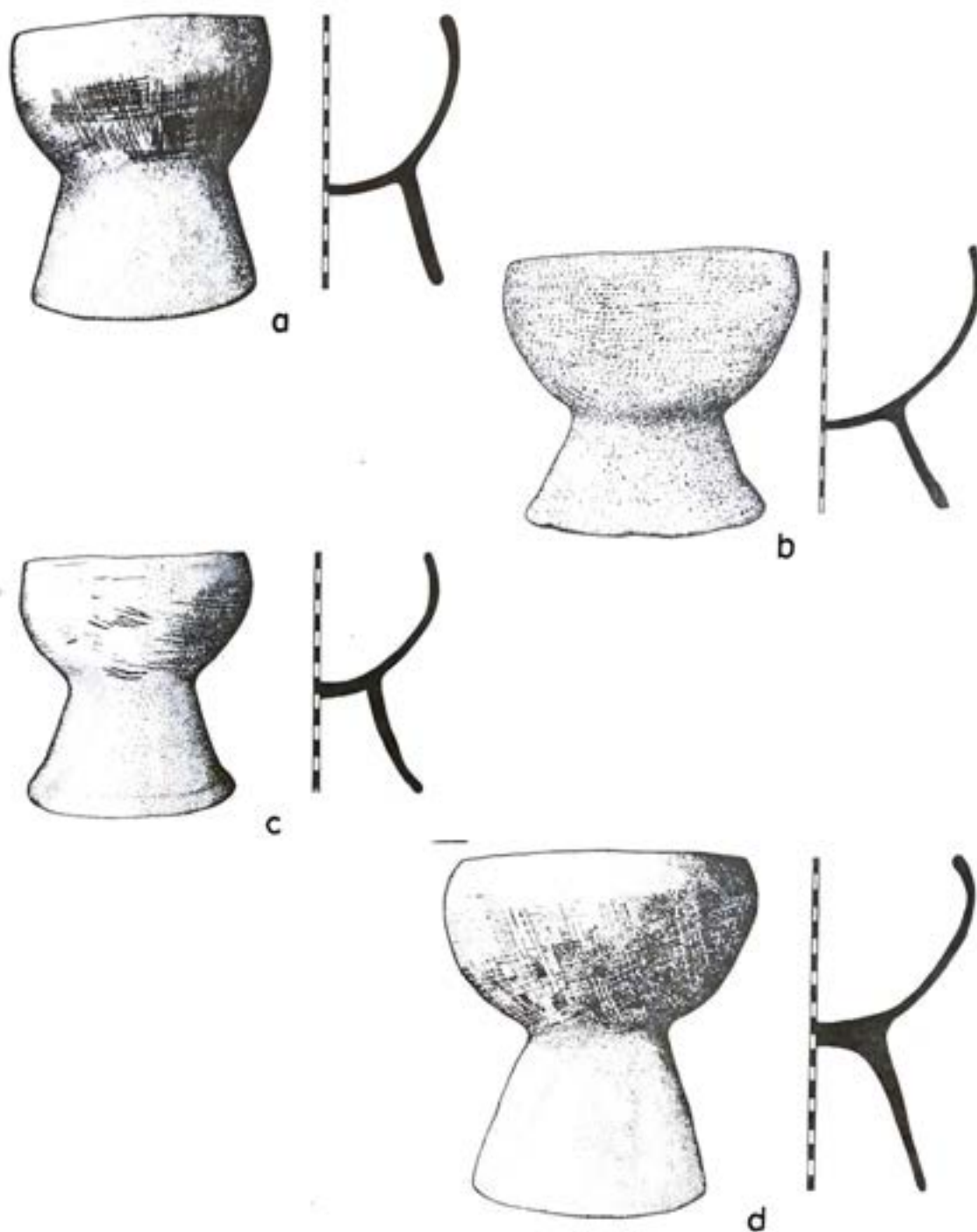


FIGURE 5-28 Ban Na Di: pot form 14a

- | | |
|-------------------------|---------------------------|
| A. Pot no.53 B.26 MP 1a | B. Pot no.52 B.TS19 MP 1a |
| C. Pot no.40 B.36 MP 1b | D. Pot no.39 B.36 MP 1b |

Ban Na Di: illustrations of complete vessels

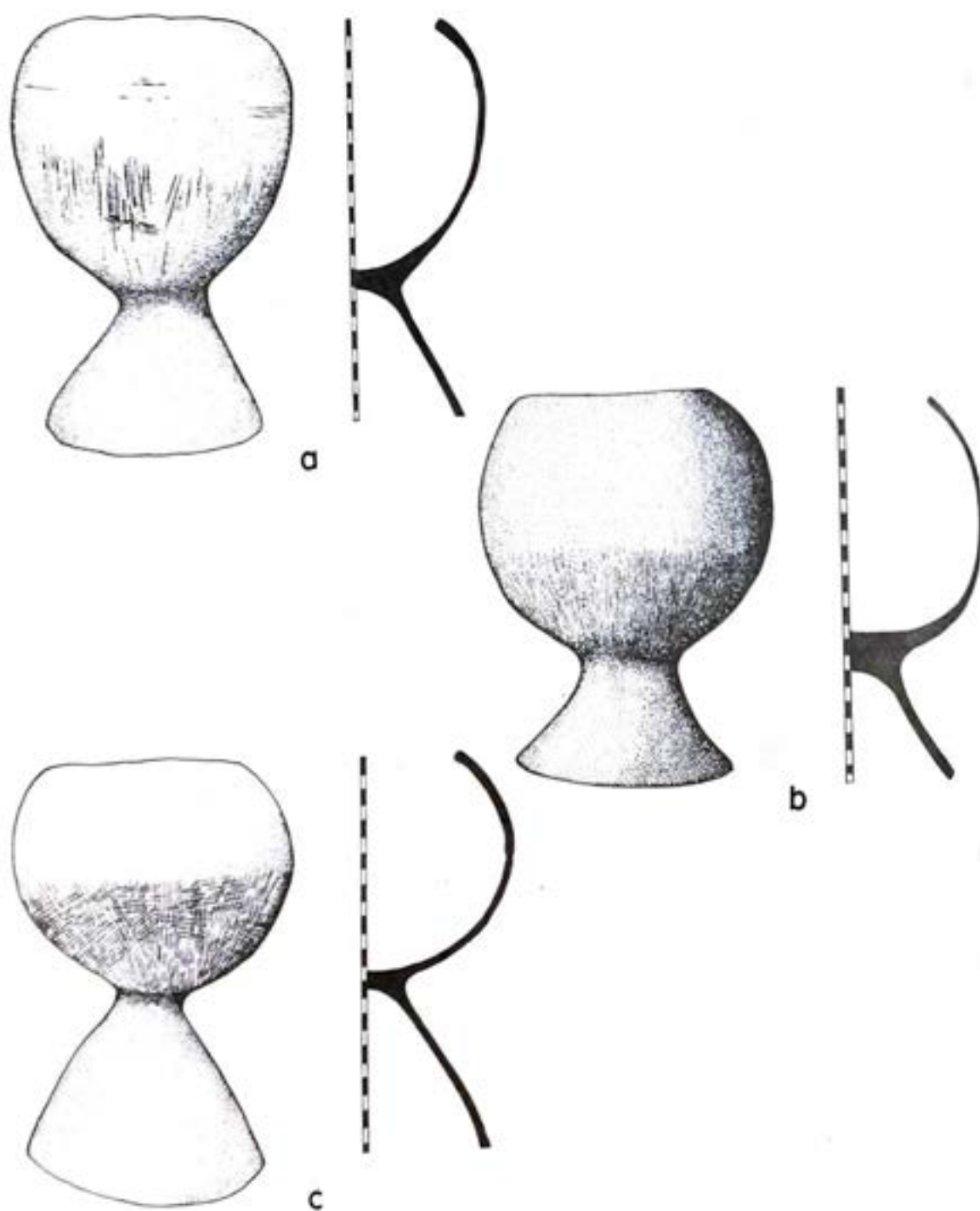


FIGURE 5-29 Ban Na Di: pot form 14b

- A. Pot no.38 B.12 MP 1b B. Pot no.49 B.19 MP 1b
C. Pot no.46 B.50 MP 1b

Ban Na Di: illustrations of complete vessels

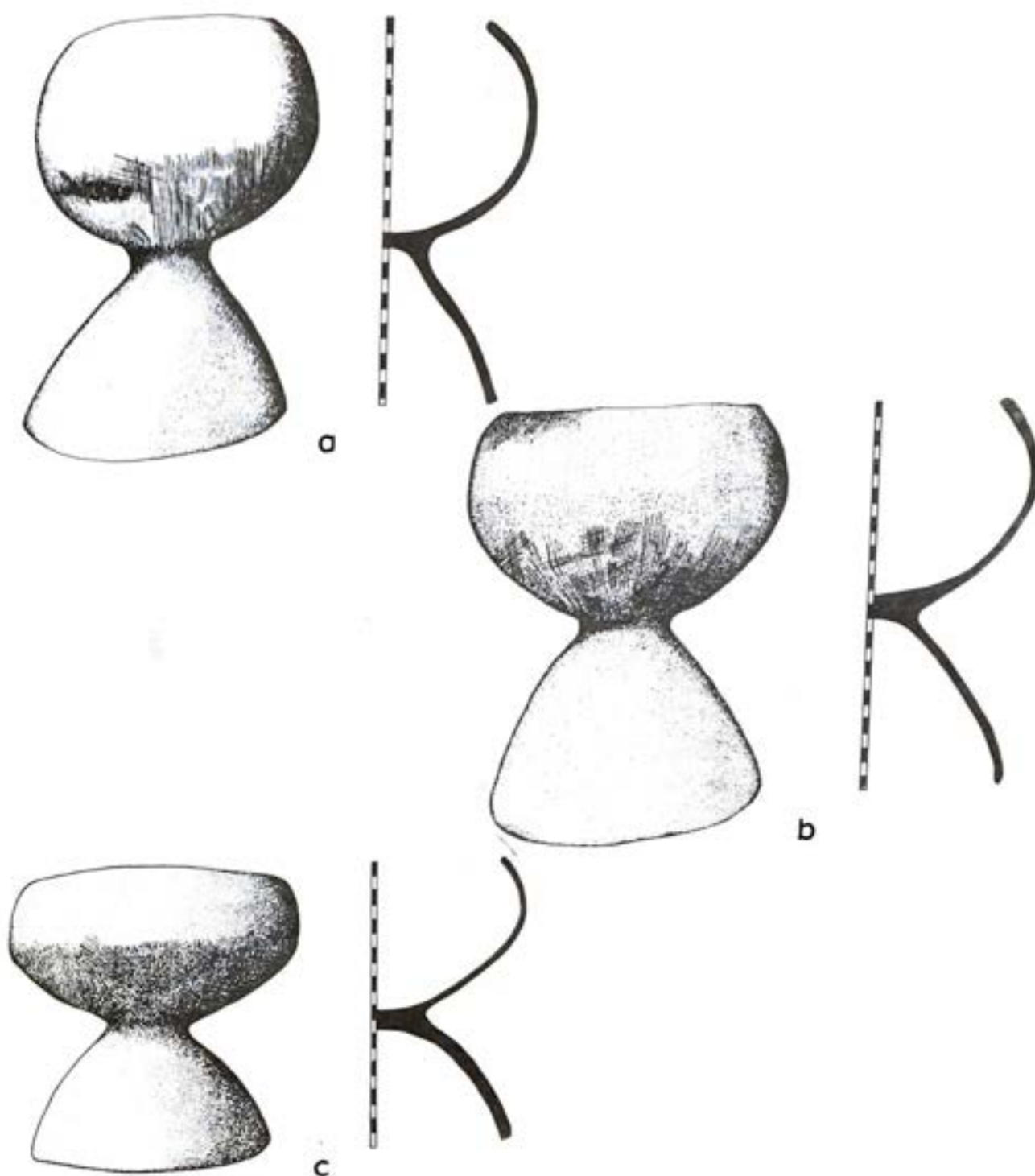


FIGURE 5-30 Ban Na Di: pot form 14b

- A. Pot no.68 B.13 MP 1b B. Pot no.37 B.14 MP 1b
C. Pot no.41 B.15 MP 1b

Ban Na Di: illustrations of complete vessels

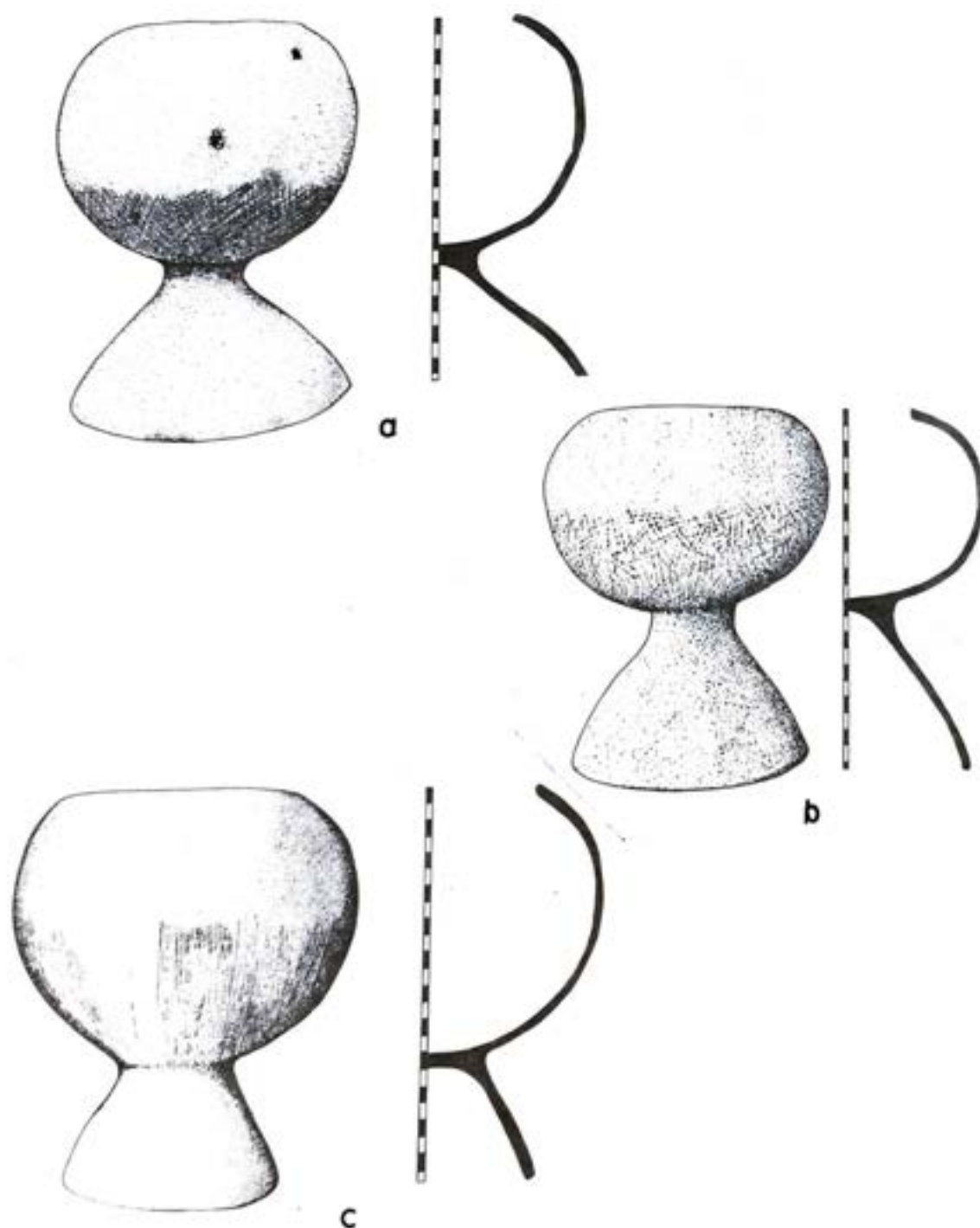


FIGURE 5-31 Ban Na Di: pot form 14b

- A. Pot no.55 B.TS5 MP 1c B. Pot no.50 B.TS5 MP 1c
C. Pot no.56 Level 7

Ban Na Di: illustrations of complete vessels

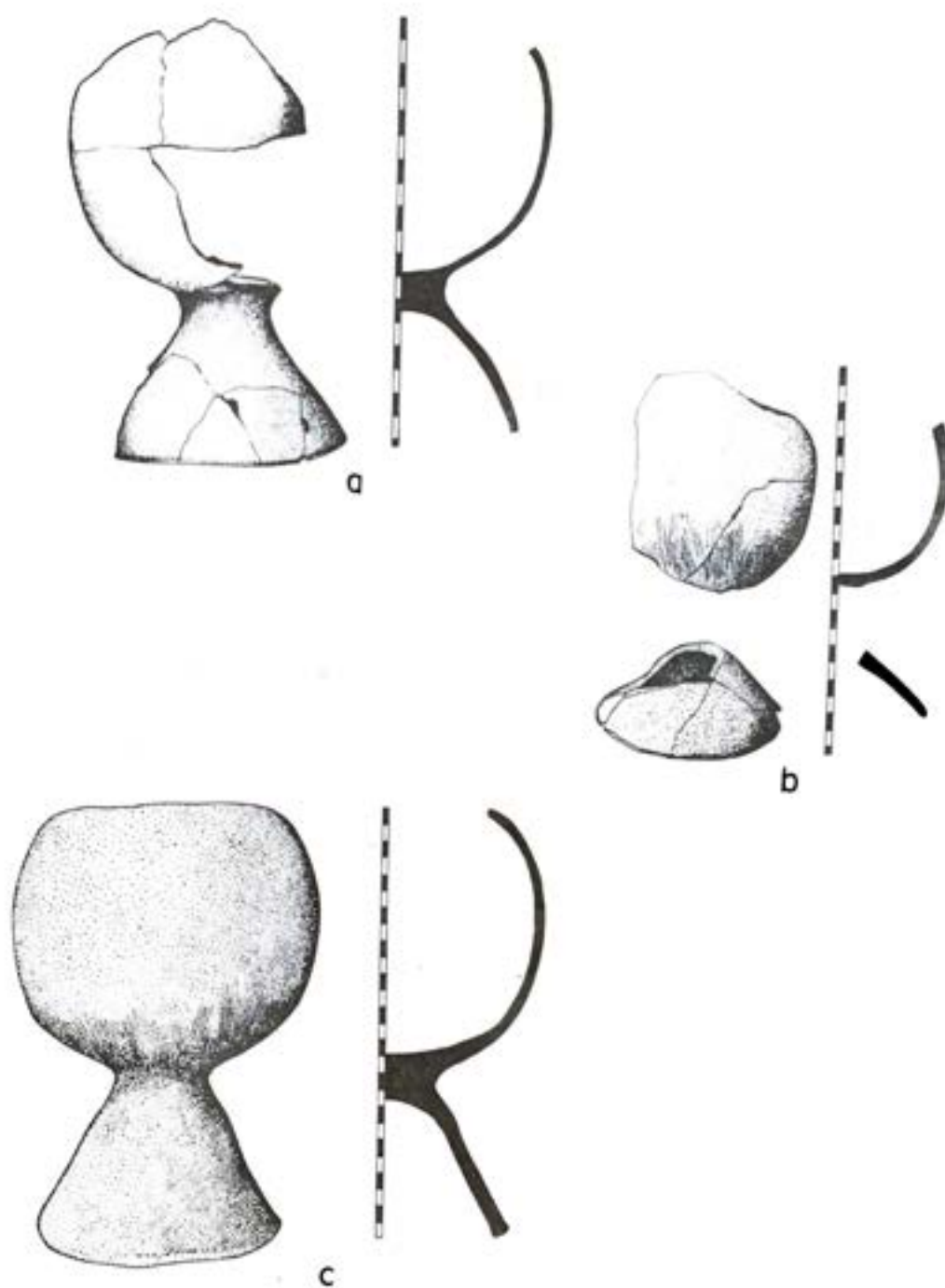


FIGURE 5-32 Ban Na Di: pot form 14b

- A. Pot no.71 B.TS6 MP 1c B. Pot no.137 B.TS6 MP 1c
 C. Pot no.51 B.TS12 MP 1c

Ban Na Di: illustrations of complete vessels

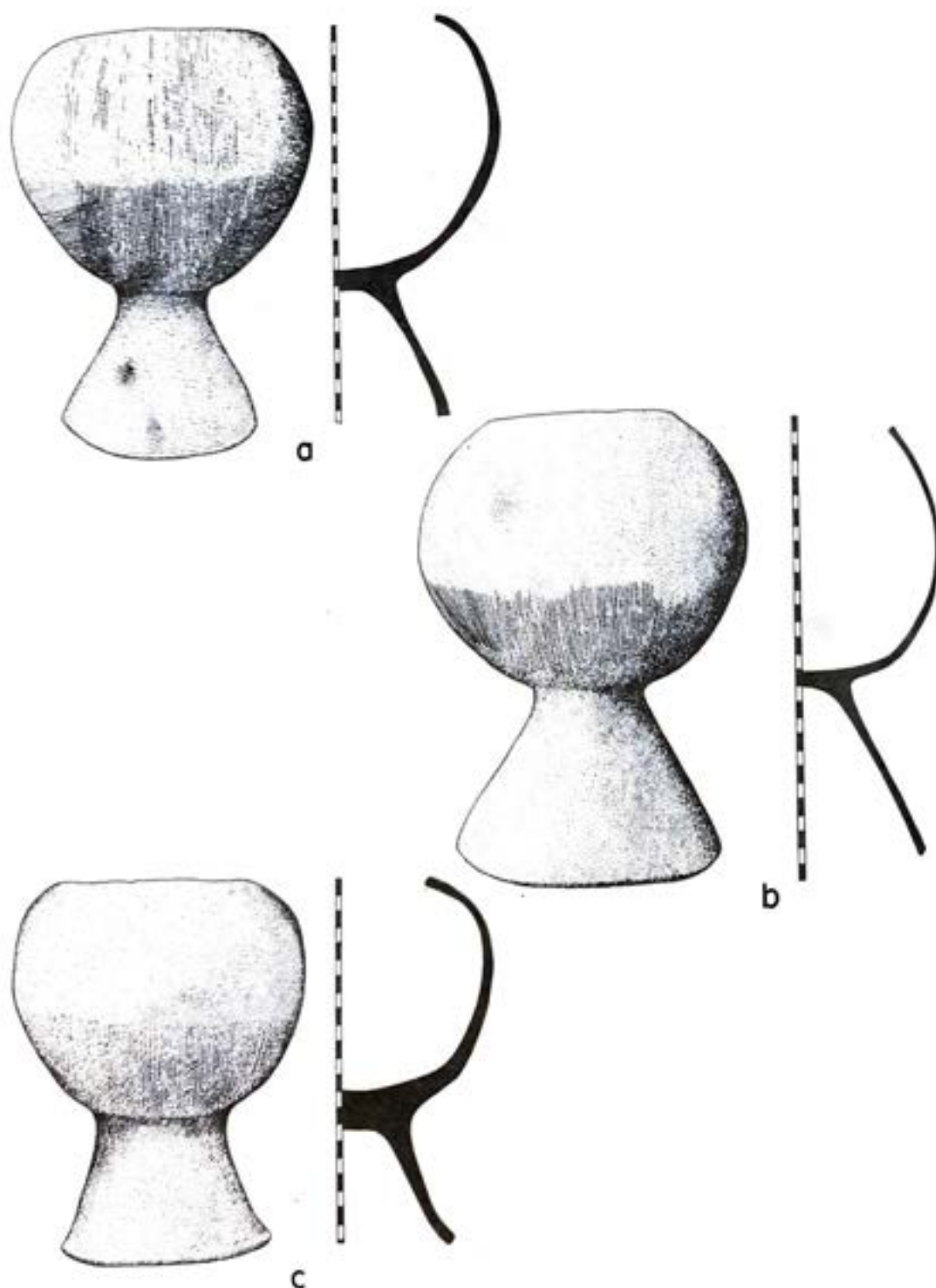


FIGURE 5-33 Ban Na Di: pot form 14b

- A. Pot no.42 B.18 MP 1c B. Pot no.43 B.31 MP 1c
C. Pot no.45 B.32 MP 1c

Ban Na Di: illustrations of complete vessels

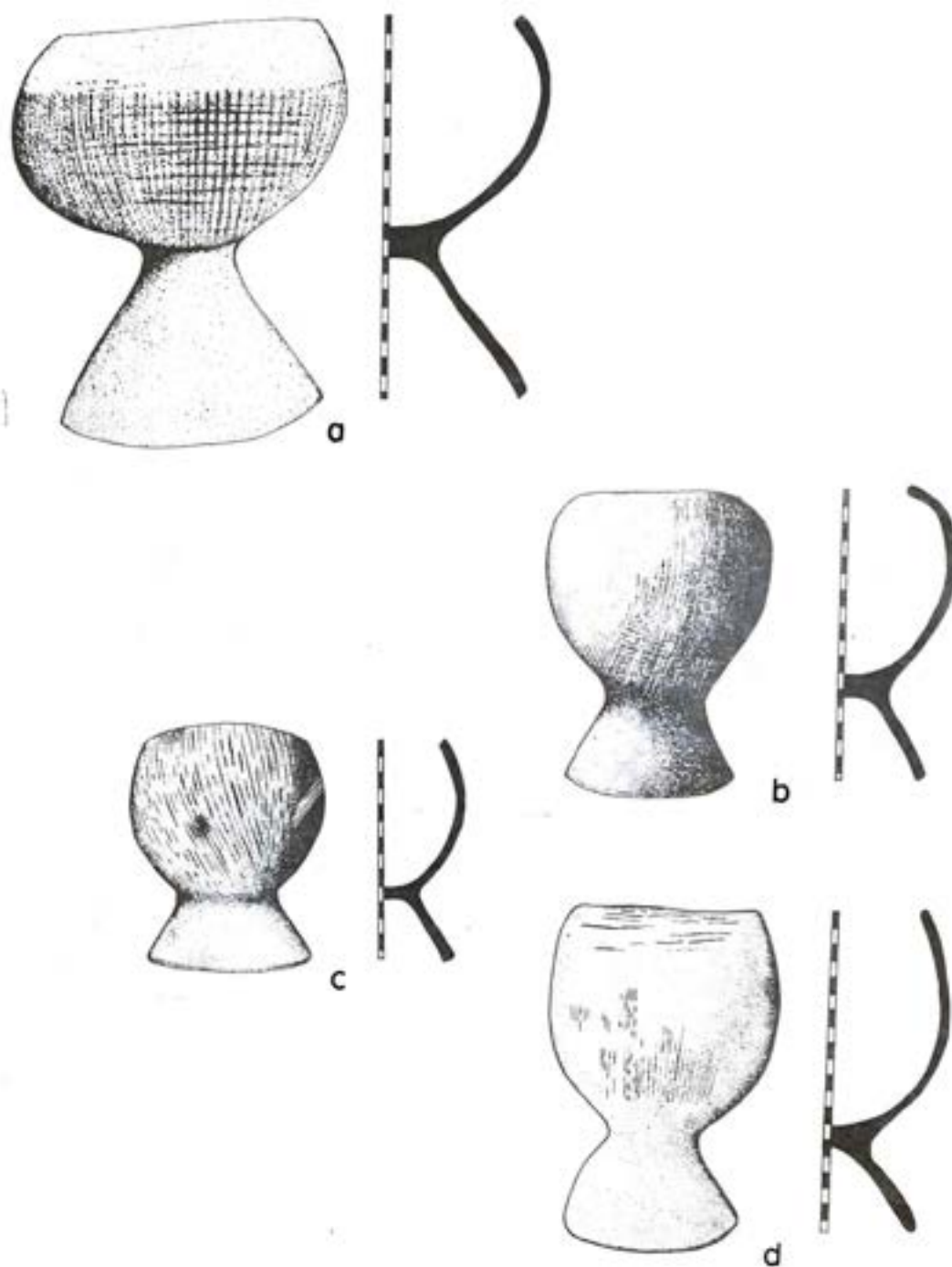


FIGURE 5-34 Ban Na Di: pot forms 14b(a) and 14c(b-d)

- | | |
|----------------------------|----------------------------|
| A. Pot no.54 B.TS13 MP 1c | B. Pot no.48 B.10/11 MP 1c |
| C. Pot no.47 B.10/11 MP 1c | D. Pot no.44 B.48 MP 1c |

Ban Na Di: illustrations of complete vessels

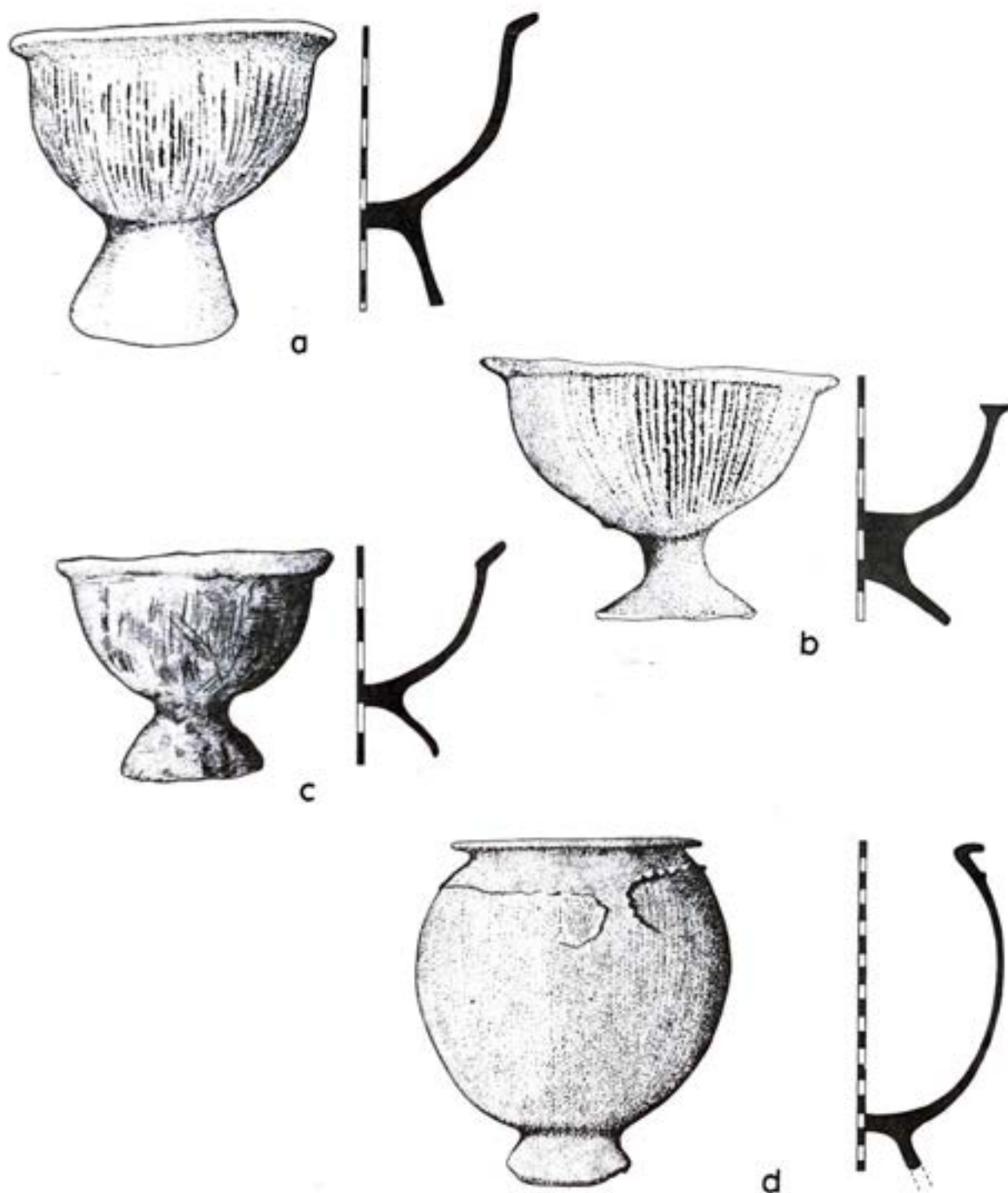


FIGURE 5-35 Ban Na Di: pot forms 15(a-c) and 17(d)

- | | |
|-------------------------|-------------------------|
| A. Pot no.84 B.12 MP 1b | B. Pot no.86 B.19 MP 1b |
| C. Pot no.85 B.48 MP 1c | D. Pot no.92 B.48 MP 1c |

Ban Na Di: illustrations of complete vessels

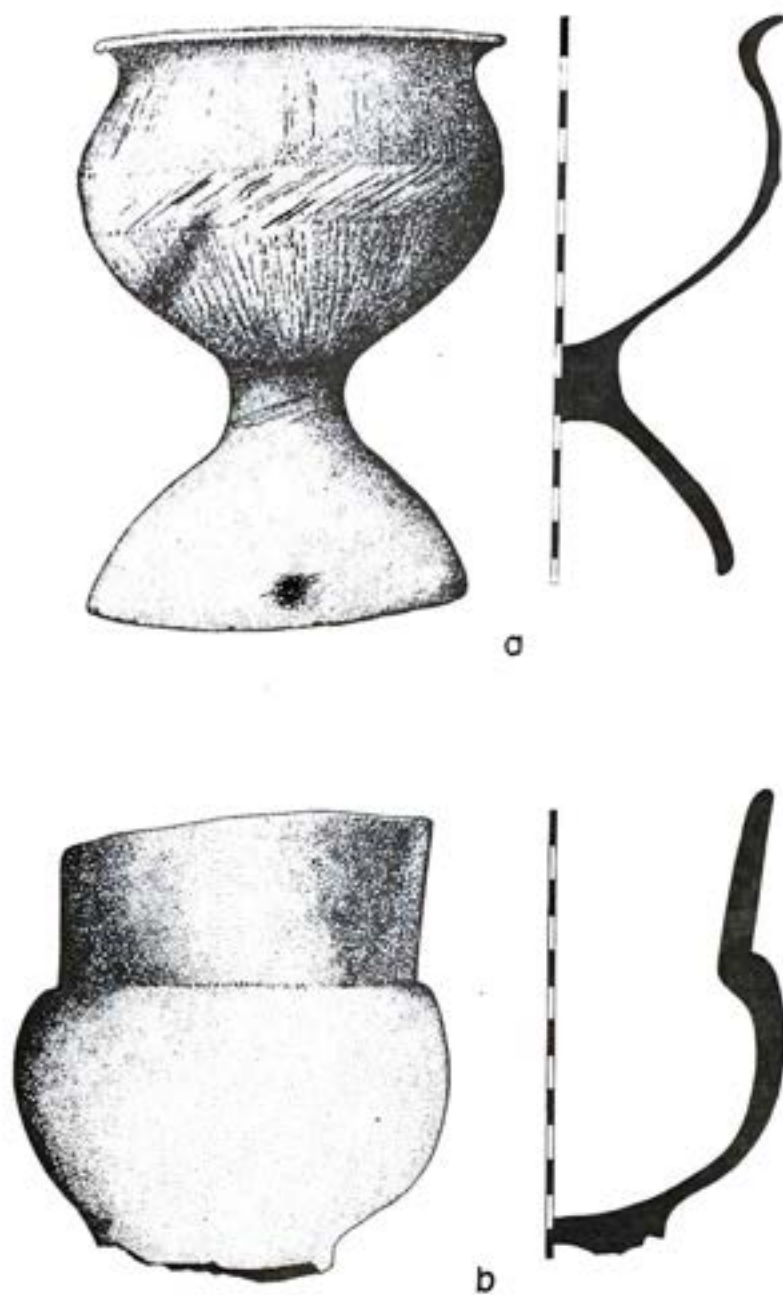


FIGURE 5-36 Ban Na Di: pot forms 16(a) and 18(b)
 A. Pot no.128 B.50 MP 1b B. Pot no.123 Level 6

Ban Na Di: illustrations of complete vessels

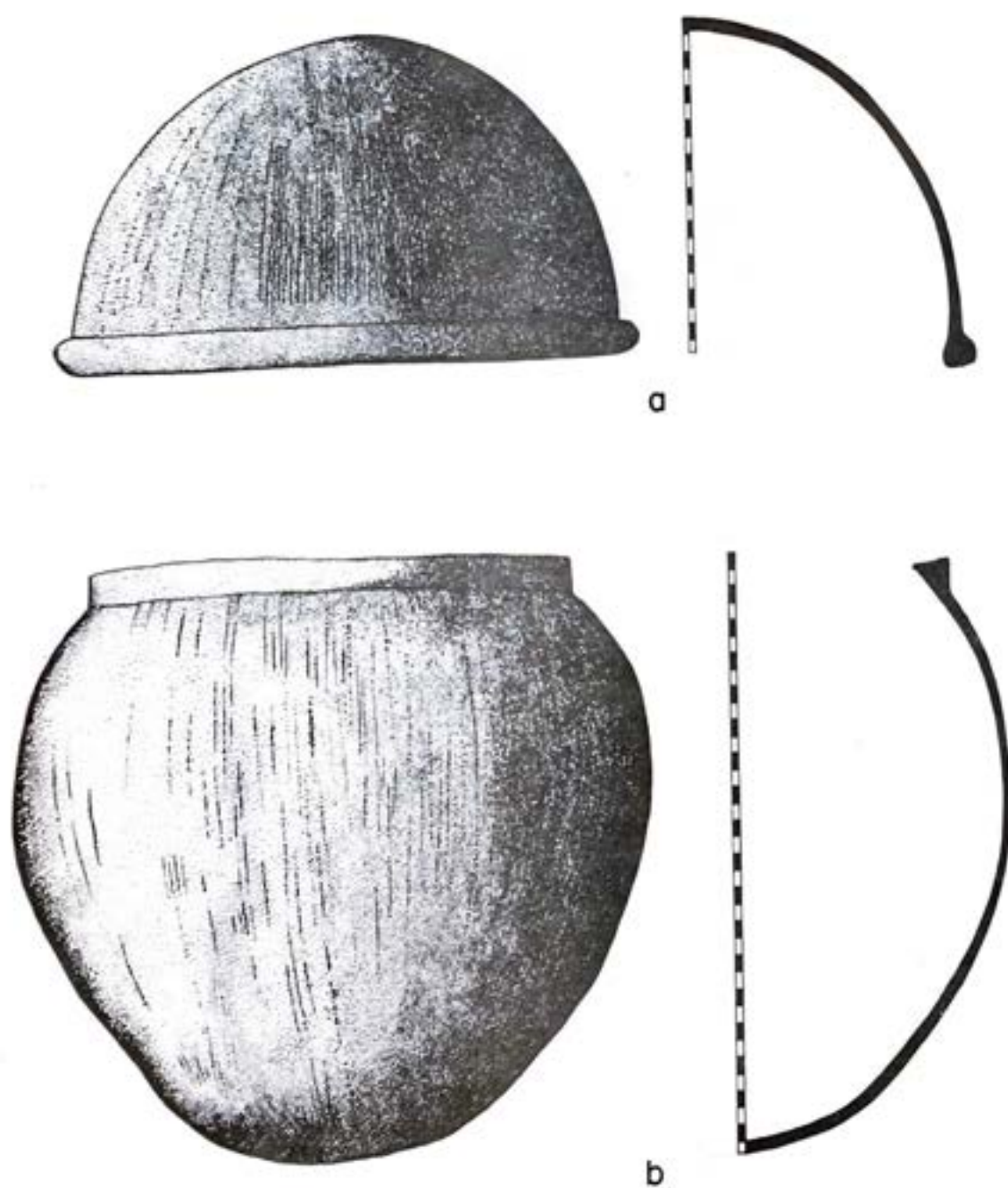


FIGURE 5-37 Ban Na Di: pot form 19
A. and B. Lid and Pot no.113 B.4 MP 2

Ban Na Di: illustrations of complete vessels

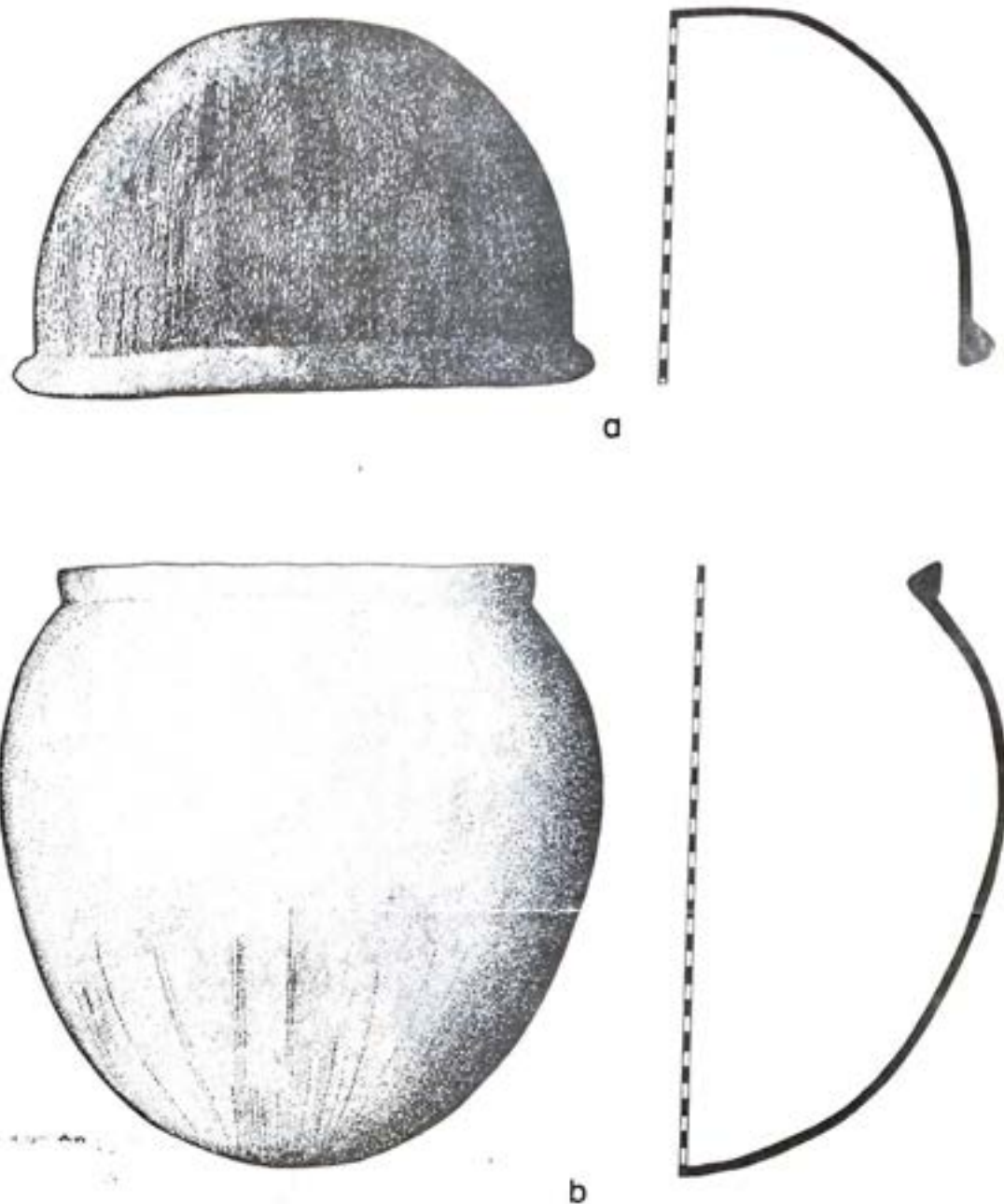


FIGURE 5-38 Ban Na Di: pot form 19
A. and B. Lid and Pot no.114 B.5 MP 2

Ban Na Di: illustrations of complete vessels

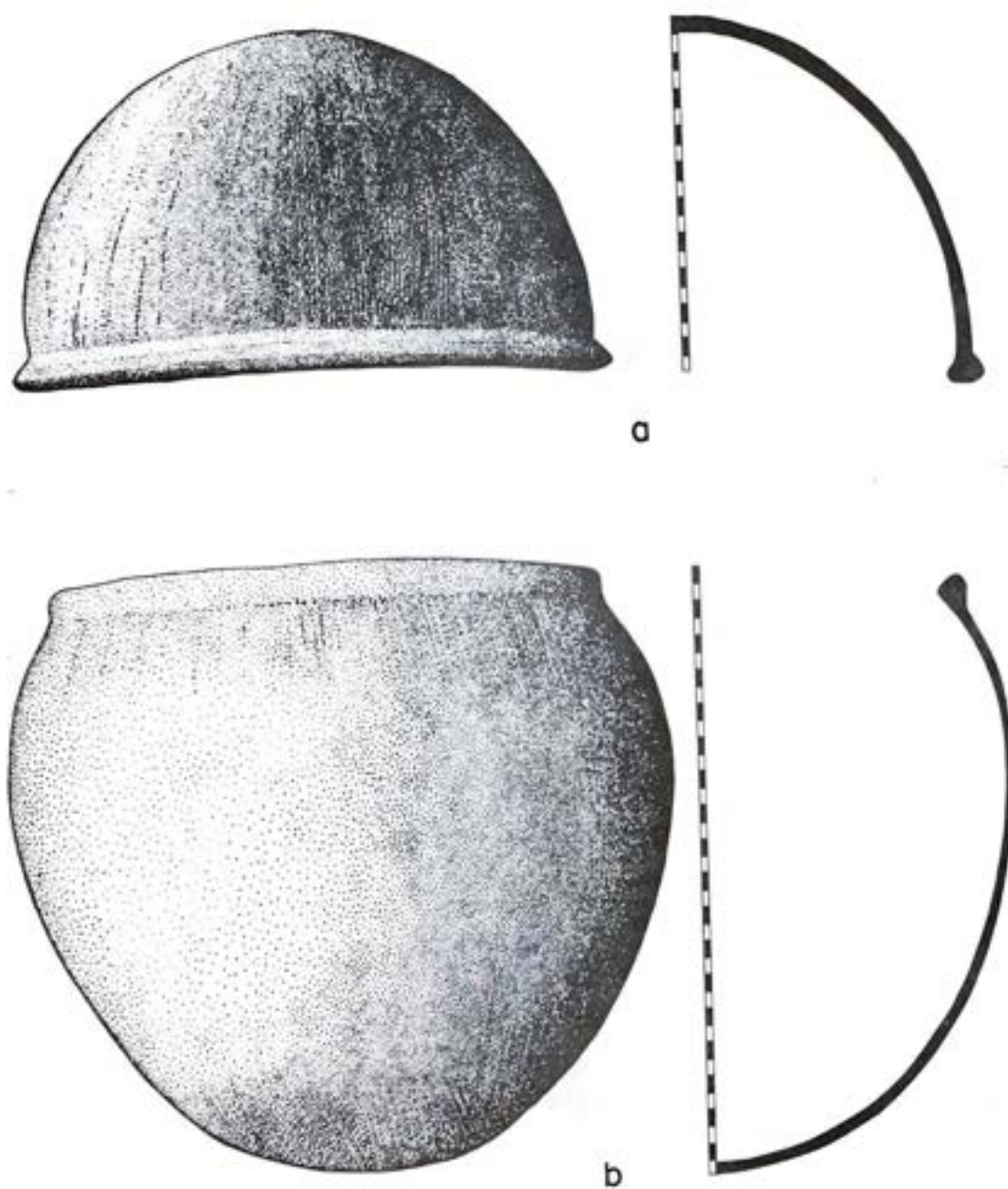


FIGURE 5-39 Ban Na Di: pot form 19
A. and B. Lid and Pot no.115 B.8 MP 2

Ban Na Di: illustrations of complete vessels

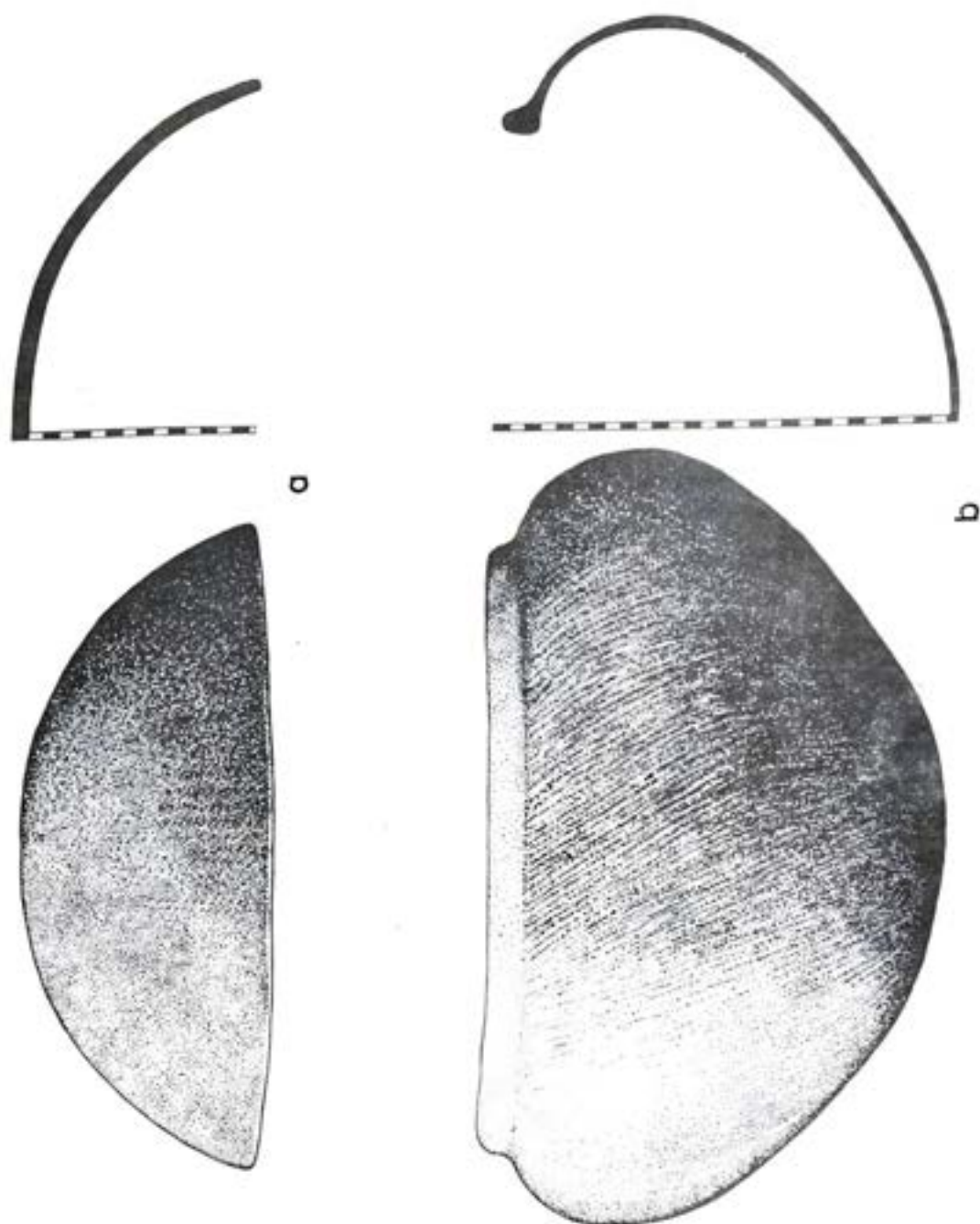


FIGURE 5-40 Ban Na Di: pot form 20
A. and B. Lid and Pot no.116 B.7 MP 2

Ban Na Di: illustrations of complete vessels

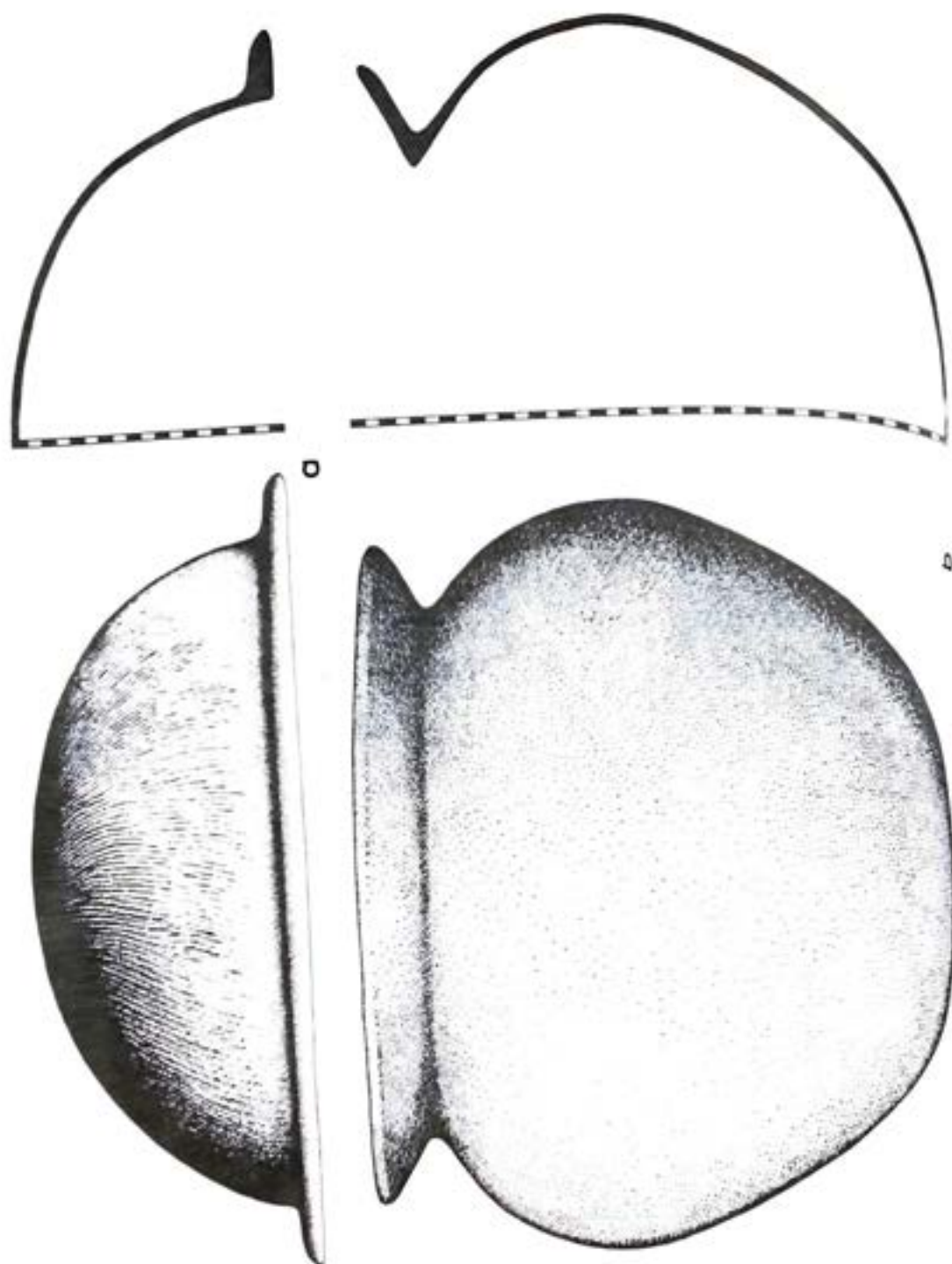


FIGURE 5-41 Ban Na Di: pot form 21
A. and B. Lid and Pot no.117 B.6 MP 2

Ban Na Di: illustrations of complete vessels

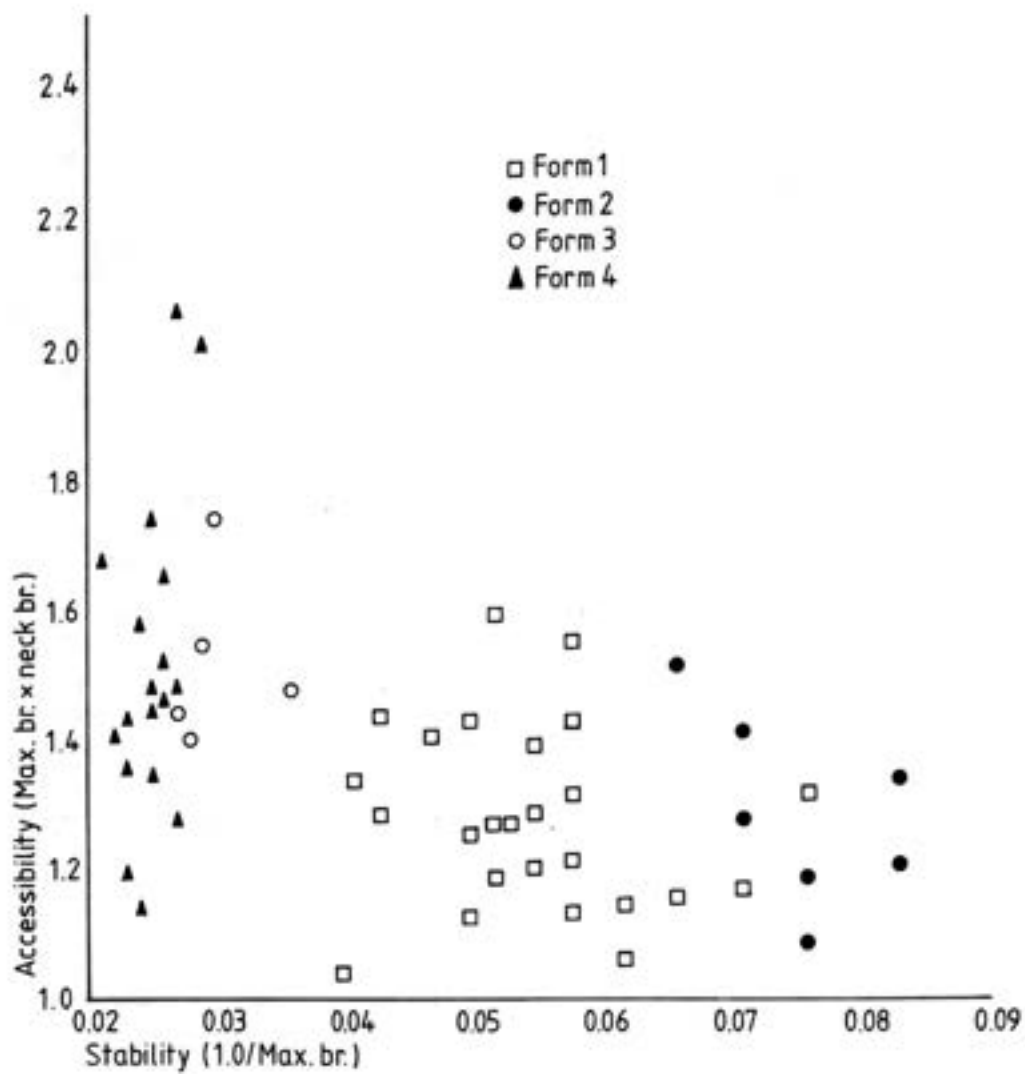


FIGURE 5-42

Stability/Access diagram for round based vessels
from Ban Na Di.

Ban Na Di: illustrations of complete vessels

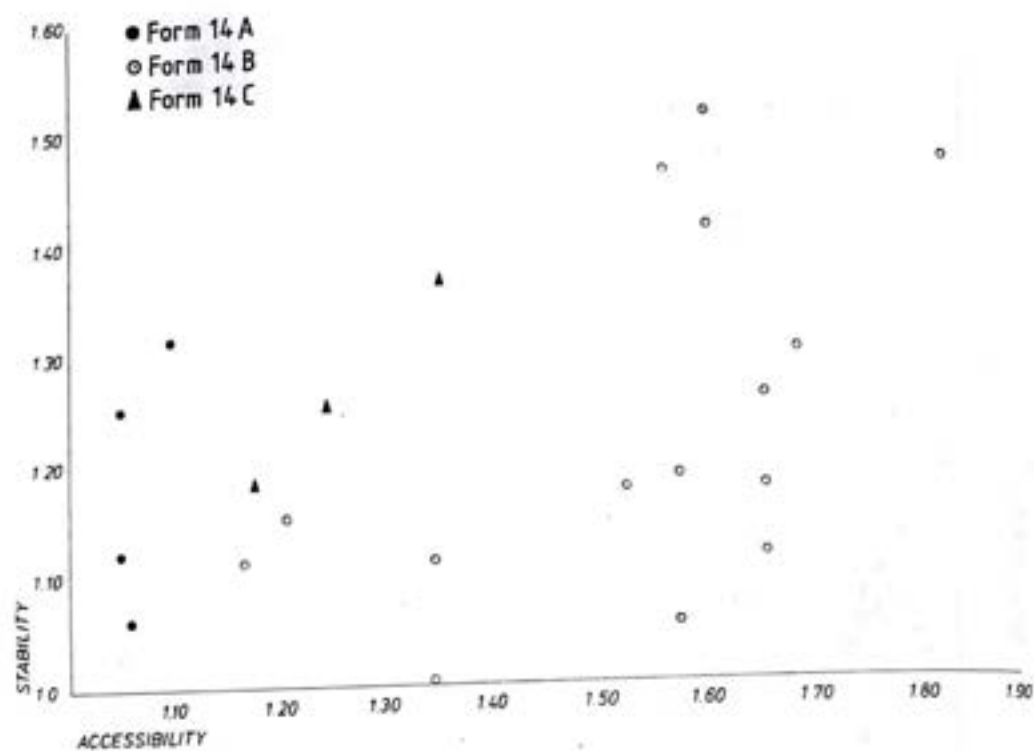


FIGURE 5-43

Stability/Access diagram for the pedestalled vessels from Ban Na Di.

CHAPTER SIX

THE BIOLOGICAL REMAINS FROM BAN NA DI

Soil conditions at Ban Na Di were most favourable for the preservation of organic material. All excavated soil was passed through a 20 mm mesh screen. This procedure was identical with that undertaken at Ban Chiang during the 1974 and 1975 excavations. The results of the faunal analyses undertaken on the Ban Chiang data have been published (Higham and Kijngam 1979). During the excavation of Ban Na Di, it was decided to pass a sample from each excavated feature and spit through a screen with a mesh size of 1 mm. This procedure began with the material comprising level 4, and continued until excavations were complete.

The material recovered from the larger screening process and of course, from the excavations themselves was cleaned and labelled according to level provenance. They were then assigned as precisely as possible to the appropriate family, genus or species. The results of this procedure are set out in fig 6-1. The material from the fine-mesh screening was scrutinised under a low-powered binocular microscope. The principal finds resulting from this procedure comprised small pieces of bone, and shell, as well as fragments of carbonised plant material. The small gastropods remain to be identified, and the rice remains are reported on below. All fragments of bone were again, ascribed to the appropriate species. Most represented very small fish. Since only 15% of all soils were sampled for fine-screening, the actual number of individuals per species was increased by a factor of 6.6. The resulting faunal spectrum is seen in fig 6-2.

Before offering an interpretation of these faunal spectra, it is necessary to consider some of the problems of identification.

BOVIDAE; *Bibos* sp., *Bubalus bubalis*

The basic problem of distinguishing between the bones of water buffalo (*Bubalis bubalis*) and cattle (*Bibos* sp.) has largely been resolved (Kijngam 1979a). For several anatomical bones, differences in the morphology have been identified which makes separation possible. There remains however, the problem of distinguishing between wild and domestic cattle, and between different species of the former. The analyses of the Ban Chiang and Non Nok Tha bovid remains (Higham 1975a) relied upon size differences. This is a reasonable but not infallible approach, because the size of a male domestic and a female wild animal could well overlap. The absence of comparative samples for the three indigenous cattle (*Bibos gaurus*, *Bibos javanicus* and *Novibos sauveli*) rules out distinctions between them on the basis of prehistoric bone samples. In practical terms, cattle bones from these sites are all described under the heading "Bovidae". The smallest were probably domestic and the largest, wild. This group could, of course, include specimens from the water buffalo for which no consistent differences between them and cattle have been identified.

Ban Na Di: the biological remains

When the bovid teeth from Ban Chiang and Ban Tong were analysed, it was found that the great majority came from adult animals. The figures from Ban Na Di also reveal a marked rarity of young bovids (table 6-1). Category 1 includes unworn teeth, and those in category 2, have only a slight amount of wear. Categories 3-4-5 reveal progressively greater degrees of tooth wear, and all represent adult animals.

TABLE 6-1

Ban Na Di: the bovid dentition

TOOTH	NO.	CATEGORY OF WEAR				
		1	2	3	4	5
Lower Teeth						
Lower incisor	34	2	3	15	14	-
PM2	1	-	1	-	-	-
PM3	5	1	-	3	1	-
PM4	5	-	-	5	-	-
M1	12	-	-	8	2	2
M2	10	-	-	8	2	-
M3	8	4	-	3	1	-
TOTAL	75	7	4	42	20	2
In addition there are 8 lower deciduous teeth						
Upper Teeth						
PM2	17	2	-	7	7	1
PM3	7	-	1	1	3	2
PM4	9	-	3	2	4	-
M1	17	-	-	2	10	5
M2	12	1	-	6	5	-
M3	15	3	3	7	2	-
TOTAL	77	6	7	25	31	8

THE SECOND FORE PHALANX

This bone is useful for the archaeozoologist because it is durable and sexually dimorphic. In fig 6-3, the specimens from Ban Na Di have been superimposed on a scatter diagram incorporating bones from modern Thai domestic cattle, those from several other prehistoric sites and

Ban Na Di: the biological remains

specimens from the indigenous wild cattle. Table 6-2 provides the provenance of the Ba Na Di phalanges and corresponding measurements. While the range of variation for the banteng and gaur is not firmly established, the lower limit for the length of this bone probably lies in the vicinity of 41-43 mm. At Ban Chiang, any specimen smaller than the wild ones was labelled "probably domestic". If the same approach is adopted for Ba Na Di, then the great majority of second phalanges falls into this category. Thus eleven out of twelve phalanges from level 7 and four out of six from level 6 were smaller than any known wild specimen. The particularly small phalanges in fig 6-3 all come from late levels (levels 2 and 3).

THE FIRST FORE PHALANX

The distribution pattern noted for the second matches that for the first phalanx (fig 6-4). Again, the prehistoric specimens from Ba Na Di fall within the area of distribution for related Northeast Thai prehistoric sites, except that more recent examples are considerably reduced in size. Very few bovid phalanges approach the size of wild banteng or gaur specimens, though that from B.38 stands out as being unusually large. The overwhelming majority of Ba Na Di bones are too small to be ascribed to either wild species for which comparative material is available.

THE MAGNUM

The magnum is a third most useful bone due to its compactness and clear differences in shape between cattle and the water buffalo. Nearly all specimens available come from human burials or from level 7. The pattern noted for phalanges clearly repeats itself. Only two specimens correspond in size to the wild species indigenous to Northeast Thailand. The balance are of the same size as both modern domestic cattle and those from related prehistoric settlements (fig 6-5).

THE METACARPAL

Complete metacarpals are most informative. It has been shown for the presumed domestic Non Nok Tha specimens that, while measurements of breadth may fall within the observed range for the female banteng, the length dimensions of the same bones are considerably shorter. It has been noted above that the phalanges of the B.38 bovid were large enough to be considered of wild derivation. Yet, the length of the metacarpal from the same animal was far too short to be ascribed to a wild species. This situation exactly parallels the metacarpal from Ban Chiang square D4 spit 14 (Kijngam 1979:16, see fig 6-6).

The smallest published banteng metacarpal has a distal width of 53.0 mm, a proximal width of 52.0 mm and a length of 241.0 mm (Hooijer 1958). The B.38 specimen from Ban Na Di has corresponding dimensions of 55.5, 55.5 and 220.0 mm. It is very likely then, that the B.38 animal was a large domestic rather than a small wild bovid. The remaining four complete metacarpals are very similar in size to modern, domestic Thai

Ban Na Di: the biological remains

cattle.

TABLE 6-2

Ban Na Di: the dimensions and provenance of the bovid
second fore phalanges

PROVENANCE	LENGTH	PROXIMAL WIDTH
F6 B.38	46.1	28.7
F6 B.38	46.5	27.6
F6 B.38	37.6	25.5
F6 B.36	37.2	26.7
F6 B.42	39.2	25.3
F6 B.42	34.1	25.2
A3 B.26	35.4	27.6
A3 B.28	34.5	26.3
A3/4 B.11	33.8	25.9
A3/4 B.11	34.8	25.9
A1 B.15	35.9	28.5
A1 B.15	36.0	27.8
L.7	43.5	30.0
L.7	32.4	24.1
L.7	35.1	25.8
L.7	35.7	26.9
L.7	36.7	26.6
L.7	39.3	28.0
L.7	35.3	27.0
L.7	36.5	27.9
L.7	34.0	25.4
L.7	35.6	25.3
L.7	38.1	25.5
L.7	39.4	26.5
L.6	44.2	32.5
L.6	39.4	29.8
L.6	42.7	27.4
L.6	33.6	25.0
L.6	33.4	23.5
L.6	35.4	25.3
L.5	35.6	23.7
L.3	33.3	25.2
L.2	35.8	28.0
L.2	31.7	28.3
L.2	31.3	22.5
L.2	29.5	21.6

Ban Na Di: the biological remains

TABLE 6-3

Ban Na Di: the dimensions and provenance of bovid magna

PROVENANCE	LENGTH	MIN. WIDTH	MW:L*
F8 B.38	31.8	35.3	1.11
F8 B.38	31.4	31.5	1.00
F8 B.42	28.7	33.3	1.16
A3 B.28	30.7	32.7	1.06
A1 B.15	30.0	32.4	1.08
L.7	37.5	48.3	1.28
L.7	29.1	31.8	1.09
L.7	29.5	31.1	1.05
L.7	38.5	41.5	1.07
L.7	28.3	29.2	1.03
L.7	30.6	33.0	1.07
L.7	30.4	34.5	1.13
L.7	28.1	31.7	1.12
L.7	29.1	34.0	1.16
L.7	29.9	32.6	1.09
L.6	31.3	35.3	1.12
L.5	29.8	31.8	1.06
L.3	30.1	32.0	1.06

* All abbreviations for bone measurements are listed at the end of the chapter.

TABLE 6-4

Ban Na Di: the dimensions of complete bovid metacarpals

PROVENANCE	L	PW	DW	MW	PW:DW
F8 B.38	220.0	55.5	55.5	11.7	1.00
F8 B.38	216.0	55.2	50.1	32.2	1.10
F8 B.42	186.5	52.4	50.0	27.6	1.04
A3 B.28	198.5	55.9	54.7	27.7	1.02
A3/4 B.11	197.9	55.8	55.2	28.2	1.01

TABLE 6-5

Ban Na Di: the dimensions and provenance of bovid first fore phalanges

Ban Na Di: the biological remains

PROVENANCE	L	PW	DW	MW	PW:L
Fore Right Interior					
F6 B.38	64.5	28.4	27.2	24.9	0.44
L7	60.0	28.4	27.4	24.5	0.47
L7	61.8	28.7	27.2	24.5	0.48
L7	58.6	28.2	27.2	25.6	0.49
L7	57.4	26.0	24.0	23.9	0.45
L6	53.8	24.4	22.8	22.0	0.45
L6	50.2	23.0	23.4	21.6	0.45
Fore Right Exterior					
F6 B.38	65.0	29.0	27.0	25.0	0.44
L7	68.60	32.5	30.5	29.8	0.48
L7	63.50	27.0	25.8	26.0	0.42
L7	62.40	29.7	28.5	28.5	0.47
L7	60.30	25.5	24.8	24.8	0.42
L7	56.60	26.1	25.2	24.3	0.46
L7	57.10	23.5	23.1	23.4	0.41
L3	50.50	23.8	-	22.4	0.47
L2	57.40	27.0	25.4	25.0	0.47
L2	48.10	23.5	22.7	21.5	0.48
Fore Left Interior					
F6 B.38	58.40	24.5	24.2	21.9	0.42
F6 B.42	54.0	26.0	23.7	21.5	0.48
A3 B.28	54.5	27.0	24.1	22.5	0.49
A3/4 B.11	58.0	27.0	24.8	23.7	0.46
A1 B.15	58.9	26.3	26.4	24.7	0.44
L7	67.3	30.1	28.9	27.8	0.44
L7	59.0	28.7	28.8	28.4	0.48
L7	54.2	23.1	21.7	18.5	0.42
L7	57.2	26.5	23.5	21.5	0.46
L7	57.2	28.4	25.3	25.0	0.49
L6	61.2	28.5	-	25.6	0.46
L3	59.9	28.5	27.4	27.0	0.47
L2	52.0	23.4	23.8	-	0.46
L2	48.7	20.1	-	-	0.41
Fore Left Exterior					
F6 B.38	58.5	24.8	25.9	22.5	0.42
F6 B.42	54.7	26.1	23.6	22.5	0.47
A3/4 B.11	57.9	26.1	25.6	25.1	0.47
A3/4 B.48	56.9	25.2	23.2	21.6	0.44
A1 B.15	57.6	27.4	26.3	23.5	0.47
L6	58.6	28.1	25.7	25.0	0.47
L3	59.5	30.0	26.3	25.9	0.50

BUBALUS BUBALIS

The wild water buffalo is indigenous to Southeast Asia, though it is now very rare. It inhabits low-lying well watered terrain and is today restricted within Thailand to Utthai Thani Province. Kijngam (1979a) has described the principal distinctions between the bones of water buffalo and cattle. This has made it possible to conclude that water buffalo are not represented in level 8 at Ban Na Di. Since there is only one specimen in upper level 7, it is quite probable that they were only abundant there from levels 6 - 5.

Measurable buffalo bones at Ban Na Di come from an animal matching in size, the present domestic stock. Most bones were also butchered and bore marks of burning, suggesting that the meat was consumed.

SUS SCROFA

The basic problem in considering pig bones from Northeast Thai prehistoric contexts, is that separating wild and domestic animals on the basis of immature bones is not possible. Moreover, the lower size range for bones from *Sus scrofa jubatus*, the indigenous wild pig, is not known. Nevertheless, the presence of a prehistoric domestic breed in Northeast Thailand has been demonstrated from the complete suid crania from burial contexts at Non Nok Tha (Higham 1975).

As at Ban Chiang and Non Nok Tha, most pig remains come from immature animals. They were invariably butchered at death and the meat cooked. Of the 34 pig mandibles from Ban Na Di, 27 come from immature animals killed when under c. 18 months of age.

TABLE 6-6

Sus scrofa: the mortality frequencies

STAGE	DENTITION DEVELOPMENT	EST. AGE IN MONTHS	n specimens
1	Deciduous premolar unerupted	fetal	-
2	Deciduous PM2,3,4 in primary eruption	birth-1 wk	-
3	Deciduous PM2,3,4 in secondary eruption	1-4 weeks	1
4	Deciduous PM2,3,4 in tertiary eruption	4-7 weeks	1
5	Deciduous PM4 in prim. wear. M1 unerup.	2 - 4 months	1

Ban Na Di: the biological remains

6	M1 in primary eruption	4 - 5	3
7	M1 in secondary eruption	5 - 6	1
8	M1 in tertiary eruption	6 - 7	1
9	M1 in primary wear, M2 unerupted	7 - 8	3
10	M1 in secondary wear, M2 unerupted	8 - 9	4
11	M2 in primary eruption	9 - 10	1
12	M2 in secondary eruption	10 - 11	-
13	M2 in tertiary eruption	11 - 12	1
14	FM2 - 4 in primary eruption	12 - 14	-
15	FM2 - 4 in secondary eruption	14 - 15	-
16	FM2 - 4 in tertiary eruption	15 - 16	-
17	FM4 in primary wear, M3 unerupted	16 - 17	9
18	M3 in primary eruption	17 - 19	1
19	M3 in secondary eruption	19 - 21	-
20	M3 in tert. erupt. cusp one in prim. wr	21 - 23	-
21	M3 cusp one in secondary wear	23 - 25	-
22	M3 cusp two in secondary wear	25 - 27	3
23	M3 cusp three in secondary wear	27 - 29	3
24	M3 all cusps in late secondary wear	30+	-
25	M3 all cusps in early tertiary wear	adult	-
26	M3 all cusps in late tertiary wear	late maturity	1
27	M3 all cusps in quaternary wear	very old	-

TABLE 6-7 Ban Na Di: the dimensions of mandibles from *Sus scrofa*

NO.	LAYER	C	FM1	FM2	FM3	FM4	M1	M2	M3	CROWN L.FM4 DEC	ALV L.FM4 DEC	CROWN L.M1	ALV L.M1	CROWN L.M2	ALV L.M2	CROWN L.M3	ALV L.M3	TOOTH WEAR
1	8	-	-	-	D	D	-	-	-	19.2	18.1	-	-	-	-	-	-	FM4 DEC 2
2	8	-	-	D	D	D	-	-	-	18.8	15.8	-	-	-	-	-	-	FM4 DEC 3
3	8	-	-	-	-	P	-	-	-	-	-	14.4	14.4	18.2	17.1	-	-	M2
4	7	-	-	-	-	-	-	P	P	-	-	-	-	-	-	30.1	33.4	M3
5	7	-	-	-	-	-	-	P	P	-	-	-	-	-	-	42.2	47.2	M3
6	7	-	-	-	-	P	-	-	-	-	-	18.6	15.3	-	-	-	-	M1
7	7	-	-	-	-	P	P	-	U/E	15.9	-	15.3	13.1	19.0	17.8	-	-	M2
8	7	P	-	-	D	D	P	U/E	-	18.1	18.1	14.5	14.0	-	-	-	-	M1
9	7	U/E	-	-	-	-	-	P	-	-	-	-	-	20.2	18.6	-	-	M2
10	7	-	-	-	-	D	E	-	-	-	-	-	-	-	-	-	-	M1
11	7	-	-	-	-	D	P	U/E	-	18.7	18.9	18.4	14.4	-	-	-	-	M1
12	7	-	-	-	-	D	-	-	-	-	-	-	-	-	-	-	-	FM4 DEC 1
13	7	-	-	-	-	-	-	P	U/E	-	-	-	-	20.9	18.1	-	-	M2
14	7	-	-	-	-	D	P	U/E	-	18.6	15.2	15.3	13.3	-	-	-	-	M1
15	7	-	U/E	-	-	D	P	U/E	-	18.6	18.6	15.8	14.5	-	-	-	-	M1
16	7	-	-	-	-	-	-	P	U/E	-	-	-	-	-	-	-	-	M2
17	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C
18	8	E	-	-	-	D	-	-	-	18.6	17.2	-	-	-	-	-	-	FM4 DEC 3
19	8	-	-	-	-	D	-	-	-	-	-	-	-	-	-	-	-	FM4 DEC E
20	8	-	-	-	D	D	E	-	-	19.0	18.1	-	-	-	-	-	-	M1
21	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FM4 DEC 3
22	5	-	-	-	-	-	-	-	E	-	-	-	-	-	-	-	-	M3
23	5	-	-	-	-	-	E	-	-	-	-	-	-	-	-	-	-	M1
24	5	-	-	-	-	-	-	P	-	-	-	-	-	21.6	20.3	-	-	M2
25	5	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	M2
26	5	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	FM4
27	4	-	-	-	-	-	P	-	-	-	-	17.1	15.7	-	-	-	-	M1
28	3	-	-	-	-	-	-	-	-	17.0	14.5	-	-	-	-	-	-	FM4 DEC 3
29	3	-	-	-	-	D	P	-	U/E	15.0	14.0	14.1	11.8	-	-	-	-	M2
30	3	-	-	-	-	-	-	-	P	-	-	-	-	-	-	20.8	-	M3
31	3	-	-	-	-	-	-	P	P	-	-	-	-	18.6	14.7	22.8	-	M3
32	3	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C
33	2	-	-	-	-	D	P	-	-	18.7	15.1	13.2	12.2	-	-	-	-	M1
34	2	-	-	-	-	P	P	-	-	-	-	14.9	12.2	15.1	14.5	-	-	M2
35	2	-	-	-	-	-	-	-	P	-	-	-	-	-	-	24.7	25.7	M3
36	2	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	M3

TABLE 6-8 Ban Na Di: the dimensions of *Sus scrofa* maxillae

NO.	LAYER	I1	I2	FM2	FM3	FM4	M1	M2	M3	CROWN		ALV		CROWN		ALV		CROWN		ALV		TOOTH WEAR
										L.FM4	DEC	L.FM4	DEC	L.M1	L.M1	L.M2	L.M2	L.M3	L.M3	L.M3	L.M3	
1	8	-	-	-	-	D	-	-	-	12.6	11.9	-	-	17.3	13.6	-	-	-	-	-	-	FM4 DEC3
2	8	-	-	-	-	D	P	-	-	14.6	12.7	-	-	-	-	-	-	-	-	-	-	M1 DEC3
3	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FM3 DEC3
4	7	-	-	-	-	-	-	-	-	13.6	12.1	-	-	-	-	-	-	-	-	-	-	FM4 DEC3
5	7	-	-	-	-	-	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
6	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
7	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
8	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
9	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
10	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
11	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
12	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
13	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
14	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
15	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
16	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
17	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
18	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
19	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
20	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
21	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
22	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
23	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
24	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
25	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
26	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
27	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
28	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
29	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
30	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
31	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E
32	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	-	-	-	-	-	-	M3 E

Ban Na Di: the biological remains

CERVIDAE: *Cervus unicolor*, *Cervus eldi*, *Axis porcinus*
and *Muntiacus muntjak*

There are two large species of deer in mainland Southeast Asia; the sambar (*Cervus unicolor*) and Schomburgk's deer (*Cervus schomburgki*). The latter was restricted during historic times, to open marshland. The sambar prefers a woodland habitat with access to open grassy areas. It is not easy to distinguish between their bones, but the antler structure is quite different. All the antler from Ban Chiang and Ban Na Di are characteristic of *Cervus unicolor* and it is assumed that the skeletal remains also come from that species. Most of the bones come from adult animals and bear the marks of butchering and charring consistent with food processing. The same remarks apply to the bones ascribed, on the basis of their size, to Eld's deer (*Cervus eldi*). Adult specimens predominate: eight of the ten mandibles come from mature animals.

It is very difficult to distinguish between the bones of the muntjak (*Muntiacus muntjak*) and the pig deer (*Axis porcinus*) because both are of similar size. The antler and frontal bones however, do differ quite markedly. A reasonable number of cervid bones from Ban Na Di match in size the modern muntjak and pig deer. Again, most specimens reveal signs of butchery and the majority (seven out of nine) mandibles come from adult animals.

TABLE 6-9

Schedule of dimensions for small deer mandibles

NO.	LEVEL	FM2	FM3	L. TOOTH ROW	ALV. LM3	DEGREE OF WEAR	COMMENT
1	7	-	-	63.3	17.0	M3 3	charred
2	7	D	D	-	-	M1 3	charred
3	7	-	-	-	-	FM4 3	charred
4	7	-	-	-	16.5	M3 3	-
5	6	-	-	-	-	M1 3	charred
6	5	-	-	-	17.2	M3 3	charred
7	4	-	-	-	-	M2 2	charred
8	3	-	-	-	-	M1 3	new break
9	3	-	-	-	(17.0)	M3 3	no mandible
10	2	-	-	-	-	FM3 3	charred

TABLE 6-10

Dimensions of *Cervus eldi* mandibles

NO.	LEVEL	FM1	FM2	FM3	M3	L ALV M1	L ALV M2	L ALV M3	DEGREE OF WEAR	COMMENT
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TABLE 6-8 Ban Na Di: the dimensions of *Sus scrofa* maxillae

NO.	LAYER	11	12	FM2	FM3	FM4	M1	M2	M3	CROWN L.FM4 DEC	ALV L.FM4 DEC	CROWN L.M1 DEC	ALV L.M1 DEC	CROWN L.M2 DEC	ALV L.M2 DEC	CROWN L.M3 DEC	ALV L.M3 DEC	TOOTH WEAR
1	8	-	-	-	-	D	-	-	-	12.6	11.8	17.3	13.0	-	-	-	-	FM4 DEC3
2	8	-	-	-	-	D	P	-	-	14.6	12.7	-	-	-	-	-	-	M1 3
3	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FM3 DEC3
4	7	-	-	-	-	D	E	-	-	13.6	12.1	-	-	-	-	-	-	FM4 DEC3
5	7	-	-	-	-	-	P	P	E	-	-	18.1	13.1	18.7	15.2	-	-	M3 E
6	7	-	-	-	-	P	P	P	E	-	-	16.0	12.3	19.5	15.8	-	-	M3 E
7	7	-	-	-	-	-	P	P	E	-	-	14.2	12.2	-	-	-	-	M1 5
8	7	-	-	-	-	P	P	P	E	-	-	17.3	13.6	21.5	17.4	-	-	M3 E
9	7	-	-	-	-	-	P	P	E	-	-	-	-	-	-	30.1	28.5	M3 3
10	7	-	-	-	-	P	P	P	E	-	-	15.8	12.3	21.5	17.1	-	-	M3 E
11	7	-	-	-	-	P	P	P	E	-	-	16.2	12.7	20.8	16.5	-	-	M3 E
12	7	-	-	-	-	P	P	P	E	-	-	-	-	-	-	-	-	M2 4
13	7	-	-	-	-	-	P	-	-	13.2	11.6	-	-	-	-	-	-	M1 3
14	7	-	-	-	-	P	P	-	-	-	-	-	11.7	-	-	-	-	M1 5
15	7	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-	-	FM2 5
16	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12 DEC3
17	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11 3
18	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FM3 DEC3
19	6	-	-	-	-	D	P	-	-	13.0	11.8	17.1	-	-	-	-	-	M1 1
20	6	-	-	-	-	-	P	-	-	-	-	16.8	15.1	-	-	-	-	M1 3
21	6	-	-	-	-	D	P	-	-	13.8	13.1	17.2	13.5	-	-	-	-	M1 3
22	6	-	-	-	-	-	P	P	-	-	-	15.8	13.6	19.8	16.1	-	-	M2 2
23	6	-	-	-	-	-	P	E	-	-	-	-	-	-	-	-	-	M2 E
24	6	-	-	-	-	-	-	P	P	-	-	-	-	-	-	-	-	M3 3
25	6	-	-	-	-	P	P	P	P	-	-	15.4	14.0	20.2	17.1	28.3	-	M3 2
26	5	-	-	-	-	D	P	-	-	14.0	12.2	-	-	-	-	-	-	FM4 DEC3
27	5	-	-	-	-	-	P	E	-	-	-	16.3	13.7	-	-	-	-	M2 E
28	5	-	-	-	-	-	P	P	E	-	-	17.3	13.5	19.6	15.5	-	-	M2 3
29	5	-	-	-	-	-	P	P	U/E	-	-	17.5	14.2	-	-	-	-	M2 2
30	5	-	-	-	-	P	P	P	-	-	-	16.3	13.4	-	-	-	-	M1 4
31	4	-	-	-	-	P	P	P	-	-	-	14.5	13.5	-	-	-	-	M1 4
32	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FM2 1

Ban Na Di: the biological remains

CERVIDAE: *Cervus unicolor*, *Cervus eldi*, *Axis porcinus*
and *Muntiacus muntjak*

There are two large species of deer in mainland Southeast Asia; the sambar (*Cervus unicolor*) and Schomburgk's deer (*Cervus schomburgkii*). The latter was restricted during historic times, to open marshland. The sambar prefers a woodland habitat with access to open grassy areas. It is not easy to distinguish between their bones, but the antler structure is quite different. All the antler from Ban Chiang and Ban Na Di are characteristic of *Cervus unicolor* and it is assumed that the skeletal remains also come from that species. Most of the bones come from adult animals and bear the marks of butchering and charring consistent with food processing. The same remarks apply to the bones ascribed, on the basis of their size, to Eld's deer (*Cervus eldi*). Adult specimens predominate: eight of the ten mandibles come from mature animals.

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TABLE 6-9

Schedule of dimensions for small deer mandibles

NO.	LEVEL	FM2	FM3	L. TOOTH ROW	ALV. LM3	DEGREE OF WEAR	COMMENT
1	7	-	-	63.3	17.0	M3 3	charred
2	7	D	D	-	-	M1 3	charred
3	7	-	-	-	-	FM4 3	charred
4	7	-	-	-	16.5	M3 3	-
5	6	-	-	-	-	M1 3	charred
6	5	-	-	-	17.2	M3 3	charred
7	4	-	-	-	-	M2 2	charred
8	3	-	-	-	-	M1 3	new break
9	3	-	-	-	(17.0)	M3 3	no mandible
10	2	-	-	-	-	FM3 3	charred

TABLE 6-10

Dimensions of *Cervus eldi* mandibles

NO.	LEVEL	FM1	FM2	FM3	M3	L. ALV M1	L. ALV M2	L. ALV M3	DEGREE OF WEAR	COMMENT
-----	-------	-----	-----	-----	----	-----------	-----------	-----------	----------------	---------

Ban Na Di: the biological remains

1	6	-	-	-	-	13.6	-	-	M2	3	smashed
2	6	-	-	-	-	13.5	-	-	M2	3	charred
3	6	-	-	-	-	14.1	-	-	M2	4	charred
4	6	D	D	D	U/E	14.0	-	-	M2		charred
5	5	-	-	-	-	14.0	-	-	M1	3	-
6	5	-	-	-	-	-	16.0	-	M2	3	-
7	3	-	-	-	-	-	15.0	24.2	M3	4	charred
8	3	-	-	-	-	-	17.1	-	M2	3	-
9	3	-	-	-	-	-	-	26.6	M3	3	-
10	2	-	-	-	-	-	17.2	-	M2	5	-

CANIDAE: *Canis familiaris*

A detailed consideration of the Ban Chiang canid bones has been undertaken, in conjunction with specimens from related Northeast Thai sites and wild species of wolf, jackal and cuon (Higham, Kingam and Manly 1980). Both multivariate analysis of cranial measurements and distinct morphological differences revealed that the Ban Chiang dogs were domestic, and descended ultimately from the wolf. The size of the Ban Na Di dog bones match those from Ban Chiang as does their *post mortem* treatment. They were smashed and charred in just the same manner as the pig, cattle and deer bones. The age at death of the Ban Na Di dogs was calculated on the basis of the patterns of tooth eruption and wear. The main age stages are:

1. Very young dogs, with unworn deciduous teeth.
2. Young dogs, with erupting permanent teeth.
3. Subadult dogs, with permanent teeth erupted, but unworn.
4. Adult dogs with permanent teeth erupted and slightly worn.
5. Old dogs with well worn permanent teeth.
6. Mandibles without teeth in place, but which are at least subadult

The mortality data are as follows:

- | | |
|----------------------|---|
| 1. Very young | 2 |
| 2. Young | - |
| 3. Subadult | 4 |
| 4. Adult | 4 |
| 5. Old | - |
| 6. At least subadult | 6 |

There are 16 mandibles, 14 of which are at least subadult. This result suggested that the dogs from Ban Na Di were killed when they were of full body size.

TABLE 6-11

Ban Na Di: the mandibles from *Canis familiaris*

NO.	LEVEL	PM3	PM4	DEGREE	COMMENT OF WEAR	BR	HT MAND.	LM1 MAND.	LM2	LM3	LFM1-	LM1- LFM4	LM1- M2	W. CANINE
1	7	-	-	unworn	burnt	11.3	21.5	20.0	8.8	5.0	(37.0)	32.6	-	-
2	7	-	-	unworn	burnt	11.3	24.2	20.1	8.7	-	-	-	-	-
3	7	-	-	unworn	burnt	8.6	20.8	-	8.1	-	-	(31.7)	-	-
4	7	-	-	unworn	traces of cutting	-	-	-	-	-	-	-	-	-
5	7	-	-	-	burnt	-	-	-	-	-	-	-	-	-
6	7	-	-	-	traces of cutting	-	-	-	-	-	-	-	-	-
7	7	D	-	unworn erupt.	burnt	-	-	-	-	-	-	-	-	-
8	7	D	-	-	very yng	-	-	-	-	-	-	-	-	-
9	8	-	-	-	very yng	-	-	-	-	-	-	-	-	-
10	7	-	-	unworn	burnt	-	-	-	-	-	-	-	-	-
11	7	-	-	just wrn	subadult	-	-	-	-	-	-	-	6.8	-
12	7	-	-	well wrn	adult	-	-	-	-	-	-	-	6.6	-
13	7	-	-	well wrn	old	-	-	-	-	-	-	-	5.5	-
14	7	-	-	well wrn	old	-	-	19.1	-	-	-	-	-	-
15	6	-	-	unworn	adult	-	-	-	-	5.5	-	-	-	-
16	6	-	-	just wrn	adult	-	-	-	-	-	-	-	6.1	-
17	6	-	-	unworn	subadult	-	-	-	-	-	-	-	6.1	-
18	6	-	-	unworn	burnt	9.1	20.1	-	8.1	-	-	-	-	-
19	3	-	-	just wrn	burnt	-	-	-	-	-	-	-	-	-
20	3	-	-	unworn	burnt	10.3	20.8	-	-	-	(34.8)	(31.2)	(5.5)	-
21	2	-	-	-	burnt	8.9	18.1	-	-	-	-	-	(6.9)	-
22	2	-	-	-	burnt	-	-	-	-	-	-	-	-	-
23	1	-	-	just wrn	burnt	-	-	-	-	-	-	-	-	-

Ban Na Di: the biological remains

TABLE 6-12
Ban Na Di: the dimensions of *Canis familiaris* maxillae

NO.	LEVEL	PM4	M1	M2	DEGREE OF WEAR	COMMENT	LM1	BR M1	LRM4	BR. PM4	W. CANINE
1	7	-	-	-	worn	charred	9.8	12.1	16.0	7.9	-
2	7	-	-	-	just wrn	charred	11.2	13.8	-	-	-
3	7	-	-	-	unworn	charred	11.3	13.4	-	-	-
4	7	-	-	-	unworn	charred	-	-	16.7	9.0	-
5	7	-	-	-	worn	charred	-	-	-	-	-
6	7	D	D	-	worn	charred	-	-	-	-	-
7	7	D	-	-	unworn	young	-	-	-	-	6.7
8	7	-	-	-	worn	charred	-	-	-	-	5.4
9	7	-	-	-	unworn	-	-	-	-	-	-
10	7	-	-	-	unworn	-	-	-	17.8	9.4	-
11	7	-	-	-	worn	-	-	-	15.7	8.6	-
12	6	-	-	-	unworn	smashed	11.1	13.2	16.9	9.1	-
13	6	-	-	-	unworn	charred	-	-	-	-	7.3
14	5	-	-	-	just wrn	charred	-	-	17.4	10.0	-
15	3	-	-	-	unworn	smashed	9.2	11.3	14.7	6.9	-
16	3	-	-	-	unworn	smashed	10.4	(12.7)	14.7	8.1	-
17	2	-	-	-	just wrn	young	-	-	-	-	-
18	2	D	-	-	charred	-	-	-	14.8	7.0	-
19	2	-	-	-	unworn	-	-	-	-	-	4.8

Ban Na Di: the biological remains

MANIDAE: *Manis* sp.

Only one pangolin bone (a humerus) was found at Ban Na Di (L. 6). The distribution of the Chinese and Malayan pangolins is complimentary, both being adapted to primary and secondary forest.

FELIDAE: *Felis* sp.

Cat bones were rare at Ban Na Di, the following two specimens being identified. *Felis bengalensis*: the leopard cat was widely distributed in Asia. Boonsong and McNeely (1978) noted that it was tolerant of human presence. Indeed they mention that it was a raider of human stock. The following specimen is identified to this species:

FEMUR L.7 max. with head: 8.3 mm

Felis sp. One felid humerus was found in level 6 but it is not possible to identify it to species level:

HUMERUS L.6 DW: 23.2 mm

MUSTELIDAE: *Melogale personata*

The Burmese ferret badger is adapted to several habitats, including forests and ricefields. Two adult mandibles were ascribed to this species as follows:

TABLE 6-13

Ban Na Di: the bones from *Melogale personata*

BONE NO.	PROVENANCE	L ALV FM ROW	L ALV M ROW	HT AT M1
Mandible 1	Level 7	17.1	12.1	10.7
Mandible 2	Level 7	17.8	-	9.7
<i>Melogale personata</i>				
British Museum 1948	.7.12.16	17.0	12.1	9.1

RANIDAE: *Rana tigrina*

Ban Na Di: the biological remains

Several specimens have been ascribed to the frog *Rana tigrina*. A smaller group of frog bones have not yet been identified to specific level and are labelled *Rana* sp.: small frog bone. The former species is adapted to an open habitat prone to flooding, and finds rice paddies congenial. The following specimens were found:

TABLE 6-14

The bones of *Rana tigrina* from Ban Na Di

BONE	LEVEL							
	1	2	3	4	5	6	7	8
Ilium		1		1	1		4	1
Urostyle	1			1	1		11	2
Maxilla	1	1	1		2		7	2
Radio Ulna				1	2	2	1	2
Humerus				1			3	
Tibio Fibula								
SMALL FROG BONE: <i>RANA</i> SP.								
Ilium	1				2	2	1	1
Urostyle						1		1
Maxilla				1			2	2
Humerus								1
Radio Ulna	1					2	3	
Tibio Fibula				1		2	1	1
Femur	1							

AVES: *Gallus domesticus* and unidentified bird

Despite the fact that within living memory there was a rich avifauna in the environs of Ban Na Di, bird bones in pre- and protohistoric contexts there are rare. Moreover, identification even to family is ruled out due to the lack of a modern comparative sample.

Chicken bones were relatively common at Ban Na Di. They were usually larger than the comparative specimen, a wild jungle fowl from Northern Thailand. The following dimensions were obtained.

TABLE 6-15

Ban Na Di: the dimensions of the bones from *Gallus*

BONE	NO.	PROVENANCE	GL	Bd	SC	Bp	COMMENT
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Ban Na Di: the biological remains

Tarsometatarsal	1	L.7	-	13.7	-	-	charred
	2	L.7	-	12.5	-	-	-
	3	L.7	-	22.5	-	-	-
	4	L.7	-	-	-	13.1	charred
	5	L.8	-	-	-	-	charred
	8	L.5	-	-	-	-	charred
	7	L.7 B.12	80.8	12.8	6.4	13.9	-
BONE	NO.	PROVENANCE	GL	SC	Bd		COMMENT
Femur	1	L.7	(75.0)	-	(19.0)	-	-
	2	L.7	-	-	-	-	charred
	3	L.2	55.0	-	13.0	-	-
	4	L.2	-	-	-	-	charred
	5	L.2	-	-	-	-	young
	6	L.2	-	-	-	-	young
	7	L.7 B12	77.4	6.9	15.1	-	young
BONE	NO.	PROVENANCE	Dip	GL	Bd		COMMENT
Tibiotarsus	1	L.7	(18.5)	-	-	-	charred
	2	L.7	-	-	11.5	-	-
	3	L.5	-	-	12.1	-	charred
	4	L.2	-	-	-	-	young
	7	L.7 B.12	20.9	114.2	11.9	-	-
BONE	NO.	PROVENANCE	Bp	Bd	SC	GL	COMMENT
Humerus	1	L.7	-	19.9	-	-	charred
	2	L.7	-	-	-	-	-
	3	L.7	-	-	-	-	charred
	4	L.6	-	-	-	-	charred
	5	L.7 B12	18.8	15.5	7.3	70.3	charred
BONE	NO.	PROVENANCE	GL	Dip	Bp		COMMENT
Carpometacarpus	1	L.7	-	-	-	-	charred
	2	L.7 B.12	37.9	7.1	-	11.7	-
BONE	NO.	PROVENANCE	GL				
Ulna	1	L.7 B.12	66.6				

In addition there are 2 pelvic bones from levels 7 and 3.

The following specimens were identified to large birds as follows:

Ban Na Di: the biological remains

Tarsometatarsus	from Level 8	Bp	24.5
Humerus	from Level 7	Bp	30.9

The following specimens were identified to small birds as follows:

Carpometacarpus	from Level 7	GL	11.5
Tarsometatarsus	from Level 6	Bd	11.2
Tibiotarsus	from Level 3	Bd	6.9

VARANIDAE: *Varanus nebulosus*

The following specimens were identified as the lizard, *Varanus nebulosus*.

Mandible fragments from level 7 (3 fragments), and levels 6, 5 and 4.

CROCODYLIDAE: *Crocodylus siamensis*

A small number of boney scutes were ascribed to *Crocodylus siamensis*. They were recovered from level 7 (3 specimens), and levels 5 and 4.

TRIONYCHIDAE

There is one fragment of carapace from level 5 which comes from a soft-shelled turtle. The two possible species in question are *Trionyx cartilagineus* and *Chitra indica*, the former having a narrower margin to the plastron. It is impossible to distinguish between the species on the basis of the available specimens.

VIVERRIDAE: *Hemigalus derbyanus*

Several species of civet are indigenous to Thailand. Apart from the cranium and mandible, assigning bones to different species is difficult. The identification of the humeri below must be regarded as tentative at best.

Ban Na Di: the biological remains

TABLE 6-16

Ban Na Di: The Bones of *Hemigalus derbyanus*

BONE	NO.	PROVENANCE	DW
Humerus	1	L.7	14.3
	2	L.6	14.6
<i>Hemigalus derbyanus</i> British Museum cat. no 67.1611			10.0

The following specimens were ascribed to *Viverricula rasse*.

TABLE 6-17

Ban Na Di: The Bones from *Viverricula rasse*

BONE	NO.	PROVENANCE	L.ALV. FM ROW	L.ALV. M.ROW	Ht. MANDIBLE BEHIND M.2
MANDIBLE	1	L.7	22.3	11.0	8.5
	2	L.7	-	11.0	9.4
	3	L.7	22.7	11.8	10.5
	4	L.6	-	11.2	9.9
	5	L.6	-	11.7	9.3
	6	L.5	21.2	11.3	8.2
	7	L.4	-	11.2	10.0

BONE	NO.	PROVENANCE	DW
Tibia	1	L.7	12.5
	2	L.5	11.4

BONE	NO.	PROVENANCE	BPC
Ulna	1	L.7	7.5
	2	L.7	8.5

Ban Na Di: the biological remains

LEPORIDAE: *Lepus peguensis*

The Siamese hare, *Lepus peguensis*, is found typically in areas where the forest has been cleared (Boonsong and McNeely 1978). They are herbivores and prefer an open, grassy habitat. The following specimens have been ascribed to this species.

TABLE 6-18

Ban Na Di: the bones from *Lepus peguensis*

BONE	LEVEL	DIMENSIONS	
FEMUR	7	DW: 20.5	Max. W. head: -
	4	-	10.1
PELVIS	7	L. Acetabulum:	9.9
SCAPULA 1. 2.	7	L. Glenoid fossa:	9.7
	7	L. Glenoid fossa:	-
	5	L. Glenoid fossa:	9.8
HUMERUS	5	DW: 10.0	
	5	DW: 11.0	
	2	DW: 10.1	
RADIUS	7	DW: 7.9	
TIBIA	7	DW: 11.9	
	6	-	
	2	DW: 13.3	
MANDIBLE	6	ALV L. Tooth row:	21.4
	4	ALV L. Tooth row:	-

MURIDAE

There are many indigenous Thai species of rat, some of which are adapted to distinct environments. In the absence of comparative data, the rat bones at this site have been assigned to two groups, 'large' and 'small' respectively. The former contains bones about the same size as *Rattus edwardsi* and *Rattus sabanus*, and the latter is the same size as *Rattus koratensis*. Measurements of large rat bones from Ban Na Di are as follows.

Ban Na Di: the biological remains

TABLE G-19

Ban Na Di: the bones from Muridae

BONE	NO.	PROVENANCE	L. ALV. TOOTH ROW
Mandible	1	L.3	10.5
	2	L.2	10.6

BONE	NO.	PROVENANCE	MAX. W. HEAD
Femur	1	L.4	5.4
	2	L.4	-
	3	L.4	-

In addition there are 2 lower incisors from level 5 and 5 upper and lower teeth from levels 5, 4 and 3.

Measurements of small rat bones from Ban Na Di

BONE	no.	PROVENANCE	L. ALV. TOOTH ROW
Mandible	1	L.7	-
	2	L.6	-
	3	L.6	7.1
	4	L.4	6.7
	5	L.1	-

Modern small rat from Ban Chiang 7.1

BONE	NO.	PROVENANCE	L	MAX W. HEAD	DW	COMMENT
Femur	1	L.8	-	-	6.5	De Fused
	2	L.8	-	-	-	De U/F
	3	L.8	-	-	-	-
	4	L.7	34.1	3.4	6.6	De Fused
	5	L.7	32.1	3.0	6.0	De Fused
	6	L.7	28.8	-	7.0	De Fused
	7	L.7	-	-	6.9	De Fused
	8	L.7	-	3.2	-	De U/F
	9	L.7	-	3.0	-	De U/F
	10	L.7	-	3.4	-	Broken
	11	L.7	-	2.9	-	Broken
	12	L.7	-	2.9	-	Broken
	13	L.6	-	2.8	-	Broken

Ban Na Di: the biological remains

BONE	NO.	PROVENANCE	L	MAX W. HEAD	DW	COMMENT
Femur	14	L.5	-	-	6.1	De Fused
	15	L.5	-	3.3	-	De U/F
	16	L.5	-	3.5	-	New Break
	17	L.5	-	-	-	-
	18	L.4	-	3.3	-	De U/F
	19	L.4	-	-	-	New Break
	20	L.4	-	-	-	New Break
	Modern small rat from Ban Chiang		-	2.1	5.5	

BONE	NO.	PROVENANCE	L	DW	COMMENT
Humerus	1	L.7	-	5.0	De U/F
	2	L.7	-	6.2	New Break
	3	L.6	-	5.7	De U/F
	Modern small rat from Ban Chiang		-	5.0	

BONE	NO.	PROVENANCE	PW	L	DW	COMMENT
Tibia	1	L.8	-	-	3.5	De U/F
	2	L.8	-	-	-	De U/F
	3	L.8	-	-	3.7	New Break
	4	L.7	-	-	3.9	De U/F
	5	L.7	-	-	4.0	De U/F
	6	L.7	-	-	3.8	De U/F
	7	L.7	-	-	-	De U/
	8	L.7	-	-	-	De U/F
	9	L.7	-	-	-	De U/F
	10	L.6	7.1	30.3	3.7	De Fused
	11	L.6	-	-	3.8	De U/F
	12	L.6	-	-	3.8	De U/F
	13	L.8	-	-	-	De U/F
	14	L.6	-	-	-	De U/F
	15	L.8	-	-	4.0	New Break
	16	L.6	-	-	-	New Break
	17	L.5	-	-	3.0	De U/F
	18	L.5	-	-	4.2	De U/F
	Modern small rat from Ban Chiang		5.4	-	3.2	

BONE	NO.	PROVENANCE	L. GLENOID FOSSA
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Ban Na Di: the biological remains

Scapula	1	L.8	2.8
	2	L.4	3.0

BONE	NO.	PROVENANCE	L. OF ACETABULUM
Pelvis	1	L.7	3.7
	2	L.7	3.5
	3	L.7	3.1
	Modern small rat from Ban Chiang		2.7

In addition there are 13 upper and lower incisors:
 2 from level 8, 4 from level 7, 2 from level 6, 2 from level 5,
 1 from level 4, 1 from level 3, and 1 from level 1.

HERPESTES JAVANICUS

This species has a wide-ranging diet and prefers open grassy terrain to thick woodland. The following bones were ascribed to it.

TABLE 6-20

Ban Na Di: the bones from *Herpestes javanicus*

BONE	NO.	PROVENANCE	L.ALV FM ROW	L.ALV M ROW	HT. MANDIBLE BEHIND M. 1
Mandible	1	L.8	14.2	9.1	8.4
	2	L.8	-	-	-
	3	L.7	15.0	9.5	7.5
	4	L.7	14.2	-	9.6
	5	L.7	-	9.7	8.3
	6	L.6	-	-	9.0
	7	L.5	-	9.0	8.4
	8	L.4	-	8.8	8.3
	9	L.4	-	8.2	6.8
	10	L.2	15.1	11.3	8.6
BONE	NO.	PROVENANCE	DW.		
Humerus	1	L.7	11.1		

Ban Na Di: the biological remains

2

L.7

11.3

OPHICEPHALIDAE: *Channa* sp.

Fish of the genus *Channa* are very widespread in Thailand today. They inhabit most types of aquatic habitat, including lakes, ponds, swamps and streams. In size, the adult range from 10 cm to over 1 m in length. The most common type in Northeast Thailand is *Ophicephalus striatus*, and most if not all the small *Channa* bones from Ban Na Di probably come from this species. It is a resilient fish which sinks into the mud in drying ponds and rivers during the dry season. Provided the skin and breathing apparatus remain moist, it can survive in this manner for several months.

The best time to catch this fish follows the onset of the monsoon, when watercourses fill and catching by net or trap is straightforward. The caught in this manner today are small (c. 10-20 cm long), a size matched in the prehistoric samples. The following specimens were recovered and identified, nearly all coming from the fine-mesh screening.

TABLE 6-21

Ban Na Di: the bones from Ophicephalids

BONE	LEVEL							
	1	2	3	4	5	6	7	8
Dentary	2		3	3	7	5	20	6
Premaxilla		1		1		1	18	20
Palatine	1			2	2	0	15	3
Quadrate			1	1	3		8	1
Maxilla	4	1		4	5	2	16	
Operculum						2	4	
Anguloarticular				2	1	1	8	

(Numbers refer to n specimens)

ANABANTIDAE: *Anabas testudineus*

The Anabantid fish of Thailand have the important characteristic of a suprabranchial cavity, which allows them to breathe out of water. Quite the commonest species in Northeast Thailand today is *Anabas testudineus*. This species is of similar size to the prehistoric specimens from Ban Na Di. Today, this species occupies swamps, lakes and ponds. It frequents rice paddies during the wet season, and can colonise wet season habitats by

Ban Na Di: the biological remains

moving across dry land from its dry season refugia. The following bones belong to this group, *Anabas testudineus* being the most likely species in question:

TABLE 6-22

Ban Na Di: the bones from Anabantids

BONE	LEVEL							
Level	1	2	3	4	5	6	7	8
Premaxilla	7		1	7	6	20	126	11
Dentary							11	
Pharyngeal					2	1	4	2
Anguloarticular	2				2		3	4
Operculum			1		2		3	10
n = number of specimens								

CLARIDAE: *Clarius batrachus*

Like other Anabantid fish, the clariid catfish can survive for long periods without water by means of the suprabranchial cavity. They are very widespread, the commonest species in Northeast Thailand being *Clarius batrachus*. They are abundant and easily netted or caught in traps during the wet season. The following specimens were recognised:

TABLE 6-23

Ban Na Di: the bones from Clarids

BONE	LEVEL							
	1	2	3	4	5	6	7	8
Pectoral spine	3	2		8	9	8	80	16
Pectoral process					1		4	

BAGRIDAE: *Mystus* sp.

Ban Na Di: the biological remains

The following bones were identified as belonging to *Mystus* sp. Most fish represented were between 5-20 cm long.

TABLE 6-24

Ban Na Di: the bones from Bagrids

BONE	LEVEL							
Level	1	2	3	4	5	6	7	8
Pectoral spine			1	3	4	8	33	4
Pectoral process				1				2
Dorsal fin spine								1

SILURIDAE

This family was represented by one dentary in level 8.

CYPRINIDAE: *Barbus* sp.

Two dorsal fin spines from L.5 and one pharyngeal bone from L.7 were ascribed to *Barbus* sp.

THE BAN NA DI FAUNAL SPECTRUM

The faunal spectrum from Ban Na Di has been expressed in two ways (figs 6-1 and 2). The first excludes the bones recovered from the fine screening process. The second incorporated the identified bones from the samples which were screened through a 1 mm mesh. In the latter case, the actual number of individuals has been increased by a factor of 6.66, because only 15% of the material was fine-screened. Only levels 4-8 remains have been incorporated in fig 6-2, because levels 1-3 material was not screened through the smaller mesh.

The effect of fine-mesh screening has been to demonstrate clearly the numerical importance of small fish. The build up of fine silty lenses at the site reflect flooding. Indeed within living memory, travel to nearby villages during the wet season was only possible by boat. Such small fish were abundant from level 8 right through to level 4. Only in level 8

Ban Na Di: the biological remains

however, were shellfish abundant. Thereafter, their numbers declined appreciably. Other aquatic species found in the lower levels at Ban Na Di were the frog, water turtle, and crocodile. In each case, they declined in frequency with time.

The mongoose (*Herpestes javanicus*), hare (*Lepus siamensis*) and small Indian civet (*Viverricula malaccensis*) are all animals which by preference, occupy a cleared rather than a forested habitat. The hare and civet appeared first in level 7 contexts, but became rare during and after the build up of level 5.

The water buffalo (*Bubalus bubalis*) was absent from level 8 deposits. One bone only was recovered from level 7, but it became more abundant from level 6. The other domesticated mammals - cattle, pig and dog as well as all deer species were exploited throughout the occupation of Ban Na Di. Domestic chickens however, were rare except in level 2.

THE FAUNAL MATERIAL FROM HUMAN BURIALS

The interment of animal remains with the dead was commonly practiced at Non Nok Tha and Ban Chiang (Higham 1975, Kijngam 1979). At the former, complete pigs and articulating limbs of cattle were placed alongside the human remains. The inhabitants of Ban Chiang preferred to place pig mandibles with the dead.

The principal mortuary assemblage at Ban Na Di has been sub-divided into three phases. The occurrence of burial bone in burials from each phase is set out in table 6-25. Where appropriate, adult bovid bones have been measured and placed on a scatter diagram (figs 6-3 and 4). It is clear that the provision of animal limbs was rare during phase 1a (one example out of 15, and became more common during phase 1b (seven out of 21) and phase 1c (11 out of 23). During all phases, the left forelimb of a cow or pig was the preferred offering. Only when two limbs were incorporated, was a right hand one used in the mortuary ritual. B.36 (phase 1b) was accompanied by a pot which contained the left forelimb of a juvenile pig. B.12, that of a 17 year old female, included a complete chicken skeleton. The young child in B.19, aged between three and ten years at death, was covered by the bony scutes of a crocodile. It is probable that these represent the placing of a skin shroud over the body.

The dimensions of the Ban Na Di bovid first fore phalanges are set out in fig 6-4. With the exception of the specimens from burial 38, all fall within the size range of corresponding bones from modern Thai domestic cattle. They are, however, smaller and more gracile than the comparative specimens from the gaur (*Bibos gaurus*) and banteng (*Bibos javanicus*). The same pattern is found in the case of the magnum and second fore phalanx. As at Non Nok Tha and Ban Chiang, domesticated animals were clearly preferred for sacrificial purposes.

ABBREVIATIONS USED IN BONE MEASUREMENTS

1. FM	Premolar	2. M	Molar
3. L	Length	4. PM	Proximal width
5. DW	Distal width	6. MW	Minimum width
7. ALV	Alveolar	8. ALV L PM row	Alveolar length of the premolar row
9. ALV L M row	Alveolar length of the molar row		
10. GL	Greatest length		
11. Bp	Breadth of the proximal end		
12. SC	Smallest breadth of the corpus		
13. Bd	Breadth of the distal end		
14. Dip	Diagonal of the proximal end		
15. HT	Height		
16. BPC	Breadth across the coronoid process		
17. De	Distal end		

Ban Na Di: table of animal bones from burials

TABLE 6-25

Ban Na Di: the animal bones from burials

NO.	SEX	AGE	PHASE	DESCRIPTION	PRIMARY ASSOCIATION
B.26	F	30-40	1a	completely excavated	<i>Bibos.</i> left forelimb
B.15	-	0-3	1b	completely excavated	<i>Bibos.</i> left forelimb
B.36	F	30-40	1b	completely excavated	<i>Bibos.</i> left forelimb <i>Sus.</i> left forelimb (in pot)
B.38	-	3-10	1b	completely excavated	<i>Bibos.</i> left forelimb
B.12	F	10-20	1b	completely excavated	<i>Sus.</i> 2 left forelimb <i>Gallus.</i> complete skeleton
B.19	-	3-10	1b	completely excavated	<i>Crocodylus.</i> about 20 bony scutes
B.42	F	20-30	1b	partially excavated	<i>Bibos.</i> left forelimb
B.16	F	17-18	1b	disturbed burial	<i>Bibos.</i> 1 humerus
B.29	-	0-3	1c	completely excavated	<i>Bibos.</i> left forelimb
B.18	F	30-40	1c	completely excavated	<i>Sus.</i> left forelimb
B.48	F	30-40	1c	disturbed burial	<i>Bibos.</i> left forelimb
B.32	M	30-40	1c	partially excavated	<i>Sus.</i> forelimb
B.16	M	30-40	1c	partially excavated	<i>Bibos.</i> left forelimb right forelimb
B.10,	F	over 50			
11	M	30-40	1c	completely excavated	<i>Bibos.</i> left forelimb
TS 8	F	30-40	1c	disturbed burial	<i>Bibos.</i> forelimb
TS 11	-	adult	1c	disturbed burial	<i>Bibos.</i> forelimb
TS 12	M	40-50	1c	partially excavated	<i>Bibos.</i> forelimb
TS 13	-	over 30	1c	disturbed burial	<i>Sus.</i> forelimb

THE RICE REMAINS

T.T. Chang and E. Loresto

Twenty two samples have been examined. All are milled rice kernels. SUMP impression only shows thin-walled parenchymatous cells. No epidermal cells of lemma/palea were noted in all the samples. With the aid of the photo enlarger, the grain length and width of whole kernels were measured (table 6-26). For broken kernels, only the width was taken. A drawing traced from the projected image is shown in fig 6-7. Based on the data and the drawings, there is a slight variation in the shape of the milled rice samples. Sample no 6, (level 7) which has six whole kernels, showed only one with a slender kernel (1.3 mm) and the other five ranged from 2.1 to 2.6 mm in width. Not much variation in the shape of the rice kernels was found in the different cultural levels. Our visual observations suggest that these samples could be rice kernels of the cultivated type.

A sample of rice from burial 17 and the photograph of a clump of rice from burial 8 have also been considered. The former derives from close proximity to an iron artefact, which was conducive to preservation. SUMP impressions did not show any evidence of epidermal cells of rice hulls. By the use of the micro lens, the sample appears to be a clump of milled rice. The grain is devoid of embryo. The starchy endosperm was pulverised, and because of pulverisation, the clump looks like empty rice hulls. The photographs of rice kernels adhering to iron artefacts is more or less the same as the actual sample. The rice kernels are devoid of the starchy endosperm, unlike the carbonised samples where one can see the whole kernel.

TABLE 6-26

The dimensions of the rice kernels from Ban Na Di

Provenance	Level	Grain L	Grain Br	Remarks
-	8	-	2.0	broken kernel
A2 46	8	4.6	2.6	
A3 41	8	-	1.3	
A2 42	7	5.0	2.0]	two were broken kernels
A2 42	7	-	3.0]	
A2 42	7	-	2.5]	
A2 43	7	-	2.2]	all four came from broken kernels
A2 43	7	-	2.3]	
A2 43	7	-	2.0]	
A2 43	7	-	2.2]	

The Rice Remains from Ban Na Di

A2 44	7	4.6	2.2]	Five of the kernels were similar in shape. Only one is slender
A2 44	7	4.2	2.4]	
A2 44	7	4.6	2.1]	
A2 44	7	4.7	2.2]	
A2 44	7	4.8	1.3]	
A2 44	7	4.6	2.6]	
A1 34		5.0	2.4	
A1/2 26	6	5.0	2.6	
A1/2 23	6	-	2.6	broken kernel
A3/4 19	6	4.5	1.8	
A3/4 20	6	5.0	2.0	
A3/4 18	6	4.3	2.4	
A2/3	6	-	2.2	broken kernel
A1/2 27	6	4.6	2.7	
A3/4 15	5	5.0	2.3	
A4 15	5	-	2.1	broken kernel
A4 11	4	5.0	3.0	
A4 11	4	-	2.3	broken kernel
A4 9		4.4	2.2	
A1/2 3	2	5.8	2.3	
A2/3 3	2	4.3	1.2	
A3/4 5	1	5.8	2.2	

Ban Na Di faunal spectra

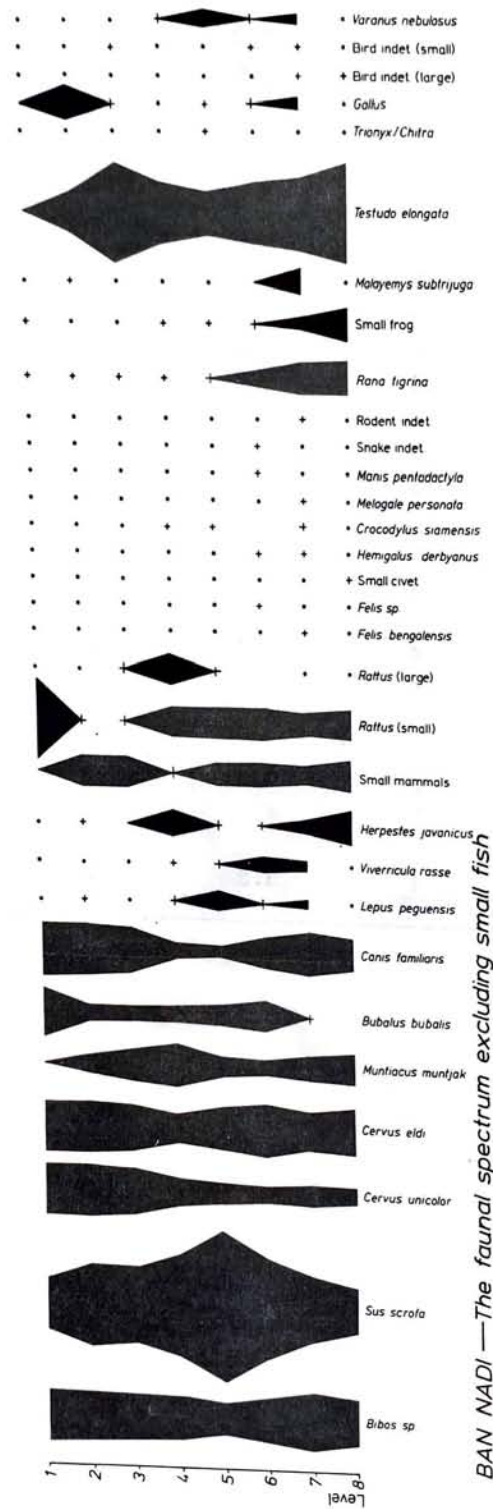
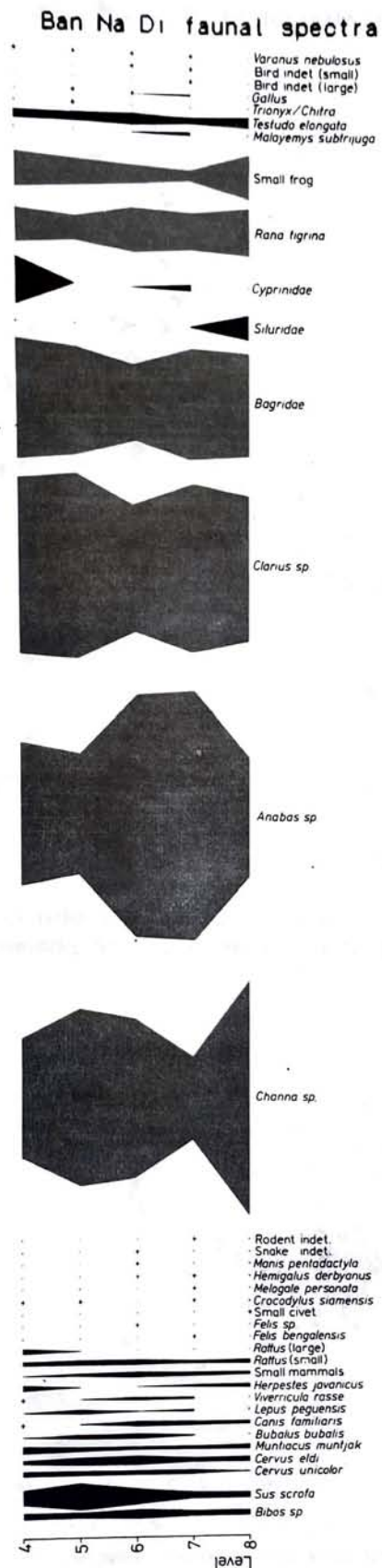


FIGURE 6-1 Ban Na Di: the faunal spectrum (excl. small fish).
Each species is represented as a % frequency per layer.
(+: trace only, .: absent)



The faunal spectrum (Represented as percentage frequency of species per layer)

**FIGURE 6-2 Ban Na Di: the faunal spectrum for levels 4-8, including small fish and frog.
(+: trace only, .: absent)**

Ban Na Di: scatter plots of bovid limb bones

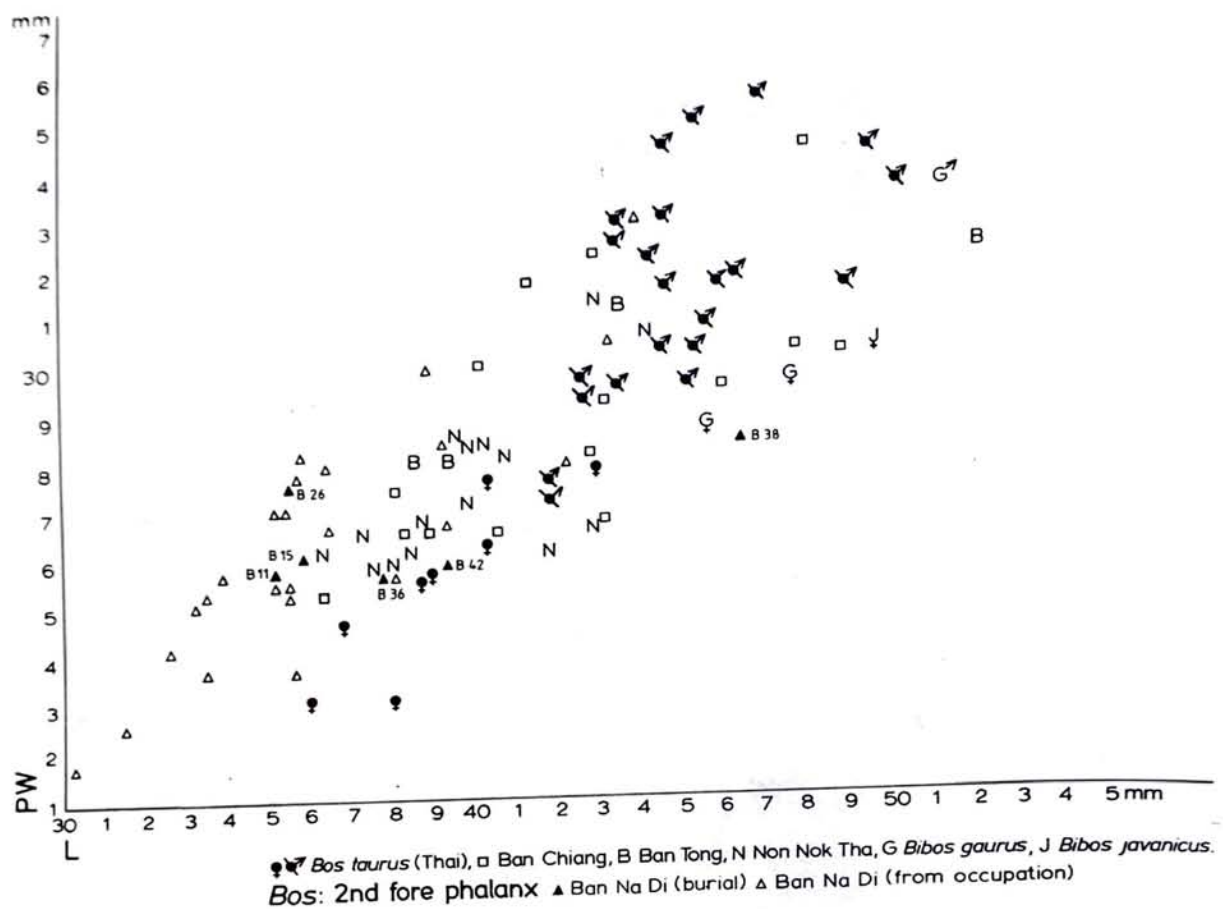


FIGURE 6-3 Ban Na Di: scatter plot of the dimensions of bovid second fore phalanges

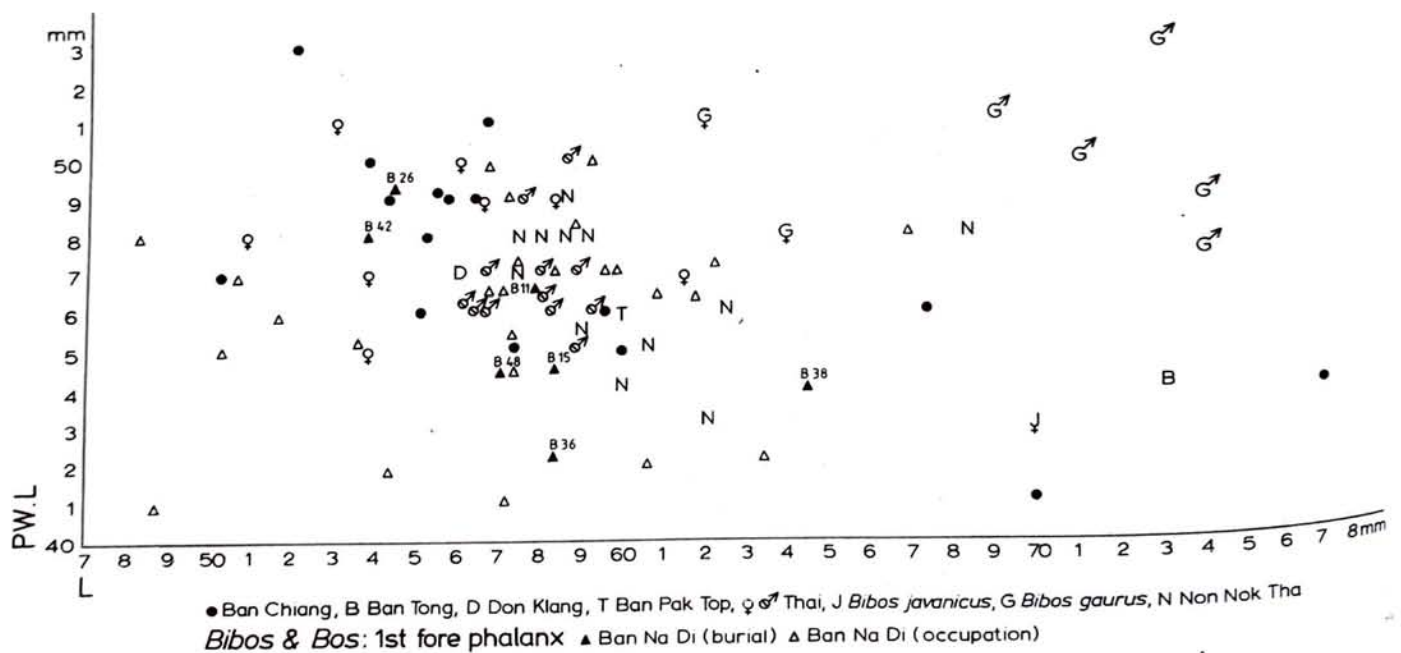


FIGURE 6-4 Ban Na Di: scatter plot of the dimensions of bovid first fore phalanges

Ban Na Di: scatter plots of bovid limb bones

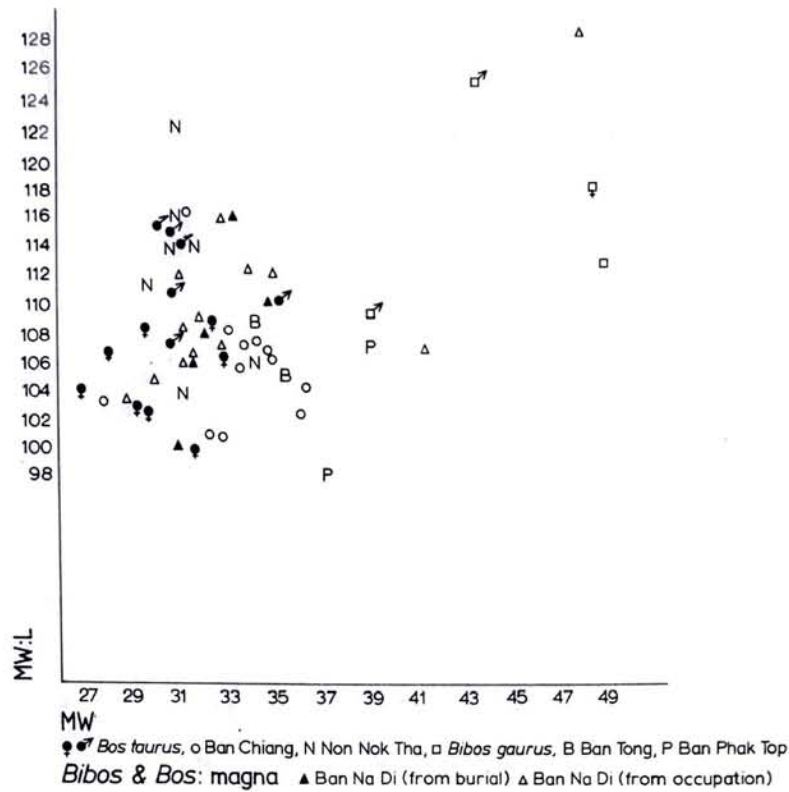


FIGURE 6-5 Ban Na Di: scatter plot of bovid magna

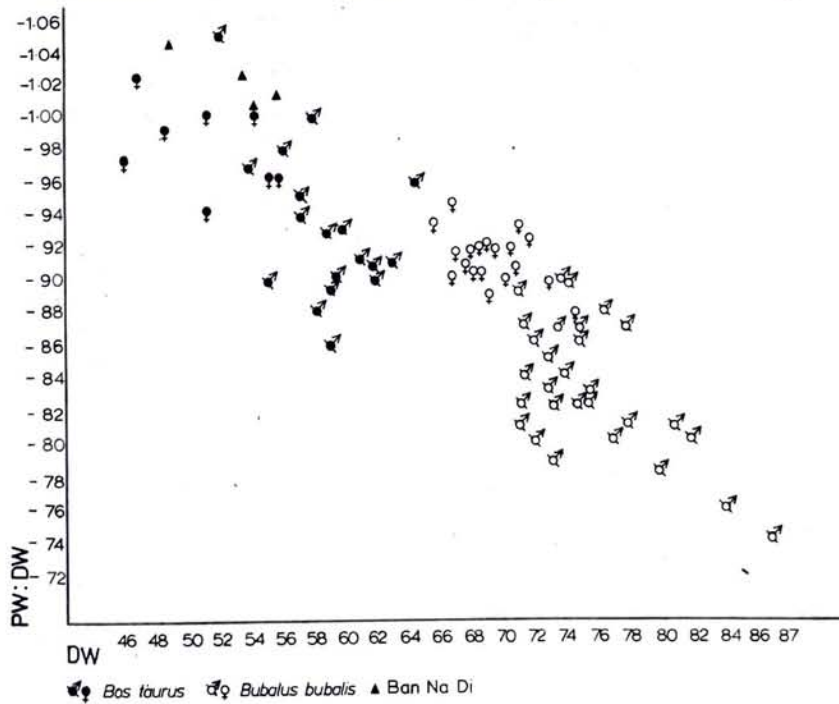


FIGURE 6-6 Ban Na Di: scatter plot of bovid metacarpals

Ban Na Di: outline of the rice grains

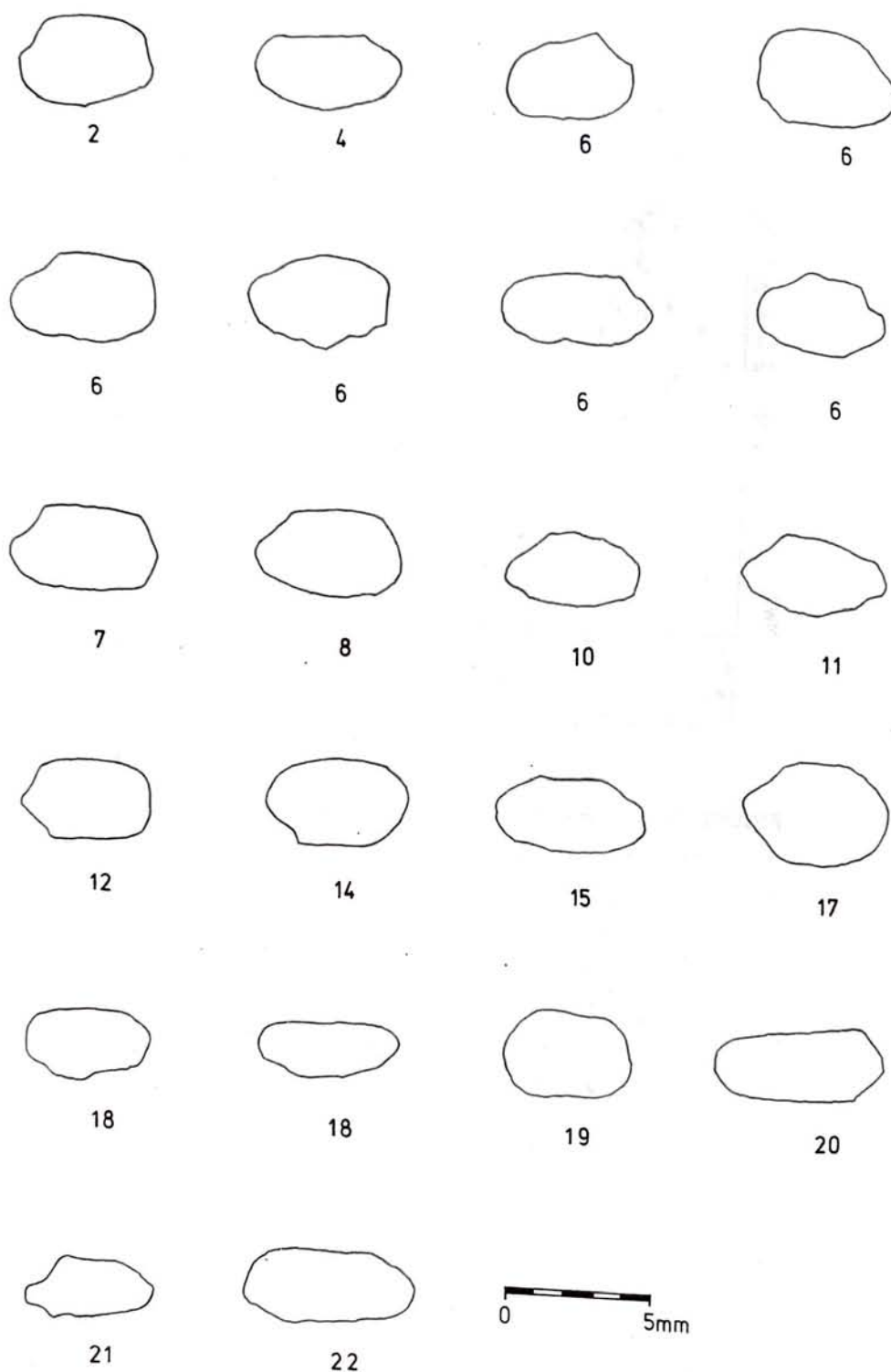


FIGURE 6-7

Ban Na Di: outline of the rice grains

CHAPTER SEVEN

THE PEOPLE OF BAN NA DI

Philip Houghton and Warrachai Wiriyaromp

INTRODUCTION

The human remains from Ban Na Di represent 73 individuals. The majority (63 individuals) are from mortuary phase 1 (1000BC-300BC). Five jar burials containing infant remains comprise the mortuary phase 2 material (early first millennium AD), while three fragmented adult skeletons dated to the middle of the first millennium AD constitute the mortuary phase 3 material. The assignment in time of three individuals is uncertain. In the discussion, only mortuary phase 1 individuals are taken to represent a discrete population. The details of each individual are set out in Appendix 2.

At excavation, much of the material was found to be fragmented or incomplete, and subsequently proved difficult or impossible to reconstruct. The fragmentation reflects in part the fact that these burials were disturbed by human activity, such as the opening of graves in antiquity. The bodies were buried directly in the soil. No signs of a protective cover, such as a wooden coffin, have been found, although one burial was found under the remains of a crocodile skin, and fabric adhering to metal ornaments may come from shrouds. The bone in general is quite fragile, and chemical analysis reveals that very little organic structure has survived.

The bone was cleaned with small instruments such as scalpels and dental probes, and no water or chemical solutions were used. After cleaning the bone was reconstructed using latex glue. Each individual skeleton or part thereof has its own identifying number, this being the number given at excavation. Some burials contained multiple human remains, and when part of a further individual was identified in the laboratory, an alphabetical subscript was added to the field number. The burials from the 1980 test excavation have the code "BND.TS" (Ban Na Di test square) before the number of the individual, while "BND" identifies the burials from the major excavation.

METHODS OF ANALYSIS

1. Ageing of individuals

The ageing of immature individuals was by standard biological criteria of bone and tooth development. Ageing adult remains is always more difficult. The most useful method involved the analysis of toothwear (Miles 1963, Akpata 1975, Nowell 1978, Kieser *et al.* 1983), the standards being provided by those individuals showing the final stages of bone or tooth maturation, or who possessed an intact pubic symphysis (Kerley 1970, McKern 1970). Some use was made of the state of the cancellous bone (Jowsey 1960, Singh *et al.* 1970, Hall 1961). Unfortunately the bone

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cortex was too fragile to allow ageing on histological criteria.

2. Sex of individuals

Determination of sex was not attempted for individuals younger than 15 years. For those over 15 years, sex was determined whenever possible from pelvic morphology. In the absence of the pelvis, morphology of the skull, and dimensions of long bones were assessed, and compared with data from the individuals sexed by pelvic morphology. Citrate analysis (Dennison 1979) was attempted, but the bone was found to have negligible organic content.

3. Stature and limb proportions

Stature was estimated from maximum lengths of long bones using the White American formulae presented by Trotter (1970). These formulae provide the best compromise when body proportions are unknown. Standard ratios between the various limb bones were assessed.

4. Radiological studies

a. Cortical thickness. This was measured on the second metacarpal by standard techniques (Garn 1970). Nordin's Score (Barnett and Nordin 1961) was derived to normalize bone thickness for size.

b. Lines of arrested growth. Intact long bones were examined for these.

5. Functional change

Each individual was examined for evidence of skeletal features resulting from some habitual activity. Pelvis were examined for bony evidence of past pregnancy (Houghton 1974).

6. Pathology

Each individual was examined for evidence of bone pathology.

7. Skeletal measurements

Where possible, dimensions of functional significance, or of use in distance analyses, were taken.

8. Dental analysis

Standard mesiodistal and buccolingual tooth dimensions were measured, and cusp morphology was noted. Dentitions were assessed for wear and pathology.

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FINDINGS

1. Life span

Figure 7-1 is a histogram of the age at death for the mortuary phase 1 individuals. Twenty individuals aged under 15 years have been arbitrarily distributed evenly between the sexes, while 14 adults who either could not be sexed or could only be judged as mature, are not included in the histogram. The graph shows high mortality in the early period of life, especially before the second year. Mortality decreased to a low level for those aged 10-14 years. The 15-19 group shows a higher mortality among females, while males predominate in age groups 20-34 and have their highest mortality between 30-34 years. Females predominate in those reaching the fifth decade of life, and only two individuals, both female, are judged to have lived into their sixth decade. The mean age at death for 17 males over 15 was 29.5 years, and of the 12 females, 37.7 years. The mean age at death for the total adult group is 32.9 years. These data are set out in table 7-1.

TABLE 7-1

Ban Na Di: mean age at death for adults (over c. 15 years of age), from mortuary phase 1

	n	mean	standard deviation
male	17	29.5	6.66
female	12	37.7	11.23
combined	29	32.9	9.58

The Ban Na Di life table (table 7-2) was constructed from the estimated age at death of all individuals from mortuary phase 1, following the method of Acsadi and Nemeskeri (1970). Such a composite life table utilises the age at death of the individuals of a sample regardless of their exact year of birth or death. These methods oversimplify demographic mechanisms, yet a variety of useful results have been based on this approach (Keyfitz 1979). Life expectancy at birth was 22.8 years. The survivorship curve derived from these data is presented in fig 7-2, the mortality curve in fig 7-3, and the life expectancy curve in fig 7-4.

2. Ratio of sexes

The number of mature males was higher in all stages of mortuary phase 1, with an overall male/female ratio for that mortuary phase of 1.4:1.

3. Body Morphology

Estimates of stature and limb proportions of the Ban Na Di people were

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based on measurements taken on complete long bones from 26 individuals (15 male, 11 female). For stature, the tibia and femur were the preferred bones, but in 5 individuals an upper limb bone had to be used. The mean height of the 15 adult males was 1737 mm, and of the 11 females, 1613 mm, the percentage difference between the means being 7.6 (see table 7-10). Proportions of limb bones are detailed in table 7-3. Individual measurements are presented in Appendix 2.

Mean mandibular dimensions are presented in table 7-4 while individual measurements for these are given in Appendix 2. Further comment on head morphology is made in the section on biological relationships.

TABLE 7-2

Ban Na Di: the combined life table for mortuary phase 1

x	span of years	d'x	dx	lx	qx	Lx	nLx	Tx	Ex ¹
0-4	5	15	29.41	1000	.294	853.0	4265	22282	22.82
5-9	5	4	7.84	706	.110	667.0	3332	18017	25.51
10-19	10	3	5.88	627	.094	598.0	5975	14685	23.42
20-29	10	9	17.64	568	.309	480.0	4800	8710	15.33
30-39	10	13	25.49	392	.650	265.0	2645	3910	9.97
40-49	10	4	7.84	137	.569	98.0	975	1265	9.23
50+	10	3	5.88	58	1.000	29.0	290	290	5.00

(total= 51)

¹ x: age interval. n: width of age interval. d'x: number of individuals dying at age x in completed years. dx: number of individuals dying at age x expressed as a proportion of a cohort of 1000 individuals. lx: number of individuals living at exact age x, obtained by subtracting the number of deaths from the number alive at the beginning of each age interval. qx: mortality rate, or the number of those dying expressed as a proportion of the living (ngx=ndx/lx). Lx: number of individuals alive between x and x+1 calculated as nLx=(lx+lx+1)/2 multiplied by the number of years in each age group. Tx: sum of the nLx values from the bottom of the column to the age interval being calculated. ex: Life expectancy or the mean life, expressed in years, remaining to those individuals attaining age x calculated by the method eox=Tx/lx.

The people of Ban Na Di

TABLE 7-3

Limb proportions in Ban Na Di adults

	mean	standard deviation	n
tibia:femur	85.2	2.52	10
radius:humerus	81.2	4.44	4

4. Radiological studies

a. Cortical thickness. Only six males and four females were available for this examination. Table 7-4 gives the findings.

b. Lines of arrested growth. Data on these are presented in table 7-5. The long bones of 23 individuals over age 15 were examined, and five (3 male, 1 female, one of undetermined sex) showed lines of arrested growth. In the immature group, four of nine individuals showed lines, most being formed in the three or four months preceding death.

TABLE 7-4

Ban Na Di: mean cortical thickness (mm) and Nordin's score for the second metacarpal

SEX	n	cortical thickness	Nordin's score
MALE	6	5.5	62.4
FEMALE	4	4.5	63.8
COMBINED SEX	10	5.1	63.01

TABLE 7-5

The mean number of lines of arrested growth in the Ban Na Di population

Group	number of individuals	mean no. of lines of arrested growth
adult male	3	5.0

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adult female	1	3.0
adult	1	2.0
immature	4	4.7

5. Functional skeletal change

The tibiae of 22 individuals could be assessed for the presence of squatting facets. Only one individual showed a large facet, where the articular cartilage of the ankle joint had clearly extended onto the anterior aspect of the tibia. Seven individuals (5 male, 1 female, 1 undetermined) showed very slight anterior extension of the joint surface. A further four individuals showed a large facet on the anterior aspect of the tibia some 3-4 mm above the joint, that could be related to a roughening on the most anterior part of the neck of the talus.

The clavicles do not show the first rib grooves characteristic of individuals who consistently paddled canoes or similar craft (Houghton 1980).

Only seven mature females had fairly intact pelves, and all show evidence of past pregnancy. The youngest was 17 years and the oldest was over 50 years. These pelves were distributed throughout mortuary phase 1.

6. Pathology

Little bone pathology was found. An adult male showed a well-healed fracture of the first metatarsal, and an unsexed adult showed thickening of the anterior tibial border, probably the result of a simple infected lesion. An unsexed individual aged over 50 years showed moderate osteoarthritis of a knee joint and of a first metatarso-phalangeal joint. Nine individuals aged over 30 years showed moderate degeneration of the lumbar spine (osteophytosis of the vertebral bodies, and slight osteoarthritis of the apophyseal joints), while slighter degeneration was seen in a male aged 20-24 years.

7. Dental analysis

a. Metric data. These are set out in tables 7-6 and 7-7.

b. Morphology. This is set out in table 7-8. The dentition is characterised by a lack of complexity: such features as shovel-shaped incisors, and additional molar cusps, are hardly manifested. Of 12 individuals on whom the entire third molar complement could be assessed, five showed absence of at least one tooth. The aplasia was particularly of the upper dentition: of 16 mandibles, three showed absence of at least one third molar, whereas of 12 maxillae, four showed at least one missing third molar.

c. Wear. Molnar's (1971) criteria were used. The progression of wear with age, deduced from individuals aged by other methods, was to grades 2-3 from 'teens through to mid-twenties, then grades 3-5 until about age 40, and grades 5-8 thereafter. In each age group wear was fairly evenly spread over the entire arch, but with accentuation on incisors and canines,

The people of Ban Na Di

and first molars. Only late in the fifth decade was any exposure of the pulp cavity evident.

Eleven of the 12 males between ages 19 and 45 years showed an unusual wear feature, predominantly of the upper left central incisor, and consisting of a shallow V-shaped groove on the occlusal surface, extending from labial to lingual edge (fig 7-6). Usually a complementary but lesser groove showed on the opposing lower incisor, and adjacent front teeth, upper and lower, sometimes showed similar but lesser grooving. A very early stage of this groove formation was apparent in a 14-year boy. In one individual aged 30-34 years, the feature extended onto most of the labial surface of the incisor with extensive exposure of dentine, and another man in the same age group showed an early stage of such labial wear. No female showed this feature.

TABLE 7-6

Ban Na Di: the mean dimensions of male teeth (mm)

Maxillary				n	mesiodistal S.D.	buccolingual S.D.
I1	8	8.40	.34		7.27	.48
I2	7	7.08	.40		6.80	.09
C	8	7.68	.30		8.37	.46
P1	8	7.12	.22		10.01	.43
P2	8	6.92	.47		10.03	.71
M1	10	10.46	.52		11.09	.57
M2	9	9.90	.61		11.61	.48
M3	6	9.18	1.05		11.50	.93
Mandibular				n	mesiodistal S.D.	buccolingual S.D.
I1	5	5.04	.24		5.86	.58
I2	6	5.83	.38		5.96	.50
C	6	6.80	.38		7.61	.74
P1	6	6.70	.41		8.05	.41
P2	8	7.17	.49		8.62	.32
M1	10	11.30	.47		11.12	.27
M2	10	10.85	.67		10.76	.49
M3	9	11.31	.79		10.85	.64

TABLE 7-7

Ban Na Di: the mean dimensions of female teeth (mm)

Maxillary n mesiodistal S.D. buccolingual S.D.

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I1	1	7.30	-	7.10	.09
I2	3	8.43	.75	8.30	.48
C	2	7.40	.80	8.15	.25
P1	3	8.73	.12	9.23	.60
P2	3	8.60	.18	9.03	.61
M1	3	10.30	.35	10.98	.26
M2	4	9.25	.73	10.50	.67
M3	1	9.0	-	10.30	-

Mandibular n mesiodistal S.D. buccolingual S.D.

I1	3	5.20	.29	5.46	.20
I2	3	5.73	.46	5.86	.49
C	4	6.32	.31	6.97	.39
P1	5	7.08	.78	7.70	.91
P2	6	7.31	.54	8.48	.41
M1	5	10.68	.26	10.82	.55
M2	6	10.38	.67	10.18	.50
M3	4	10.57	.35	10.30	.29

d. Pathology

(i) hypoplastic enamel. From mortuary phase 1, gross enamel defects were seen in the teeth of two children dying at about 3 years, these defects being formed either late in fetal development or in the first year of life. A nine year old showed a suggestion of minor hypoplasia, and one man showed transverse lines, formed during early childhood. One of the jar burials from mortuary phase 2, aged 18 months, showed hypoplasia, formed at about six months in utero.

(ii) Salivary calculus and alveolar erosion were found to a slight degree in most younger adults, with some progression in severity through to the sixth decade. However the pathology was never sufficient to endanger the stability of the teeth.

(iii) caries. Three mortuary phase 1 men showed this pathology. One in his late twenties showed advanced caries of the lower right third molar, and minor caries of the related first molar: in both teeth the pathology was of the occlusal surface. One in his early thirties showed caries of the occlusal surface of the left lower third molar, while a third man showed extensive caries of a left upper second molar. An 18 year old female from mortuary phase 3 showed early caries in a deep buccal pit on the lower right second molar.

(iv) Two individuals in the 45-49 group, a male and a female, and an individual of undetermined sex aged 50+, showed periapical abscess cavities consequent on exposure of the pulp cavity from wear.

DISCUSSION

A. HEALTH

The various findings relevant to the state of health of the group are discussed, and a general assessment is then made.

1. Life span

The life expectancy at birth of 22.8 years is quite good by the standards of tribal society, recent or prehistoric, where values as low as 20 years are recorded (Weiss 1973). For the adjacent sites of Ban Chiang and Non Nok Tha, Pietrusewsky (1982, 1974) calculated life expectancies at birth of 26.1 years and 25.2 years respectively. Figure 7-5 compares the survivorship curves for these Thai populations and two other prehistoric groups. The Namu group is from Taumako, an outlier of the Solomon Islands, having cultural, linguistic and biological affinities with Polynesia, and dated to AD 1200-1500 (Houghton, in press). The Libben group is Amerindian and dates to AD 800-1100 (Lovejoy *et al.* 1977). The graph suggests a rather higher mortality at Ban Na Di until early adult life, when compared to the other Thai groups, but the curves closely match in later adult life. By contrast, the mortality at the Libben site, where the analyses indicate a diet rich in animal protein but rather sparse in vegetable foods, was consistently higher, with a life expectancy at birth of 20 years. As a further contrast, the Namu group, in a favourable tropical coastal environment with good marine food resources, had a life expectancy at birth of 24.5 years, and showed significantly lower mortality until early adult life, when a sudden increase occurred. This can be related to the occurrence of yaws in this group, at least 50% of the adults having the tertiary (bone involvement) stage of the disease.

As demographic calculations from skeletal data tend to strain the inherent methodological assumptions, and different workers place varying emphasis on the different sexing and ageing criteria, it is gratifying to find results that appear reasonably to mirror the data on diet and environment. As there is some evidence (see below) that the Ban Na Di environment was rather more favourable than that of the other two Thai sites, the differences in life expectancy at birth may perhaps be ascribed to slightly differing ageing criteria of different workers.

2. Skeletal indicators of health and nutrition

Both male and female stature for the Ban Na Di population fall into the tall range for *Homo sapiens* as defined by Wells (1963), and exceed values for other prehistoric Thai groups (table 7-9).

Data for second metacarpal cortical thickness are limited for Ban Na Di, and no other Thai values are available, but comparative data are set out in table 7-11. The Ban Na Di values clearly fall within the range of modern well-nourished groups. The few individuals on whom lines of arrested growth can be assessed, limit the validity of comparison, but other data are 2.6 for Anglo-Saxon (Wells 1967), 5.72 for Maori (Simpson 1979) and 8.01 for Amerindian (McHenry 1968). Thus the Ban Na Di mean of 4.3 seems low in the range for material from prehistory.

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These skeletal indicators of well-formed, robust bone structure, with a modest incidence of lines of arrested growth, suggest a good diet throughout life, without recurrent episodes of seasonal malnutrition or endemic illness. One 17-year female showed pelvic evidence of past pregnancy, implying menarche as early as 15 years, again suggesting good nutrition with associated early fertility (Short 1978).

3. Specific pathology

No pathology was endemic, beyond the usual evidence that the lumbar spine of *Homo sapiens* bears the brunt of the upright posture.

4. Dental indicators of state of health.

There have been few studies of the incidence of enamel hypoplasia in discrete populations, recent or from prehistory, and criteria and classification vary, so only general comment is possible. The incidence of hypoplasia in the Ban Na Di people seems low, involving four individuals from mortuary phase 1, only one being adult. By contrast, Goodman *et al.* (1980) found a mean incidence of about 1.2 growth disruptions in the 122 adults of their Amerindian series, with some 80% of the adults showing hypoplastic change.

5. General assessment

These indicators of the state of health of the group all suggest that the environment at Ban Na Di over this period of prehistory was favourable, that the diet was generally good, and that there were no significant endemic diseases. The absence of certain bone pathology is of interest: this group did not show either porotic hyperostosis or cribra orbitalia, features indicative of some form of anaemia. Three other prehistoric Thai sites, Ban Kao, Ban Chiang, and Non Nok Tha, all show a moderate incidence of the condition (Sangvichien *et al.* 1969, Pietrusewsky 1974, 1982). In this region the basis of this pathology has been ascribed to the existence of haemoglobin polymorphisms, particularly thalassaemia and haemoglobin E, which in the heterozygote offer some resistance to malaria (Mourant 1982, Weatherall and Clegg 1981). The disease is endemic in the region now, and there is no evidence of environmental change since prehistory to suggest it was not then present. However, in view of the proximity and similar environments of Ban Chiang, Non Nok Tha and Ban Na Di, the absence of such bone pathology from the latter group is surprising, and suggests that iron deficiency anaemia – that is, a dietary deficiency – may be the basis of the changes.

B. EVIDENCE BEARING ON SOCIAL AND CULTURAL FEATURES OF PREHISTORIC BAN NA DI

Several lines of evidence suggest the sexes had equal standing in the society that existed at Ban Na Di. These include the fairly even male/female ratio with an equitable distribution of grave goods, and the biological evidence of a relatively thicker bone structure and a higher average age at death for the mature females.

The pattern and rate of tooth wear suggests a mildly abrasive diet with a balance between plant and animal components. While some staining of the roots suggests chewing of betel by at least one individual, salivary calculus and alveolar erosion are never gross, and it seems unlikely that the habit was much indulged in.

The grooves on the incisor teeth of men suggest an industrial use such as the working of fibre that was carried out only by this sex. Of interest is the fact that similar grooves appear to be present on the individuals from Ban Kao (Sangvichien *et al.* 1969), Phong Tuk (Quaritch-Wales 1937) and Non Nok Tha (Pietrusewsky 1974), but the latter study at least found the grooves only in females, and an even distribution between the upper central incisors. Outside Thailand, no similar feature seems to be described, and most studies report predominantly interproximal grooving (Schultz 1977).

The general lack of pronounced squatting facets indicates that this posture was not emphasised in this society.

C. BIOLOGICAL RELATIONSHIPS

On the limited material, there is no evidence to suggest alteration in the phenotype, or the gene pool, during mortuary phase 1. Comment on the extremely limited comparison possible between mortuary phase 1 and mortuary phase 3 - the latter, for this purpose, being limited to a fragment of mandible and three teeth - must be most tentative: but the small molars set in a thick mandibular body do differ from the general morphology of this region in the mortuary phase 1 individuals. That is, as there is evidence of cultural change between these periods, there is slight evidence of biological change. This impression was tested by a discriminant analysis of data from the three lower molars on one side, and the thickness of the mandibular body in this region. The analysis confirmed the subjective impression in clearly separating the mortuary phase 3 individual from the six comparable females from mortuary phase 1.

The other purpose of this section is to assess whether the peoples of the prehistoric sites of the Khorat Plateau, Ban Na Di, Non Nok Tha, and Ban Chiang, with fairly close geographical and temporal provenance, and of the more distant Ban Kao, shared a common gene pool - that is, whether they represent the same group of *Homo sapiens*. The usual current approach to the assessment of biological relationships between skeletal series is to subject large amounts of metric data, particularly cranial, to multivariate discriminant analyses such as Mahalanobis D^2 to obtain biological distances expressed in figures. The value of such studies as usually carried out is questionable. It is not necessary to argue that the numerical results create a spurious sense of certainty, because they usually make very little sense. The objection is that the complex biological structure of the head, functionally involved with the body, and influenced by environment, is usually measured without regard to its biology. That is, measurements are generally used without defining their biological significance, the possible influence of differing environment, or even whether they simply overlap other measurements. Only after such biological consideration should multivariate techniques judiciously be used (Houghton and Kean 1984). Similarly, the use of non-metric data from groups separated by hundreds or thousands of kilometres, and as many

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years, does not yet rest on sound biological theory. When these problems are added to that of scanty and incomplete data, sweeping statistical comparisons seem rarely justified.

In this section therefore, assessment of biological relationships is limited to some simple comparisons and limited multivariate studies of material from provenanced prehistoric Thai sites.

1. Stature and body proportions

None of the stature differences between the Ban Na Di, Ban Chiang, and Non Nok Tha, achieve statistical significance, and in the event may relate to the environment, the taller people of Ban Na Di lacking the evidence of spongy hyperostosis evident at the other sites (table 7-9). The body proportions of the Ban Na Di people are almost the same as those of Non Nok Tha. Thus, there is no evidence of difference in overall body form between the sites.

2. Dentition

The view that size and shape of teeth are under tight genetic control and that "of all the aspects of observable adult morphology, teeth are least subject to environmental modification of genetic intent" (Brace 1980) does not stand up to scrutiny (eg Townsend and Brown 1978, Harris and Bailit 1980, Houghton and Kean 1984). Nevertheless, dental data, circumspectly used, may contribute to the assessment of biological relationships, particularly between groups contiguous in time and space.

Unfortunately, such data for prehistoric Thai groups are limited. Comparative morphological data for Ban Na Di and Non Nok Tha are set out in table 7-8. Only the difference in cusp pattern of the lower molars differs markedly, and this is so striking in comparison with the similarities that it must be suspected that for these features, differing criteria have been used in the two studies.

Comparative metric data are also limited. Those presented by Brace (1978) for Non Nok Tha, and additional data from Ban Chiang (Pietrusewsky n.d.) unfortunately involve unknown or unstated proportions of male and female. With this caution, it can be said that there are no significant differences between the dimensions of individual teeth, or the overall proportions of the components of the dental arcade, for these three prehistoric Thai groups. Furthermore, the teeth are generally in the smaller size range for *Homo sapiens*.

3. Skulls

The Ban Na Di crania, particularly the faces, are generally fragmented or missing, and no sensible comparison with other groups is possible. However from mortuary phase 1, eight male and six female mandibles are suitable for analysis and comparison. The form of the mandible must be a reflection of the cranial template with which it functioned, and from the mandible alone, significant understanding of the overall headform of an individual may be gained.

The basic data are presented in table 7-10. A general comparison of these data with that from other groups of *Homo sapiens* (eg Hrdlicka 1940, Morant 1937) indicates that the people of Ban Na Di (and these general comments apply also to the material from Non Nok Tha and Ban Kao) had large, robust mandibles. The large bicondylar and bigonal dimensions indicate a broad cranial base, and the considerable ramal and

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condylar breadths indicate a well developed masticatory musculature. The mandibular angle is small and the ramal height large, which is in harmony with the data on stature and bone robusticity; these tall, robust individuals would have had considerable vertical development of the upper face to accomodate a large airway, and the mandibular data reflect the related adaptive change of the mandible. Univariate tests of significance show no difference between the mandibular data from the sites of Ban Na Di, Non Nok Tha and Ban Kao.

The mandibular data from these three sites were also examined by canonical discriminant analysis. No separation of the groups was achieved, and the conclusion is that for these sites, over the period involved, the people were of similar genetic stock.

TABLE 7-8

Comparative tooth morphology (as %) for Ban Na Di and Non Nok Tha. Data for Non Nok Tha from Pietrusewsky (1974)

Feature	Ban Na Di	Non Nok Tha
shovel-shaped incisors		
slight	42	17
mod	0	3
carabelli (bilat)	0	7
lower molar		
M1 Y5	71	0
Y4	9	0
X5	20	0
+5	0	20
+4	0	80
M2 Y4	30	0
+4	30	89
+5	20	31
X4	7	0
X5	0	0
protostylid	0	0

TABLE 7-9

Mean stature (mm) of men and women from several prehistoric Thai sites. Data for Non Nok Tha and Ban Chiang are from Pietrusewsky (1974, 1981) and Ban Kao data are from Sangvichien *et al.* (1969).

The people of Ban Na Di

Group	mean	s.d.	n	range
Ban Na Di				
male	1737	57.05	15	1640-1830
female	1613	55.82	11	1520-1720
Ban Chiang				
male	1700	38.65	24	1650-1750
female	1594	59.53	21	1500-1570
Non Nok Tha				
male	1717	43.63	10	1630-1860
female	1578	45.98	18	1404-1700
Ban Kao				
male	1685	59.00	8	1600-1760
female	1566	64.00	5	1460-1610

TABLE 7-10

Mean mandibular dimensions for three prehistoric Thai groups. Linear dimensions are in mm. Non Nok Tha data from Pietrusewsky (1974), Ban Kao data from Sangvichien (1969).

		Ban Na Di		Non Nok Tha		Ban Kao	
		male	female	male	female	male	female
BIC	mean	124	117	127	118	129	122
	n	8	6	3	7	7	5
	SD	7.17	7.13	7.6	8.4	8.2	8.0
BIG	mean	103	95	108	95	107	98
	n	8	6	6	7	8	5
	SD	6.52	4.38	5.1	9.3	9.8	6.6
CB	mean	22.4	20.4				
	SD	1.92	2.15				
RB	mean	33.8	32.2	35.0	33.0	35.0	34.0
	n	8	6	8	9	9	7
	SD	2.32	2.79	2.8	1.5	2.4	28.8
RH	mean	59.4	53.2	66.0	57.0	60.0	60.0
	n	8	6	8	9	8	6
	SD	7.69	7.91	2.0	4.6	4.8	5.7

The people of Ban Na Di

SH	mean	34.5	30.5	36.0	32.0	31.5	31.0
	n	8	8	7	9	8	6
	SD	2.07	7.91	2.9	2.2	4.3	4.1
L	mean	104.0	101.0	113.0	105.0		
	n	8	6	3	7		
	SD	4.49	2.43	6.1	3.3		
ANGLE	mean	118	125			120.0	121.0
	n	8	8			8	4
	SD	4.63	6.02			3.8	4.5

BIC: bicondylar breadth BIG: bigonial breadth CB: condylar br.
 RB: ramus min. br. RH: ramus height SH: symphyseal height
 L: overall mandibular length ANGLE: mandibular angle

TABLE 7-11

Cortical thickness of the 2nd metacarpal and Nordin's score
 for the males of several groups

Group	n	era	cortical thickness (mm)	Nordin's score
Ban Na Di	6	1000-300 BC	5.5	62.4
Maori	27	800-1800 AD	4.8	52.9
Taunako	31	1200-1500 AD	5.1	57.0
White American		modern	5.8	62.5
Norwegian		modern	5.6	57.8

The age at death of the people of Ban Na Di

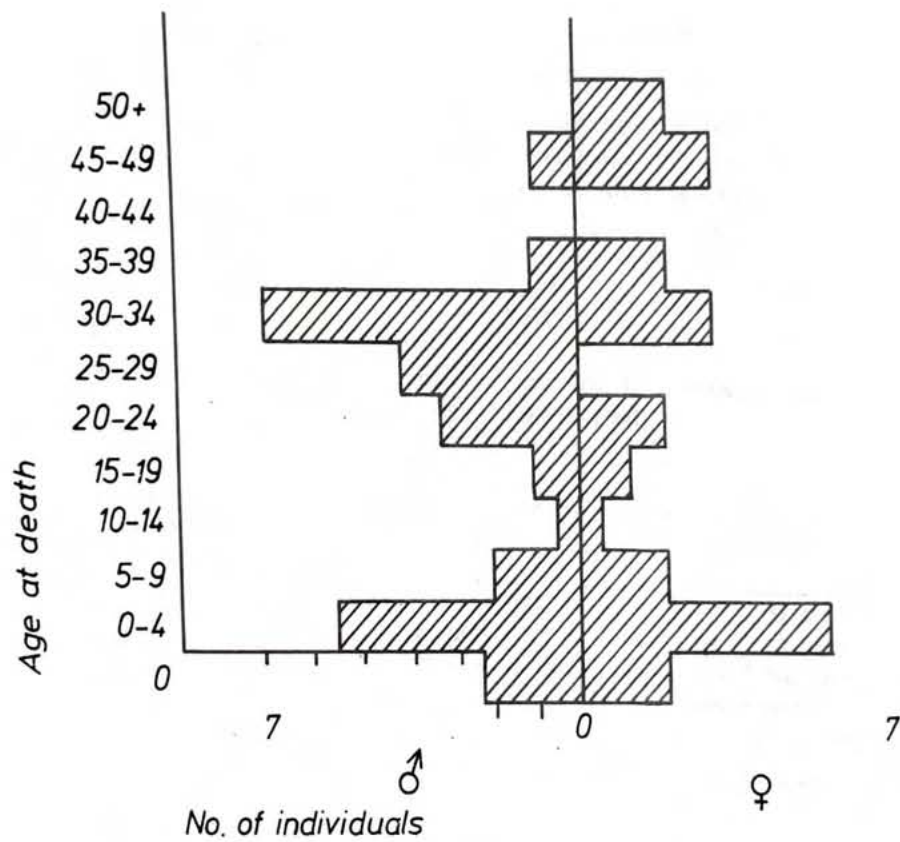


FIGURE 7-1

Graph showing the age at death of the people of Ban Na Di

The age at death of the people of Ban Na Di



FIGURE 7-2

Ban Na Di: survivorship curve for mortuary phase 1

The age at death of the people of Ban Na Di

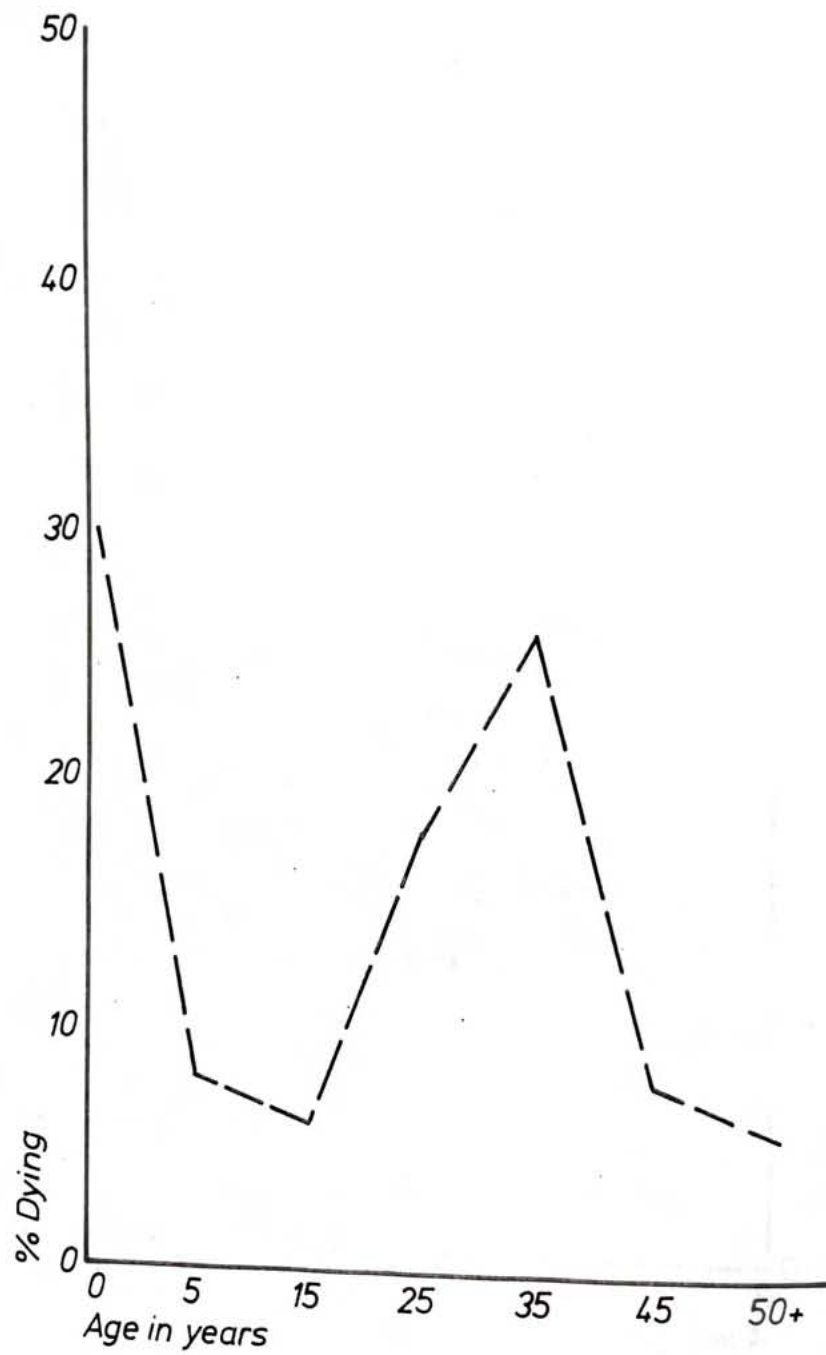


FIGURE 7-3

Ban Na Di: mortality curve for mortuary phase 1

The age at death of the people of Ban Na Di

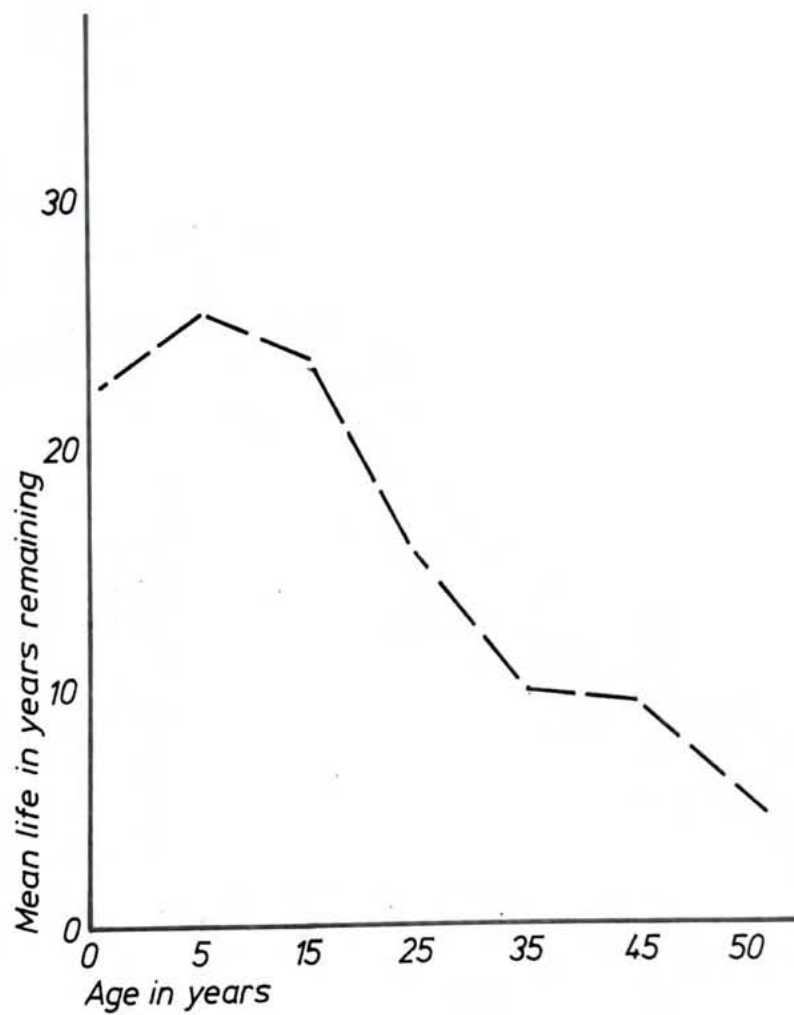


FIGURE 7-4

Ban Na Di: life expectancy curve for mortuary phase 1

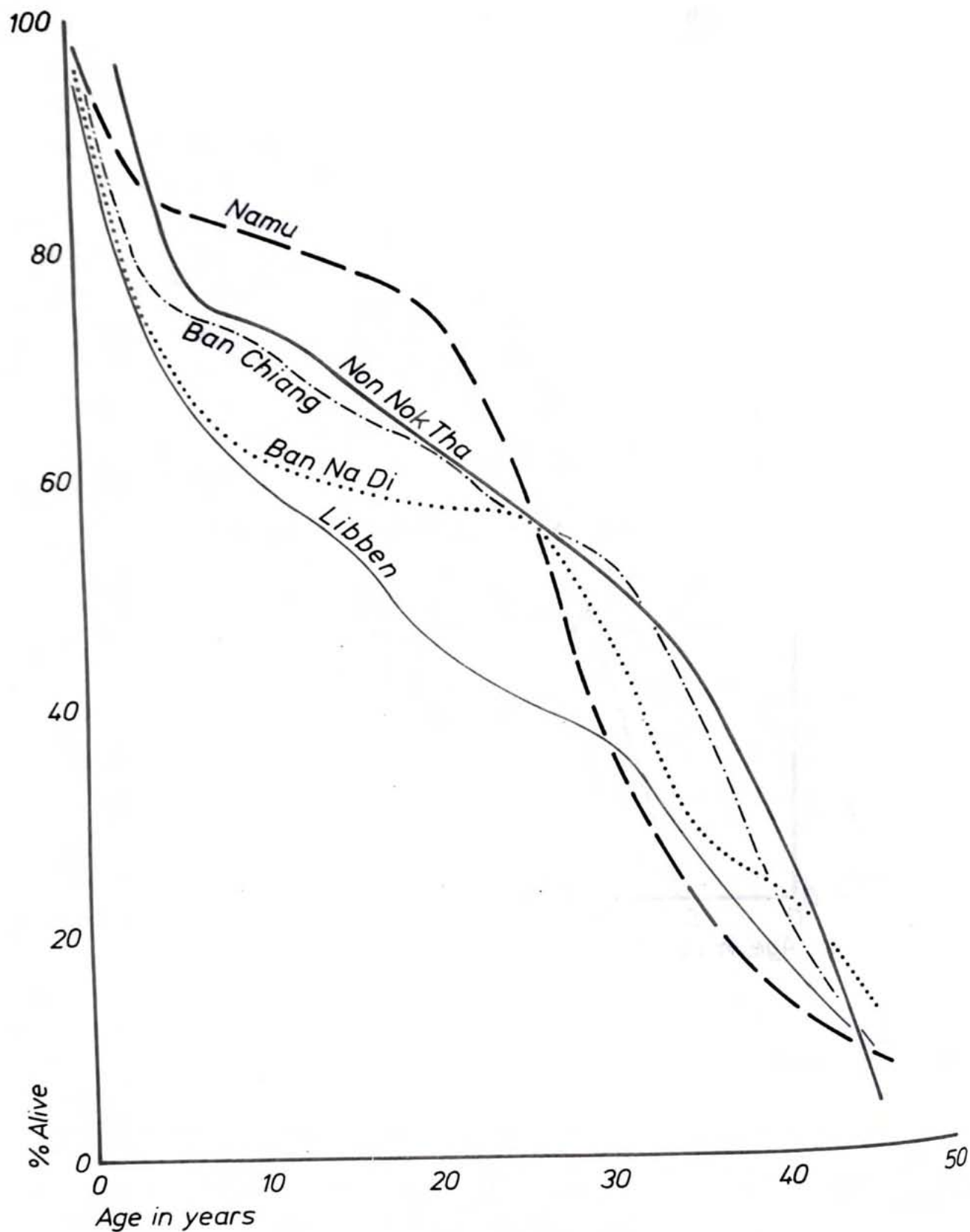


FIGURE 7-5

Survivorship curves for Ban Na Di and comparative samples
(see text for explanation)

photographs of human remains from Ban Na Di



FIGURE 7-6 Burial 23, mortuary phase 1b. Anterior view of female aged 30 to 34 years.



FIGURE 7-7 Burial 7, mortuary phase 2. Fetus, aged *c.* 7 months *in utero*

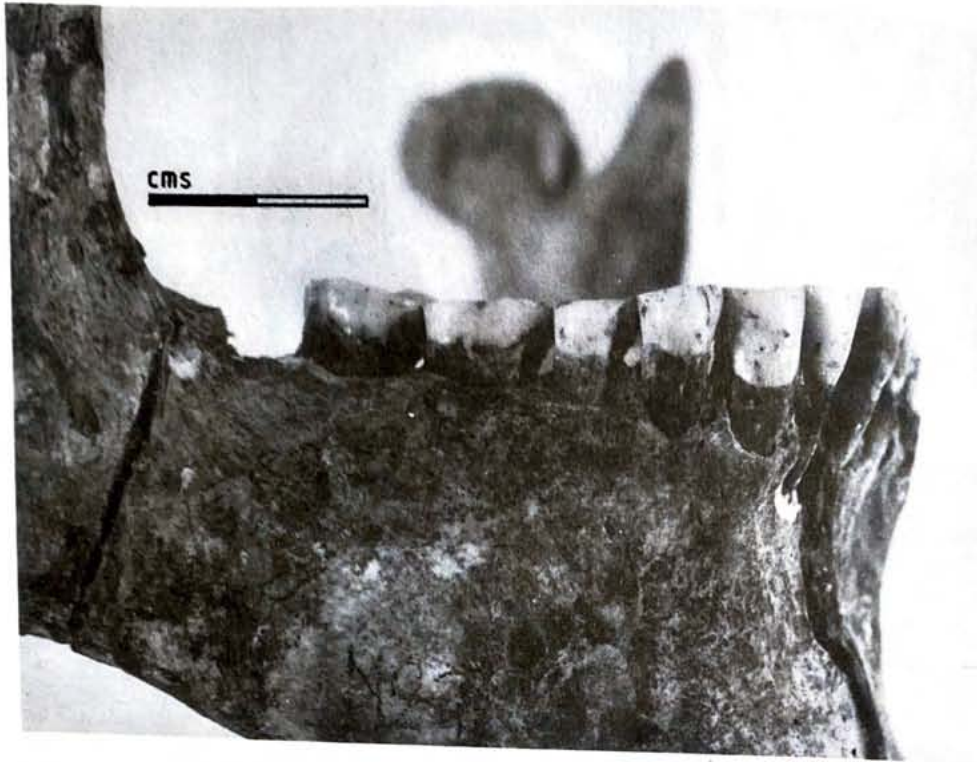


FIGURE 7-8 Burial TS8a, mortuary phase 1c. Male mandible of male aged 25 to 29 years at death showing alveolar erosion

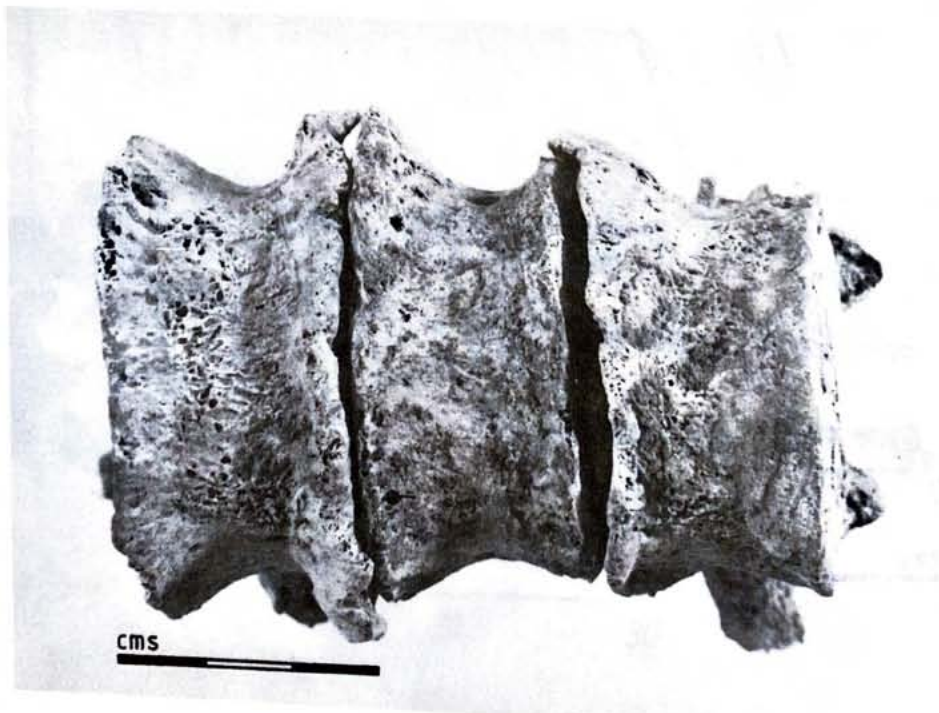


FIGURE 7-9 Burial TS17, mortuary phase 1b. Male aged 45 to 49 years showing degenerative change of grade 2+ at the lumbar spine

CHAPTER EIGHT

THE MORTUARY RITUAL AND ITS IMPLICATIONS

The analysis of the mortuary remains from Ban Na Di is undertaken in the light of the clear potential of burials as a source of social information. Such an approach originates in the exploratory papers of Binford (1971) and Saxe (1971). Both proposed regularities between mortuary ritual and social organisation, and these have much potential for the prehistorian. Their conclusions have stimulated many subsequent workers and the literature is now considerable. At its most basic level the burial behaviour, from the preparation of the corpse, placement in a receptacle, fulfilment of due rites and giving of grave goods, is a social act which varies with the nature and structure of the society in question.

This proposition is important and requires some elaboration. To the basic variables of age and sex, should be added the dead person's rank or distinctiveness in his or her society, and affiliations within the social network. When he compared the burial rituals of hunter-gatherers, pastoralists, shifting agriculturalists and settled agriculturalists, Binford found that those for the settled agriculturalists were the most complex. Thus, whereas hunter gatherers distinguished between the age, sex and personal qualities of the deceased, more complex sedentary societies recognised their social status by conferring more elaborate ritual on the higher ranked individuals. These rites, often expressed in terms of artefacts symbolising status, tended to cross-cut age and sex boundaries.

There are many variables which may be considered for a given society. Binford recognised the treatment of the body, the facility within which it was placed and the variation and quantity of accompanying grave goods. These incorporate the location of the interment relative to others and to other social activities. Many societies for example, retain a place set apart for the burial of a particular class of individual.

Aspects of this study have been expanded by more recent analyses, both by consideration of further ethnographic situations and specific prehistoric samples. These have elaborated rather than seriously modified Binford's initial propositions and many have a direct bearing on the approach adopted in analysing the burials from Ban Na Di. Two specific ethnographic examples are of particular interest, because they come from societies which cultivate rice. In the first, Bloch (1975) contrasted the mortuary rites of two Malagasy societies. The Zafimaniry practice forest swiddening, have no land-holding descent groups, and no formal disposal areas for the dead. The Merina on the other hand, cultivate rice in permanent fields using irrigation techniques. The scarcity of suitable land has stimulated investment of labour in the construction of terraces. The society is structured along the lines of land-holding descent groups, members of which are interred in monumental, collective tombs. Bloch interprets the latter as symbolising their relationship with the land they own and which has sustained them through the generations. Saxe and Gall (1977) have noted a similar distinction, but this time involving diachronic changes in the economy, land tenure, social organisation and burial

procedures among the Temuan of Malaysia. The introduction there of wet rice cultivation in suitable areas and land shortage reflecting population expansion has occurred at the same time as the establishment of permanent cemeteries for members of proto-lineages which now own scarce land under wet rice cultivation.

But are such patterns restricted to agricultural societies? King (1978) has warned against relegating all hunter-gatherer societies to the status of simple, egalitarian social structure. Thus the virtually complete excavation of the Medea Creek cemetery yielded approximately 450 protohistoric Chumash burials set out in distinct "lobes". The western lobe was distinguished by assemblages of non-utilitarian "wealthy" objects associated with adults and children. Other concentrations evidenced achieved status, but neither ascribed nor hereditary rank. This situation contrasted with the earlier Rincom cemetery seen by King as essentially egalitarian in burial procedures. The temporal change to formal ranking was thought by King to reflect the emergence of vested control over redistribution within an ecologically variable region.

Chapman (1981) on the other hand, has emphasised the importance in European hunter-gatherer societies of preferred or restricted resources. The localised Mesolithic cemeteries on the coasts of Brittany and Denmark may be explained if we accept that these semi or completely sedentary societies had inherited access to specific, limited coastal resources. These findings all reveal the importance of recognising circumscribed cemeteries. Clearly, the demographic features of the sample of burials, their mode of interment and quality and quantity of grave goods are also of vital importance.

Peebles and Kus's (1977) consideration of ranked societies is relevant to this discussion, for they number the characteristics of burial as one of five features by which it is possible to recognise ranked social systems in prehistory. They stress that there must be clear evidence for the presence of two distinct social groups distinguished by a combination of different symbols, expenditure of energy and rituals which cut across divisions of age and sex. They argue cogently that the presence of richly furnished children's graves alone is not enough to conclude that ranking is present. It is rather the separate treatment of a superordinate group of persons contrasted with a less well endowed subordinate group which is critical. Brown (1981) has further suggested that it is not only relative wealth which is at issue, but also rights to special burial locations. This finding is clearly seen in the Moundville site, where Peebles (1971) has shown that the few top echelon members of the Mississippian social system were buried with rich goods in the largest, central mound. The many lower order graves were found in remoter cemeteries with few, if any, accompanying artefacts.

Given this preliminary statement on the proposed adhesions between mortuary rites and the structure of society, there are clearly several variables in the Ban Na Di excavated remains which require scrutiny. These are, in order of analysis:

1. Is there evidence for restricted burial locations.
2. To what extent are certain burials distinguished by higher levels of energy expenditure than others.

3. What is the composition of the sample and its subsets in terms of age and sex.

Examination of these three variables are a preliminary to an assessment of the social characteristics of the Ban Na Di population.

The excavations at Ban Na Di were undertaken in two places towards the centre of the mound, the areas being approximately 25 m apart. This procedure reflects nothing more than the location of areas within the present village available for excavation. As may be seen in fig 2-2, two houses lie between squares A1-4 and F5-6, one occupied by the present headman and his family. Adjacent areas are now village roads or have been looted.

As excavations proceeded, it became increasingly clear that the burials in square F6 were interred over each other, successive burials in effect being placed in the same grave, and accorded the same burial rite as their predecessors. This procedure is clearly apparent by an inspection of figs 8-1 to 13. Only one quarter of the excavated area in square F6 contains inhumation graves. That area has yielded 37 burials.

The same situation obtains for squares A3-4. Bodies were once again interred over preceding ones. In one case, two adults were buried simultaneously in the same grave. There can be no doubt that the prehistoric inhabitants of Ban Na Di knew precisely where their ancestors were buried and returned continually to the same place when the need arose to undertake a fresh interment. It is less clear whether we are dealing with one large cemetery area, or two different ones. Excavation under the present headman's house would resolve this question, but for the moment, it will be assumed that there are two distinct areas designated for burials. This will permit comparison.

During the initial stage of analysis the burials from Ban Na Di were divided into five phases, depending on the level from which each was cut. There are no burials which clearly belong to the initial occupation phase. Mortuary phase 1a-c burials were so designated because they were cut from lower level 7, upper level 7 and lower level 8 respectively. The distinction between levels 7 and 8 is the presence only in the former of sand lenses laid down by floodwater. This distinction may well have little if any cultural significance. Consequently, each cluster of burials in A3/4 and F6 were treated as specific units and are described in detail below, commencing with the earliest. There are strong stratigraphic grounds for assigning the accumulation of each group to the same period of time. There are three children's burials in square A1 which are not included in the square A3/4 group because they are somewhat far removed from it.

There are two further burial groups. The first (mortuary phase 2) comprises five infant burials interred in lidded burial jars. These were cut from level 4 and belong to the early - mid 1st millennium AD. All were found within an area of 10 m². The last (mortuary phase 3) incorporates three incomplete and late prehistoric adult inhumations.

The second issue concerns the presence or absence of differences of ritual, expenditure of energy or demographic structure when the two principal burial groups are compared. It is considered necessary, as a prelude to addressing this question, to describe each group in some detail.

Ban Na Di: the mortuary ritual

MORTUARY PHASE ONE

GROUP A

Group A derives from squares F5 and F6. Burial 47 is the earliest in this group, and one of the earliest found at Ban Na Di (figs 8-14 to 17). It is an adult male, aged between 30 and 34 years at death. The grave is cut at least 20 cm into the natural soil, and the corpse was laid out on its back, with the hands parallel with the body. A single form 1A vessel was placed beside the head. This pot contained some fragments of fish bone and shell, and a small piece of bronze. A stone bracelet was worn on the right wrist. It had been broken in antiquity and repaired with bronze wire. At least 12 clay figurines were placed near the body. Eight were modelled in the shape of cattle, and located at the neck, left shoulder, right and left forearms, stomach and groin area and by the left shin. A deer figurine was placed between the knees, that of an elephant on the upper left arm and figurines of two hominoids near the left and right forearms. The body was interred wearing a necklace of 15 circular shell beads with a large stone bead. A block of laterite was found beside the right ankle. Unfortunately, the edge of the excavated area coincided with the top of the cranium. More funerary offerings probably lie beyond the skull.

Burials 40, 45 and 46

(figs 8-18 to 8-20)

All three burials lie in the same grave, which is adjacent to and parallel with grave 47. Burial 40 comprises the skull, tibiae, humerus, femur, ulna, vertebrae, scapula, and pelvis of a 50 year old female. They were found in a disarticulated group in association with three bovid figurines and a fragmentary vessel of form 1A. The same grave includes the remains of an infant about 6 months old at death (burial 45). This skeleton, though fragmentary, was found essentially in articulation. Six cattle figurines were located round the body. A stone bracelet was placed on the right hand side and a necklace of 215 shell-disc beads with five large shell beads were found in the neck area. The bracelet, like that in adjacent burial 47, had been repaired in antiquity with bronze wire. Burial 46 is located about 40 cm beyond the cranium of burial 45. Only the ribs and vertebrae were found. These come from a child aged about 9 years of age at death. Two disarticulated bovid figurines were found beside the human remains, and part of a vessel (form 3) was found over the human bones. Finally 790 shell-disc and 2 large beads were located in association.

It seems probable that the primary interment in this multiple grave was the adult female (burial 40). The bones were clearly in disarticulation as if to make way for the interment of the infant (burial no 45). The latter was, in fact, the lowest found in this square. The chronological relationship between burials 40 and 46 is unclear, although the reasoning above suggests that burial 45 is the latest of the three. Given this interpretation, the relationship of the bovid figurines and the stone bracelet with the children's remains is equivocal. It is not impossible that

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these artefacts were relocated when the adult female remains were disturbed. Whichever is the case, the grave was clearly of adult size and contains eleven figurines.

Burials 37, 39 and 42

(figs 8-21 to 8-23)

Only burial 42 in this grave was found in articulation, and the upper part of the body was not located within the excavated area (fig 8-23).

The lower limbs however, lay directly over part of burial 47, and 30 cm above it. A pot of form 1B was found over the left foot and the complete fore limb of a cow had been placed alongside the left leg. The large "crocodile skull" artefact illustrated in fig 8-24e was found by the left wrist in the south section. The artefact has teeth cut into one side, resembling those of a saw, and a hole, perhaps for suspension, on the opposite end. The human remains come from a 30-34 year old male.

This grave also contained the partial and disarticulated remains of two males aged between 20 and 30 years at death. All the bones from these burials overlie burial 42 (fig 8-21). It is possible that they were disturbed when burial 42 was interred and replaced immediately over it. The fact that the bones of burials 37 and 39 were found in direct contact with those of burial 42, with no intervening soil, argues against the notion that they were later, secondary burials.

Burial 38

(figs 8-25 and 8-26)

This lies directly over burials 40, 45, and 46, with only 2 cm between it and burial 40. It had been disturbed in antiquity, but the right hand leg and trunk were found *in situ*. The remains come from a child aged about 7 years at death. Two pots of form 1B were placed over the abdomen. Their contents remained intact and were investigated. One contained a few scraps of animal bone, and fragments of shell. The other revealed two shell disc beads, shell fragments and small fragments of fish bone. A bronze bracelet bearing a knobbed decoration all round the exterior was found on the child's left wrist. Two bovid figurines were found. One was placed adjacent to the left elbow and the other over the stomach. A bovid scapula and humerus were found on the right hand side of the skeleton. While the human bones were being removed, one complete and part of a second marine shell bracelet were recovered. 219 shell beads and one large shell bead were found in the vicinity of the child's neck.

Burial 41

(fig 8-27)

Burial 41 comprises the remains of an infant aged approximately 6-9 months at death. It is located between the graves for burials 38 and 38 (figs 8-8 and 8-9). It was disturbed and disarticulated, quite possibly with

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TABLE 8-1

Burial statistics and contents of Ban Na Di mortuary phase 1 burials
(abbreviations: C = complete, P = partial, D = disturbed,
a = adult, f = fetus, m = months of age, N = north, S = south)

MORTUARY PHASE 1A BURIALS															
	28	33	22	26	47	34	46	44	40	45	41	43	19	21	22
Burial No.	28	33	22	26	47	34	46	44	40	45	41	43	19	21	22
Area A/B	A	A	A	A	B	A	B	B	B	B	B	A	B	B	B
Sex	F	-	M	F	M	-	-	-	F	-	-	-	-	M	-
Age	47	14	32	50	32	8m	9	f	50	6m	f	f	23	20	7
Orientation	N	S	S	N	S	-	-	-	-	S	-	-	S	S	-
Amount present	C	C	C	C	C	D	D	D	D	D	D	D	P	P	D
Pot form 1a	-	-	1	2	1	1	-	-	1	-	-	-	-	1	-
Pot form 3	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
Pot form 14a	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
Stone bracelet	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-
Large shell bead	-	-	-	-	-	-	2	4	-	5	-	-	-	-	-
Cattle figurine	-	-	-	-	8	-	2	-	3	6	-	-	2	-	-
Deer figurine	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Human figurine	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Elephant figurine	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cattle forelimb	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Stone bead	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Shell-disc bead	-	-	-	242	15	-	790	165	-	215	-	-	7850	776	220

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TABLE 8-1 continued

MORTUARY PHASE 1B BURIALS																										
Burial No.	Area	25	23	14	15	36	38	12	19	30	49	13	42	24	37	39	21	50	15	20	16	17	TS	TS	TS	TS
Sex		A	A	A	A	B	B	A	B	A	A	A	B	B	B	B	B	B	A	A	B	B	B	B	B	B
Age		-	F	-	F	-	F	-	F	-	F	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
Orientation		1	32	3	2	32	7	17	5	1	37	27	32	1	27	22	a	-	22	a	22	47	-	-	-	
Amount present		-	N	N	S	N	S	S	S	-	N	S	S	S	-	-	S	-	-	W	-	-	-	-	S	
Pot form 1a		C	C	C	C	C	C	C	C	P	P	P	P	D	D	D	D	D	D	P	D	D	P	D	P	
Pot form 1b		-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 1c		-	-	2	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 2		-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 3		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 4		-	-	1	-	-	-	-	2	3	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
Pot form 5		-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 9		-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 12		-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 14a		-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 14b		-	-	1	1	-	-	-	1	1	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	
Pot form 15		-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pot form 16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Stone bracelet		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
Bronze bracelet		-	-	-	-	-	19	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
Shell-disc bead		-	-	-	-	-	127	219	-	-	5	-	-	-	-	-	-	-	-	-	24	-	-	-	6 400	
Large shell bead		-	-	-	-	-	14	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cowrie shell		-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Shell bracelet		-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cattle figurine		-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chicken skeleton		-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cattle forelimb		-	-	-	1	1	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	
Pig forelimb		-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crocodile skin shroud		-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bone tool		-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	

n.b.: Burials 37 & 39 should be combined as they were found in the same grave.

Ban Na Di: the mortuary ritual

TABLE 8-1 continued

Burial No.	PHASE 1C BURIALS																															
	29	18	20	9	48	32	17	16	27	31	35	10	11	5	6	7	8	9	10	11	12	13	14	3	TS	TS	TS	TS	TS	TS	TS	
Area	A	A	A	A	A	B	B	B	B	B	B	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Sex	-	F	F	-	F	M	M	M	F	M	M	F	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
Age	237>25	1	35	22	32	27	47	25	32	50	a	32	a	47	a	a	35	37	30	a	a	a	a	a	a	a	a	a	a	a	a	
Orientation	N	N	-	-	S	-	S	N	-	S	N	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amount present	C	C	D	D	P	D	P	D	D	P	C	C	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
pot form 1a	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 1b	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 1c	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 2	-	1	-	2	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 4	-	1	-	3	2	-	-	3	2	-	1	2	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 6	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 7	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 8	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 9	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 13	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 14b	1	1	-	-	1	-	-	1	-	1	-	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 14c	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 15	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pot form 17	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Stone bracelet	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bronze bracelet	-	1	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bronze anklet	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bronze coil	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Shell-disc bead	236	-	-	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Large shell bead	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Shell bracelet	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cattle figurine	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dog-tooth necklace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iron spear head	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iron bracelet	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iron coil	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iron ring	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iron knife	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

n.b.: Burials 10 & 11 were buried simultaneously.

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the excavation of the grave for burial 38 or 40. No material remains were found associated with it.

Burial 44

(fig 8-28)

This jar burial of a form 3 vessel consists of the fragmentary remains of a fetus aged about 5 months. The cranial bones were found associated with 165 small, circular shell beads and 4 large shell beads of probable marine origin.

Burial 36

(figs 8-29 and 8-30)

This is the only burial in square F6 with the head to the north. The grave cut is parallel with and at the same depth as that for burial 42. It does not overlie lower graves, but is 0.5 m below and partially sealed by burial 32.

The grave contains the articulating limb bones of a woman aged 30 to 34 years at death. The skull was found in a fragmentary condition. Two vessels of form 1A and B were associated, the former being placed beyond the head and the latter, between the knees. The former contained a few scraps of animal bone, a tiny fragment of bronze and some fragmentary fish bones. The latter contained the articulating fore limb of a young pig, together with a quantity of fragmentary fish bone. There were also some concentrations of ash, shell fragments and some shell disc beads. The rodent teeth probably represent post-interment scavenging. A form 14A vessel was found in the genital area. The right hand lay parallel with the body but the left hand was placed over the stomach. It bore nineteen bracelets to which fabric still adhered. One hundred and twenty-seven shell disc beads and 14 large shell beads were found in the neck region. Two whole vessels of forms 1A and 14A were found in the grave fill, c. 30 cm higher than the human remains. These were probably associated with another burial located outside the excavated area. Half a bracelet made of trochus shell was found while the burial was being exposed. It was probably associated with this particular interment. An entire bovid forelimb was found lying alongside the woman's left leg.

Burial 31

(figs 8-31 and 8-32)

Burial 31 was disturbed by the excavation of the grave for burial 35. Five broken vessels of forms 2, 14 and 4 (three specimens) were found lying round grave 35, and the disarticulated limb bones, presumably from the original interment in grave 31, were found overlying the remains of burial 35. These bones come from an adult male aged at least 25 at death.

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Burial 35

(figs 8-33 and 8-34)

Unfortunately, the cranium lies only partially in the excavated area, and grave goods may lie beyond it. The rest of the skeleton was recovered in articulation with the hands laid crossing each other over the hips. The bones come from a male aged 30-34 years at death. A bovid figurine was found at the right shoulder. There were two pots found in association, a form 5 placed over the feet and form 7 over the head. This burial underlies and is sealed by burial 27.

Burial 32

(figs 8-31, 35 and 36)

Burial 32 lies parallel with and at the same depth as burial 35. It too contains the remains of a male aged between 20-24 at death. Most, but not all the burial, lay within the excavated area. This individual wore 13 shell armlets, six on the left arm and seven on the other. These were cut from specimens of trochus, a marine gastropod (figs 3-3/4). Along the left side of the body lay two form 4 vessels. There are many further broken sherds associated with them, but it has not been possible to reconstruct complete vessel forms. A form 1C pot was found at the left shoulder and form 14B vessel beyond the left leg, and a small form 2, beyond the left ankle.

Burial 27

(fig 8-37)

The entire left hand side of this burial was removed in prehistory. It lies over burial 35 and under burial 17. The skeleton comes from a female aged 45-49 years at death. No grave goods were found definitely in association, though due to prehistoric disturbance, this does not mean that the grave was devoid of funerary offerings.

Burials 19, 21 and 24

(figs 8-22, 38, 39, 40 and 41)

Three interments were found in this grave, though successive grave cuts and disarticulation of the earlier burials indicate that the burials were not contemporaneous. The earliest was clearly no 21, of which only the lower limbs have survived, and these are only partially articulated. Sherds of a form 4 vessel and a pot belonging to an "Om Kaeo" vessel of form 6 were associated. The remains probably come from an adult male. Into this grave was placed the body of an infant so young that it was probably new-born (burial 24). No grave goods were associated with it. The third body in this grave comes from a child aged about 5 years at

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death (burial 19). The corpse was covered with the bony scutes of a crocodile, indicating a skin shroud. It was also associated with eight pottery vessels of forms 2, 14B, 9, 4 (3), 12 and 15. Several blocks of undressed laterite were found beyond the infant's feet.

It must be stressed that in a situation where a primary adult interment was disturbed by the later placement of children's remains, the degree of association between broken or even complete pots in any given burial is open to doubt.

Burial 16 and 17

(figs 8-42 to 8-44)

These two graves were the latest in the series, both having been cut through a series of sand lenses which sealed burials 19, 21 and 24. The grave cuts were clearly visible, and lay parallel with each other, with only 10-20 cm between them. Burial 16 contained the lower limb bones of an adult male, who died between 25-29 years. Just beyond the feet were placed a discrete heap of further human remains, which probably were disturbed and placed there when the adult male was interred. This assemblage included a fragment of stone bracelet, an iron spear and iron bracelet, and four iron rings large enough to be worn round the neck. The edge of the excavated area contained two bovid limb bones.

The adjacent grave (burial 17) contained the remains of five individuals, none being found in articulation. One individual was a 30-34 year old male. There were also two other adults, and the remains of a ten year old child and an infant aged between 8 and 9 months from conception. Two bronze ornaments were found, probably being either bracelets or anklets, and a large shell bead. Two iron artefacts were found in the grave: a coiled ring and a tanged knife.

GROUP B BURIALS

This group of burials concentrated in squares A3/4. One burial was located in square A2.

Burial 22

(figs 8-45 and 8-46)

This grave was cut through a circular pit into the natural soil from at least 30 cm above the surface of natural. It contains the complete skeleton of a male aged between 30-34 at death. The only grave furniture was a pot of form 1A which was placed over the knees. It contained a few scraps of fish bone and shell, some fragmentary plant, probably rice, remains and some human phalanges.

Burial 26

(figs 8-47 and 8-48)

Burial 26 lies on the same axis as burial 22, but was interred later. It contains the remains of an adult female, aged over 50 years at death. Three whole pottery vessels, two of form 1A and one of form 14A were identified. The first two were found beyond the head and on the upper chest. One was found intact, and laboratory excavation of its contents revealed a few pieces of bone and shell, and one human vertebra. The form 14A vessel was found over the chest. Fragments of a fourth pot were found beyond the head also, but these cannot be reconstructed. There were 242 shell beads in the neck area, and a bovid forelimb over the legs.

Burial 28

(fig 8-49)

This grave contained the articulating skeleton of an adult female 45-49 years of age at death. Although undisturbed, it was found without any accompanying grave goods.

Burial 33

(fig 8-50)

This burial lay alongside burial 28, but the head was oriented to the south rather than to the north. It was found in articulation and complete but for the right tibia and right radius. The arms lay alongside the body. No grave goods were found. The adolescent was aged about 14 years at death.

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Burial 43

(fig 8-51)

This burial was found in a circular pit cut into natural soil, 452 cm below datum. The infant remains come from an individual aged 8-9 months after conception. It was in a flexed position, and unaccompanied by any grave goods.

Burial 23

(fig 8-52)

This burial was placed directly over burial 28, 180° in the opposite orientation and 80 cm higher. The trunk and lower limbs were undisturbed, but the upper limbs and pelvic area had been disturbed in antiquity. The human remains represent a 30-34 year old female. No grave goods were found in association with the body.

Burial 49

(fig 8-53)

Burial 49 was found underneath burials 13 and 18, at a depth of 384 cm below datum. Only half the skeleton was found in the excavation square. The remains come from a 35-39 year old female. The only grave goods recovered were 5 shell disc beads.

Burial 25

(figs 8-46 and 8-54)

This burial was found resting on a sand lens at a depth of 404 cm below datum. It comprised a large cord-marked vessel of form 3, within which had been placed the remains of a fetus aged c. 6 months from conception. No grave goods were associated.

Burial 30

(figs 8-36 and 8-55)

Like burial 25, the human remains were from a 5 month term fetus, found in a whole pot of form 4.

Burial 12

(figs 8-56 to 8-58)

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Burial 12 contains the complete, articulating remains of a female aged 17 years at death. She was accompanied by nine complete pots of forms 1C (2), 14B, 4 (2), 9 (2) 15 and 5. The form 14B vessel lay beyond the feet and two form 9 vessels by the right ankle. The form 15 as well as the two form 1C vessels were placed at the right shoulder. The two large pots of form 4 were found broken at the right shoulder and beyond the feet. The form 5 painted vessel was found to the left of the skull. It contained a few scraps of animal bone. The complete skeleton of a cockerel was found under these pots, and a pig forelimb was located by the left wrist. A spread of red ochre was noted over the chest area.

Burial 13

(figs 8-59 and 8-80)

This burial was disturbed when burial 18 was cut into its upper torso. A pot of form 14B was found in the section overlying part of this grave. It contained some fragments of bone, probably derived from fish. The primary interment was an adult male aged 25-29 at death.

All the burials in squares A2, 3 and 4 described above were stratigraphically sealed by a series of clear sand lenses. They were thus interred during the build up of level 7. The series of burials which follows were all cut through the sand lensing and therefore belong to the build-up of level 6. The clear evidence for superpositions incorporating burials of each group suggests strongly that they belong to the same, established use of this cemetery.

Burial 18

(figs 8-59 to 8-81)

Burial 18 was cut through the lower part of burial 13. The primary interment was a 35-39 year old woman, holding an infant aged 8-9 months after conception. The woman wore a bronze bracelet on the left forearm and was accompanied by seven broken pottery vessels. A form 2 and a form 13 pot were placed beyond the head and to the left, and a form 6 vessel was found by the left shoulder and over the upper body. A form 4 pot was located over the right hand side of the upper body, a form 14B over the feet and a form 10, over the abdomen. The woman's thighs overlay the forelimb of a pig. The ladle found beyond the right shoulder may have belonged to this burial, its distance from the body makes this a tentative conclusion only. A form 1C vessel was found over the body and to the right of the skull.

Burial 48

(figs 8-82 to 8-85)

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The bones of this 30-34 year old female had been disturbed in prehistory. In fact, only the cranium and foot bones were found. That part of the grave where the rest of the body should lie contains broken pottery vessels. Two bronze bracelets were located near the skull. A coarsely woven fabric was found adhering to them. It may represent a grave shroud, as this was not the only example of such material adhering to bronze artefacts in mortuary contexts. Seventy-eight shell disc beads were also found, together with at least 12 pottery vessels belonging to forms 1C, 2 (2), 4 (3), 8, 9 (2), 14C, 15 and 17.

Pots of forms 2 and 17 were found to the left of the skull, a form 14C by the right ankle, and forms 1C and 4 (2) between the skull and foot bones. The other form 4 vessel was found to the right hand side of the feet. The two miniatures (form 9) were located beyond the head, and a form 15 was found over the skull area. In addition, sherds from forms 2 and 8, two of which were reconstructed from fragments, were found in the general area of the skeleton. The forelimb of a cow was found lying on the left hand side of the cranium.

Burial 50

(figs 8-24 and 8-66)

A clear grave was noted in the western section of A4, partially extending into the square itself. It contained at one end, six complete pots of forms 1B, 1C, 2, 9, 14B and 16. These were adjacent to a small scatter of fragmentary human bones probably disturbed with the interment of burial 48. A human femur and tibia, found about 30 cm above the base of the grave, quite probably results from this disturbance.

Burial 20

(figs 8-46 and 8-67)

The grave cut for burial 20 was clearly visible, but the human remains, representing a female aged at least 25 years at death and a 3-10 year old child, were scattered in the grave fill. A pot of form 1B was found in association.

Burial 29

(figs 8-68 and 8-69)

The disturbance to burial 20 was probably caused by the interment of burial 29. This lies within the larger grave cut for burial 20, and was one or two years of age at death. The infant wore two solid bronze anklets and 236 shell-disc beads round the neck. A complete articulating forelimb of a cow was placed along the right side of the body. It is likely that the pots of forms 1A, 1B and 14B found in this grave belong to burial 29. The pots were found beyond the child's head. The form 1B specimen contained a few pieces of animal bone.

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Burials 10 and 11

(figs 8-70 to 8-72)

These two burials were interred simultaneously, burial 11 lying directly over burial 10 but oriented in the opposite direction. The former comes from an adult male 30-34 years at death, and the latter from an adult female aged over 50 at death. Two form 14C and two pots of form 4 accompanied the bodies. The former were placed over the hips and beyond the head of burial 10. The latter were placed over the pelvic area. The articulating forelimb of a cow was found alongside the right arm and shoulder of burial 11. A bone tool was found in the grave fill. This grave lies immediately over burials 23 and 28. All have the same north to south orientation.

GROUP C

Square A1 yielded three burials. Their orientation matches that for the group B graves. These three could belong to group B, but are rather far removed from them and are treated separately.

Burial 34

(figs 8-46 and 8-73)

This grave contained the scattered remains of a 7-8 month old infant. It was associated with a pot of form 1A. The applique band on this pot forms a circle which is unique at Ban Na Di. This vessel was found intact and it was therefore possible to examine its contents. These comprise a few very small scraps of animal bone, some fragments of shell and an unidentified seed. A large block of uncut laterite was found in the opposite end of the grave. This burial was cut from only about 30 cm above natural and is thus one of the earliest found.

Burial 14

(figs 8-74 and 8-75)

This grave directly overlies burial 34 but is 1 m above it. It contains the disarticulated remains of a three year old child, together with four pots of forms 1C (2), 4 and 14B. All lie in a line on the left hand side of the body. Pot no 6 contained some fragments of shell and animal bone.

Burial 15

(figs 8-76 and 8-77)

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This grave was found cut to the same depth as burial 14 and has the same orientation. It contains the articulating skeleton of a one to two year old child, lying on its back, and associated with two cowrie shells (*Cypraea moneta*). The complete forelimb of a cow lay alongside the left hand side of the child. Three whole pottery vessels were found beyond the feet. They were forms 1C (2) and 14B. A block of uncut laterite was located by the left ankle.

GROUP D

This group is treated as an entity only because it derives from the initial test square excavated at Ban Na Di during April and May 1980. It lies adjacent to square F6 and the disposition and relative depths of the graves indicate that Groups A and D are in fact parts of the same mortuary area distinguished only by the way the excavations proceeded. The earliest graves in this square were cut into the natural soil.

Burial TS 19 (TS stands for test square)

(figs 8-78 and 8-79)

Only the upper portion of this burial lay within the excavated area. It represents an adult, aged 20-25 years at death. A pot of form 14A lay above the cranium, and 7850 shell-disc beads were found in the neck area. Two bovid figurines were located in association, one being represented only by the fore-legs.

Burial TS 21

(figs 8-78 and 8-80)

This grave contained the remains of a 19-20 year old male. It was found in articulation, with the hands placed over the hips. Three later holes were dug through the body, one of which removed or destroyed the skull. A form 1A pot was placed beyond the head and 776 shell disc-beads were found in the region of the neck. There may once have been more, but later disturbance affected this area.

Burial TS 22

(fig 8-78)

This burial lay between burials 19 and 21, but only the radius and ulna of a 7-8 year old were located. 220 shell disc heads were found in association with the human bones.

Burial TS 18

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(fig 8-81)

Only the edge of a grave cut and some fragmentary human ribs were found in a corner of the square. After excavations were completed, a villager looted the area near these remains and located a form 1 pot.

Burial TS 17

(figs 8-81 to 8-83)

This grave lay immediately over and 26 cm higher than burial TS 19. Again, only the upper part of the body was located in the excavated area. These remains came from a male aged 45-49 years at death. Two stone bracelets were found near the right shoulder, and 400 shell-disc beads were found in the neck area.

Burial TS 20

(fig 8-78)

Burial 20 lies at the edge of the excavated area and comprised only a scatter of adult human bone.

Burial TS 16

(figs 8-80 and 8-81)

This is a disturbed burial, and lies partially within the excavated area. The human remains come from a 20-24 year old female. She was associated with one form 1A pot, six shell-disc beads and the forelimb of a cow. Three bronze bracelets of identical size were also found.

Burial TS 15

(figs 8-79 and 8-81)

This burial is unusual because the orientation is east-west. It cuts through burial TS 16, and the remains come from a 20-24 year old male. The lower limbs and pelvic area only were located within the excavation square. Twenty-four shell-disc beads accompanied the human remains, together with pots of forms 1B and 14B.

Burials TS 7-14

(fig 8-82)

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At 335 cm below datum, square F5 was covered with the remains of eight burials. With the exception of burial TS 12 which is clearly the latest, all are to some extent intercut by other burials. All however, have the same north-south orientation.

It is not possible to offer a precise ordering in time of all eight burials, but some were clearly cut by others, making possible a partial relative chronology. Thus burial TS 10 appears to antedate burials TS 8 and 9. The adult tibiae are all that survive. Burial TS 9 is also incomplete, having been disturbed by the cutting of the grave for burial TS 8. All that remains are the femur, pelvis, vertebrae, radii and ulnae of an adult individual.

Burial TS 8

(fig 8-82)

Most of this skeleton has survived, though the area beyond the head lies outside the excavation square. The grave contained the remains of a woman aged 45-49 years at death. The forelimb of a cow was found beside the left side of the trunk. Nine hundred shell-disc beads were found in the vicinity of human remains. The remains of a 25-29 year old male were also present.

Burial TS 11

(fig 8-82)

This burial was found as a group of disarticulated long bones, which were probably exhumed and redeposited when the grave for burial TS 8 was cut. The long bones come, in fact, from two adults aged over 35 and c. 20 years. The articulating forelimb of a cow was found adjacent to the human bones.

Burial TS 13

(figs 8-82 and 8-83)

The burial was cut into with the excavation of the grave for burials TS 12 and TS 7. All that remained were some limb bones of an adult aged over 30 at death, a vessel of form 14, and the forelimbs of a pig.

Burial TS 7

(figs 8-82 and 8-83)

Only the ankle and foot bones of this burial were located in the excavated area. These came from an adult, and were associated with two broken vessels of form 4.

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Burial TS 14

(fig 8-82)

The tibia, clavicle and rib of an adult are all that remains of this burial which was disturbed with the cutting of the grave for burial TS 12.

Burial TS 12

(figs 8-82, 84, 85, 86 and 87)

Since this was the last interment at this level, it is also the most complete. The remains of a man aged 35-39 at death were found, although the area beyond the cranium lay outside the excavation square. The man wore a necklace of at least 36 pierced dog canine teeth, as well as a string of 170 shell-disc beads and one large shell bead. There were ten pots in association: two of form 14B, one of form 2, three of form 1C and four of form 4. Form 14B pots were found on the right hand side of the skull and the right hand side of the ankle area. Pot form 4 was placed over the abdomen. The forelimb of a cow was found under the human femora.

Burials TS 4, 5 and 6

(fig 8-88)

These three burials are located approximately 13 cm above the series just described (burials TS 7-14). Burial TS 5 overlies burials TS 8 and 13. It was found to be disturbed in antiquity, and contained the remains of an adult male. The human bones were associated with one pot of form 2, two pots of form 14B, and one of form 4 (figs 8-88 and 8-89).

Burial TS 6

(figs 8-88 and 8-90)

This burial was also disturbed. It contained the remains of an adult, aged 30-40 years at death. In addition to a miniature pot (form 9), sherds from other vessels were found, two being of form 14B, and the other of form 4. This burial lies over burials TS 7 and 11.

Burial TS 4

(fig 8-88)

This burial comprises only a group of adult rib fragments. It overlies burials TS 8 and TS 10.

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Burials TS 1-3

(figs 8-80 and 8-91)

About 30 cm above burials TS 8-6, there was a scatter of disarticulated human bone representing six individuals. These were found in three concentrations each of which was accorded a burial number. Burial TS 1 comprised the remains of three individuals, and no associated material culture. An adult male, an infant aged 1-2 years at death and a second adult were represented. Burial TS 2 incorporated the bones of a male in his early twenties. A second adult male was also represented. Burial TS3 incorporated the remains of an adult. It was found associated with broken sherds from pot forms 1B and 4. It is considered likely that all these "burials" comprise bones lifted in prehistory when fresh graves were cut into earlier interments.

MORTUARY PHASE TWO

GROUP E

This group comprises the five lidded jar burials. They were found at approximately the same level, and in the same part of the site.

Burial 4

(figs 8-92 and 8-93)

This jar lay in level 5, the grave pit being invisible but probably cut down from level 4. The vessel contained the complete skeleton of an infant aged approximately eight months from conception. The infant was interred with an iron knife-like implement which has a lunate shape with the vestiges of two projections at each end. The surfaces of the tool were encrusted with rice grains, preserved through iron oxide impregnation.

Burial 5

(figs 8-94 and 8-95)

This burial jar, which has the same stratigraphic context as burial 4, contained a 1-2 year old infant. It was accompanied by three very small bronze bracelets.

Burial 6

(fig 8-96)

Ban Na Di: the mortuary ritual

This pot was, unfortunately, damaged in antiquity when a post was driven through it. It was found within level 5 and again, this grave was probably cut down from the overlying layer.

Burial 7

(figs 8-97 and 8-98)

The jar contained the remains of a fetus aged approximately six months after conception. The vessel was found slightly fragmented. No grave goods were found.

Burial 8

(figs 8-99 to 101)

In the case of burial 8, the grave cut from layer 4 was visible. The jar contained the skeleton of an infant aged about seven months. It was associated with a tiny bronze bracelet, five blue-glass beads and six badly corroded pieces of iron which may once have been a complete artefact.

MORTUARY PHASE THREE

GROUP F

Three late graves were found in squares A3-4. None was found undisturbed.

Burial 2

(fig 8-102)

This grave comprised only a few adult limb bones. Half a bronze bracelet, a bronze ring and two glass beads were found in the vicinity of the human remains, and may well have belonged to this grave. Burial 2 lies within level 4 and was presumably interred during the late prehistoric period.

Burial 1

(fig 8-103)

This burial was also found at the base of level 3. Very fragmentary, it was associated with part of a bronze ring. The remains represent a female, aged about 18 years.

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Burial 3

(fig 8-104)

This burial was relatively intact and represents an adult aged 45-49 years at death. He or she wore a bronze bracelet on the left hand, but there were no other grave goods in clear association. Again, this grave was found within level 4.

REVIEW OF THE MORTUARY EVIDENCE

It is now necessary to summarise the principal features of the Ban Na Di burial rite and consider the evidence for the social characteristics of the prehistoric inhabitants. We may recognise three distinct phases of burial. The first commenced shortly after the initial occupation, at a point when c.30 cm of cultural material had already built up. The earliest burials were cut through occupation material comprising ash lenses, hearths, and organic remains including animal bone and shellfish. At Ban Koeng, a modern village in Mahasarakham Province, Calder (1972) has shown that 10-25 cm of occupation material were built up in 21 years of occupation. Compression of occupation detritus at Ban Na Di may have occurred, but there is still little doubt that early burials there followed fairly soon after initial occupation. This burial phase continued through c.1.8 m of stratigraphy and according to the radiocarbon chronology, lasted for about 800 years.

Burials of the second phase were found only in squares A1 and A2, and comprised infants buried in lidded jars. The third phase belongs late in the prehistoric period. Only three badly disturbed burials were found.

Most attention will be devoted to the first of the three phases because it contains so many burials and also provides a sequence of interments. In the first instance, it is necessary to consider the evidence for the actual burial rite. There are some cases where the burial was not disturbed and these provide the best evidence. There is nothing to suggest that the body was placed in any form of receptacle. It is possible that it was interred in a perishable shroud, a situation which may account for the fragments of cloth found adhering to iron and bronze jewellery. In the case of burial 19, the remains of a child were covered by a crocodile skin, but this is, as far as is known, unique in the area as well as the site. The body was laid out in a grave dug to a depth of at least 40 cm, with an orientation varying a few degrees either side of north-south. On most occasions the head faced the north and on others, to the south. The body was accompanied by grave goods, the quantity of which varied with each individual. Pottery vessels were nearly always placed near the body. Recurrent locations were beyond the feet and head, on either side of the corpse and sometimes, over the body. There is no clear association between particular types of vessel and a specific location. The contents of complete pots has revealed that they contained food. One yielded the complete forelimb of a young pig, while others contained fragments of fish bone and, more rarely, of rice.

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Bodies were often associated with the limbs of cattle and pigs. These were invariably the fore quarter, and were chosen from immature animals. It is evident that animal sacrifice was part of the mortuary ritual. The bones were nearly always found in complete articulation with no signs of butchery. On one occasion (burial 12), a complete chicken was laid alongside the body.

Animal figurines were also interred, though rarely. They were crudely moulded from clay, and most represent cattle, with particular attention being paid to the horns. There are also single examples of elephant and deer figurines. Only on two occasions were human figures found.

The dead were also interred wearing items of jewellery. By far the commonest were circular disc beads cut from shell. These were strung as necklaces. Over 7500 were found in the neck area of burial TS 19, and several other burials had hundreds of such beads. The necklaces also incorporated long beads made of shell. In both cases, the shell was probably of marine origin. Burial 32 contained the remains of an adult male wearing trochus armlets. *Trochus niloticus* is a marine species. Several other bodies were also interred wearing bracelets made of stone or bronze, the former being repaired with bronze wire when they broke. Bronze anklets were also found on one occasion (burial 29). Burial TS 12 contained the remains of an adult male wearing a necklace made of pierced dog canines. After the placement of grave goods, the grave was filled with soil. There is no evidence for grave markers, although some graves contain large uncut blocks of laterite which may be displaced headstones. The regularity with which fresh interments were made in the same part of the cemetery strongly suggests that the prehistoric inhabitants were familiar with the location of earlier graves.

The same burial rite accommodated adults of both sexes as well as children. The disposal of infants was more varied. Burial 18 incorporated an adult female holding the remains of an infant in her left arm. Burials 25 and 30 comprised infants buried without grave goods in a complete pot. Burial 9 was that of an infant lying alone without any grave goods or other associations. The remains of an infant (burial 44) were found between two adult graves.

We may consider the social implications of the mortuary phase 1 Ban Na Di burials through a series of questions. These are formulated in such a way that the answers should allow insight into the social structure of those responsible for this particular mortuary ritual. At this juncture, it is stressed that it was originally planned to apply a series of multivariate statistical tests to the data. Thus Peebles (1971) has isolated factors which group the Moundsville burials into clusters based on the variations in mortuary ritual, location and association of different types of artefact. This has not been undertaken on the Ban Na Di material because the constant opening of the cemetery has led to the survival of relatively few intact, undisturbed graves. It has to be stressed that some finds from burials are of uncertain provenance. Moreover, the small size of the excavation squares has resulted in the situation where some graves were only partially located in a square and therefore, we may have only part of the associated material culture. Finally, since there is no obvious difference in ritual, groupings would necessarily emerge only from differences in associated material culture. As it happens, these differences are self evident and don't require the use of a computer.

Ban Na Di: the mortuary ritual

One of the strengths of King's study of the Chumash cemeteries at Medea Creek, is that the site has been practically completely excavated, and it has been possible to isolate specific areas - called "lobes" - of the cemetery (King 1978). These lobes evidence a structured layout of graves and concentrations of wealth in discrete areas. Desirable as it would be to repeat this procedure at Ban Na Di, it was out of the question.

The first issue concerns the relationship between the two areas which have yielded concentrations of burials, that is squares A3-4 and squares F5-8. These are located about 25 m apart. It is conceded that there may well be a contiguous burial area linking the two excavated places into one large cemetery. On the other hand, it is possible that each is a sample drawn from two contemporary but distinct lobes of a cemetery. There is just one reason why the latter possibility can be seriously entertained. In both squares, burials were concentrated in only part of the excavated area, and there is a discrete edge to the part yielding them. Pending further excavation, it is assumed that the latter is valid.

Several workers have stressed the significance of the special layout of a cemetery, and the demographic structure of the people buried there. Thus, the reservation of an area for individuals of one sex, or distinctiveness based on age, plane of nutrition or wealth, tells us something about their social structure. Particular attention is often paid to the status of child burials. Whereas a child could hardly attain high rank or prominent social persona on his or her own merits, it could be born with ascribed status. To find a child buried with lavish grave goods does not in itself permit the conclusion that social ranking is in question. Peebles and Kus (1977) rather stress the position of the child's grave and relation to the remains of other people of similar age.

Our first enquiry then, concerns the demographic structure of the Ban Na Di burial population. All remains have been sexed where possible, then ascribed to one of seven age groups. The youngest refers to infants which were probably still born. The succeeding age stages are as follows: 0-3 years, 3-10, 10-20, 20-30, 30-40, and over 40 years of age at death. The histogram giving the details of age at death disclosed that all age stages are represented. Infants and children were particularly susceptible, with fewest deaths being recorded in the age range of 10-20. There is a considerable preponderance of mortality among males in the range 20-30, and more females survived beyond the age of 40. The number of fragmentary or disturbed remains of adults makes a statistical testing of the significance of an apparent preponderance of adult males over females (18-14) rather pointless. The principal points made on the basis of these figures, are that mortality was distributed in a way not unusual among pre-industrial societies, and that all age groups are represented in the cemetery.

Having established the presence of children and adult males and females in the cemetery, it is now necessary to explore Binford's (1971) proposition that in egalitarian societies, burial ritual should recognise the dimensions of age, sex and achieved personal qualities. The question at issue is whether males and females were distinguished by a range of different grave goods. The commonest styles of pottery vessel are forms 1, 2, 4 and 14. These cross-cut the male and female graves. In some cases, vessel forms are rare. There is, however, no evidence to suggest that particular styles were placed with either sex. This is hardly surprising

if it is agreed that the role of pottery containers in the mortuary rite was as receptacles of sustenance for the dead. Pots were also regularly placed in the graves of sub-adults and young children. The same situation applies to the remains of pig and cattle fore limbs, in that these remains cross-cut different age and sex groups.

Since the dogs-tooth necklace, and clay figurines in the forms of deer, elephant and humans are rare or unique, their associations are of little value for the present purposes. It is interesting, however, to note that the bovid figurines are found in the graves of an adult female and of children.

Shell-disc beads were associated with all age and sex groups. Only in the case of bracelets is there some evidence for distinctions in grave goods according to sex. The bronze bracelets were found associated with adult females and in one case, with a 3-10 year old child. Stone bracelets, while rare, were associated with adult males. The sample size is small, and certainly insufficient to modify the general conclusion that there is no clear recognition of sex or age in the distribution of grave goods. On the other hand, children were not only buried together with adults, but shared the same range of grave goods and the same burial ritual. Wright (1978) has argued that where adults, children and infants are buried together, and children have their share of wealth, then a degree of social ranking together with sub-group affiliation are probably represented. The converse is that where children are buried away from adults, with no ritual or grave goods, social status is normally not inherited. An ethnographic example of this situation has been provided for the Temuan by Saxe and Gall (1977).

Given the possibility that the Ban Na Di burials reflect a degree of social ranking, it is opportune now, to turn to the possibility that the two burial areas during phase 1 have evidence for differences in energy expenditure. This enquiry is based on Brown's (1981) proposition that more energy is expended in the mortuary rites of a highly ranked than a lower ranked individual. Such gradations in energy expenditure, according to Tainter (1978) reflect the presence of inherited status.

Let us assume that the graves from squares A3-4 and F5-6 do represent different social sub-groups of the settlement's prehistoric population. Was there more energy expended in one area compared with the other? The quantification of energy expended should incorporate the provision of a facility in which to place the body, effort involved in preparing the body, amount and richness of goods placed with the dead and provision of a monument to commemorate the deceased.

There is no definite evidence for facilities for placing the body, although the presence of a coarsely woven material adhering to bronzes in mortuary contexts suggests that a shroud was used. The same bracelets also reveal at least two types of fine fabric, one having a filament the same thickness as silk. These suggest that the body wore clothes when interred. There is no evident difference in body preparation between the two areas, or provision of a monument. Of course such distinctions may have been present, but if so, they are archaeologically invisible. There remains only the question of differentials in grave furniture. In this context, there is a broad division which may be made, between artefacts made locally, and those imported from some distance. It is held that the latter were probably rarer, more expensive and may therefore reflect a higher level of energy expenditure. This does not of course, rule out the possibility that artefacts made from locally available raw materials are

also indicative of status.

While most burial pots are matched in occupation deposits and appear to have been made from local clays, there are a few unusual vessels which may well have been imports. Preliminary examination of the petrology of the clays for pots 94-5 (form 5) suggests a different source from that used for the great majority of funerary vessels. Particular interest therefore, centres on these two painted vessels and on those of "Om Kao" style. This distinctive ware was found in only three relatively late phase 1 graves. The clay figurines, while probably made from locally available material may well have been important, symbolically. The same applies to the unusual crocodile skull artefact which was pierced in such a way as to suggest that it was used as a pendant.

The situation with artefacts of stone, shell and bronze is clearer. The few stone bracelets must have been imported since the stone itself is foreign to the vicinity of Ban Na Di. Hoang Xuan Chinh and Nguyen Ngoc Bich (1978) have drawn attention to the presence in a Phung Nguyen context, of a site in which similar bracelets were manufactured. Their rarity at Ban Na Di is attested by the care taken to repair them with bronze wire when they fractured. Stone of any sort is extremely rare at Ban Na Di in non-burial contexts. While it is clear that bronze axes, bracelets and arrowheads were made at Ban Na Di, the ores or metal in ingot form were necessarily imported. Bronze artefacts are therefore, regarded as prestige items. Two iron artefacts were found. Our understanding of the site's chronology indicates that iron at that period was rare in Northeast Thailand. At least two marine species of shellfish are found in Ban Na Di burial contexts. Two specimens of the cowrie are found in burial 15. The trochus species was used in the manufacture of the 13 armbands found in burial 32. It is less easy to document the origin of shell which has been modified in the manufacture of disc and large beads. Mason however (pers. comm.) has suggested that a marine source is likely.

It would be desirable at this juncture, to turn to a large sample of complete graves and apply appropriate statistical procedures to test the proposition that both grave groups have a similar incidence of high energy, i.e. imported, artefacts. This is not possible. Consequently, the areas will be compared on a qualitative and quantitative basis. In the following discussion, squares A1-4 will be designated area A, and F5-8, area B.

There are four complete or fragmentary stone bracelets. All come from area B. Seven graves have yielded large, probably marine shell beads. All are from area B. Area B graves yielded all clay figurines. Bronze is present in nine graves (ca. 14% of all graves), either in the form of bracelets, anklets or wire used in repairing stone bracelets. Six of the nine graves were found in area B, and of the 32 bronze artefacts found, 27 come from area B graves. The 13 shell bracelets come from an area B grave. Twenty burials contain shell-disc beads. Fifteen of these come from area B. Approximately 11000 such beads were found. Over 90% come from area B burials. Area B also yielded all the iron artefacts as well as several unique items: the child buried under a crocodile skin shroud, the large crocodile skull pendant-like artefact, the dog canine necklace, a stone necklace bead and two bronze beads. Area A yielded the two cowrie shells. It is concluded that area B burials contained significantly more high energy, or imported objects than the burials in area A.

Ban Na Di: the mortuary ritual

These data allow us to conclude that the burials in area B were considerably richer, in terms of imported objects, than those in area A. Certain artefacts, such as clay figurines, large shell beads, stone bracelets and iron objects, were restricted to area B. The exotic goods were found in graves of all age groups and both sexes.

The next question is concerned with the identification of temporal change in grave goods. The burials available are ideally suited to this enquiry, because the superposition of graves, and relationship between some burials and flood lenses, makes it possible to place graves in chronological order. It has just been observed that area B graves were considerably better endowed with imported grave goods. It must now be seen whether there is evidence suggesting changes in wealth with time.

For this purpose graves in each area have been subdivided into three sub-phases. The latest (1c) comprises graves cut into level 7, that is the layer containing sand lensing. The middle phase (1b) includes burials sealed by flood lenses within level 7, and the earliest phase (1a) comprises those burials cut from basal level 7.

In terms of exotic artefacts, there is some evidence for changes with time. Iron belongs to mortuary phase 1c. Stone bracelets don't appear after phase 1b. Bronze bracelets or anklets are found only in phases 1b and c graves, the only metal in phase 1a being the bronze wire used to repair broken stone bracelets. These artefacts sustain the notion that area B was consistently the richer.

What inferences may be drawn from the Ban Na Di mortuary remains during mortuary phase 1? The superpositions of the graves and their relationships with dated stratigraphic units reveal that the cemetery was used over a period of at least 800 and perhaps for over 1000 years. During that period of time, the ritual remained the same. Ceramic styles changed to some extent but the same basic repertoire continued. Some new forms were added with time, and the actual number of vessels placed into the graves likewise increased. The area ceased being used as a cemetery when iron and pottery of the so-called "Om Kaeo" style were available.

There is structure to the layout of the graves. They lie alongside each other on the same orientation, and directly above each other. In some instances, the dead were buried simultaneously in the same grave. Square F6, and squares A3-4 incorporate what seems to have been the edge of the cemetery.

The burials in area B were endowed with richer grave goods than those in area A. This was consistent through time, although in the latter, the later burials were undoubtedly richer than the earlier ones. This distinction indicates a concentration of wealth in one part of the cemetery. Imported artefacts, including metal objects, were found to cross-cut age and sex distinctions in both areas. Again, each area incorporated individuals from all age and sex groups.

The accumulating body of theory linking mortuary rites with social structure makes it desirable to explore further the possible social characteristics of the Ban Na Di people during burial phase 1. The following review will be brief and of a summary nature, because a detailed examination must also incorporate what is known about the settlement pattern, economy and the analyses of other cemeteries in the general area.

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At present, it is necessary to turn to the propositions linking burials and social order summarised recently by Brown (1981). These bear repetition. In essence, it is held that societies with minimal ranking will recognise the deceased person's age, sex, personal achievements and personality. A weakly ranked structure, which lacks supra-village authority and power, will record symbolic distinctions with wealth objects depending on their availability. Increases in hierarchic structure result in increased gradations in burial treatment, depending on a person's ascribed rank. Increased hierarchy will also incorporate increasingly elaborate attention to children, in proportion to the reduced opportunity to replace the present generation. Increases in authority are accompanied by greater energy in burying persons who wield it. As power increases, the potent will live and be buried in or near their power base.

The above theories link with the archaeological record by the consideration of the energy expended in burial ritual, in the recognition of symbols of authority and in the demographic structure of the burial population. Brown has demonstrated these linkages by outlining the mortuary practices of the Spiro (1200-1400 AD), Harlan (1000-1200 AD) and Hopewell (pre 1000 AD) phases of the Caddoan area (Brown 1981). He was able to show that the Hopewell phase burials represent a society with inherited status but no centralised leadership. The richest Harlan phase burials contained copper artefacts and conch-shell cups. Brown suggested the presence of three descent groups, one being of higher status than the other two. There was no evidence for distinctive treatment of children. By the Spiro phase, there was organised warfare, and a civic-ceremonial complex within the settlement pattern. Headdresses were used as symbols of authority and all age groups were found represented in a particularly rich charnel house.

Such a situation, which recurs in many other ethnographic and prehistoric situations, has clear implications for the Ban Na Di data. Given the distribution of grave goods, and conjunction of children's and infant graves with adult burials and association of imported objects with all age and sex categories, it is highly unlikely that the Ban Na Di people had an egalitarian social structure. The evidence is, in fact, unanimous in supporting the presence of hereditary inequality. The most likely situation, given our understanding of the prehistoric settlement pattern and economy, is that there was a moderate degree of lineage ranking there, with little if any supra-village authority structure.

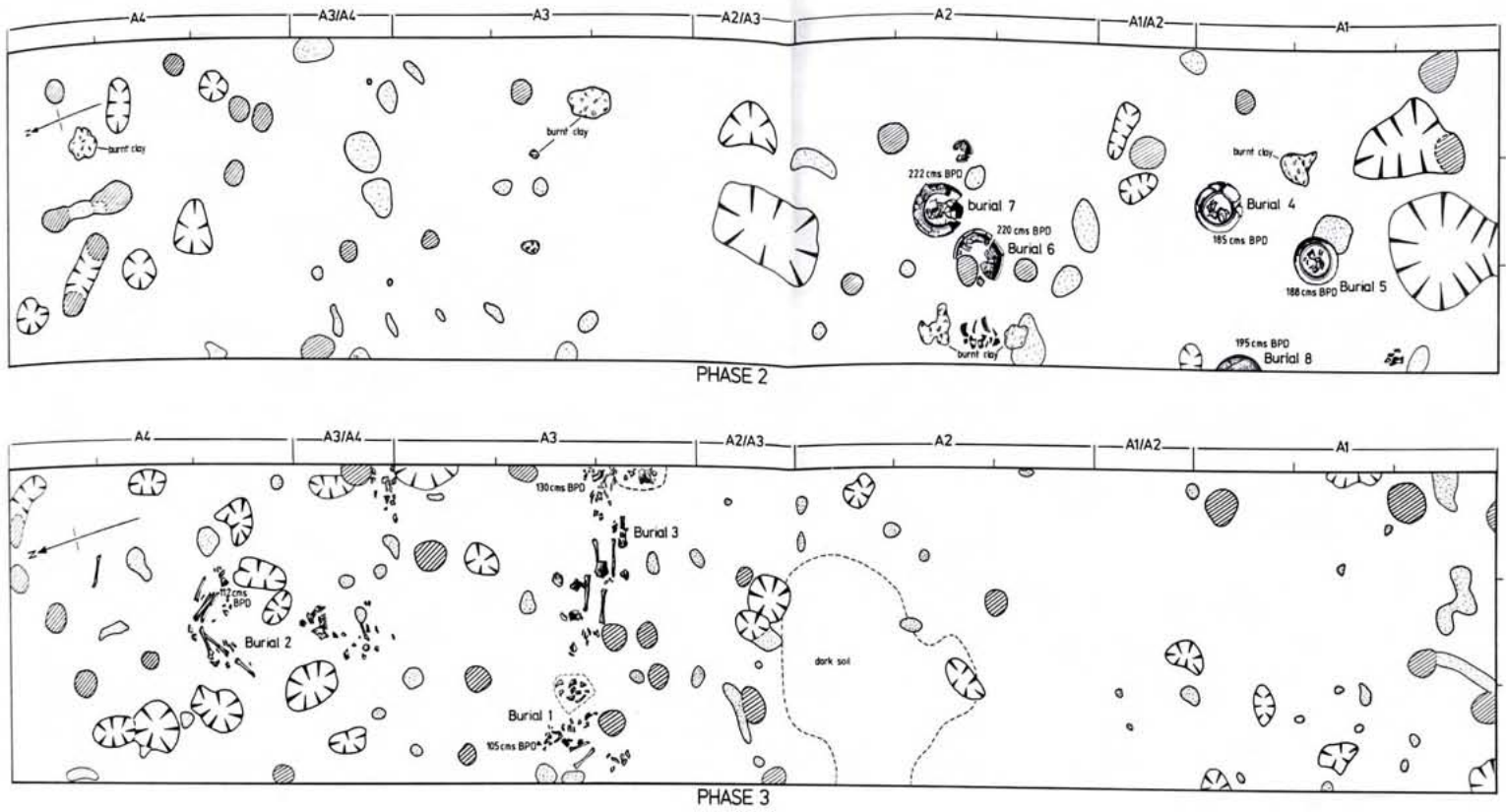
The long term use of the cemetery area and complete spectrum of age groups within it is thought to reflect localised use by members of one or more distinctive social groups. Confirmation of this would suggest that such groups had restricted and differential access to scarce resources.

Phase two burials comprise only infant burials in jars. These concentrate in square A1-2. The pottery vessels used were lidded and very similar to each other, being cord-marked on the outside and red-slipped on the interior surfaces. The infants vary in age from approximately 6 months after conception until between 1-2 years at death. It is interesting to note that these infants were buried with grave goods. The eight month infant in burial 5, presumably prematurely still born, was interred with an iron knife or sickle to which rice grains were adhering. In burial 6 the 1-2 year old baby wore three tiny bronze bracelets. No artefacts were found in burial 7, which contained the six month old fetus,

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but the 6 month - 1 year old child in burial 8 was accompanied by five blue-glass beads, an iron implement and a bronze ring or bracelet.

These remains are, in stratigraphic terms, contemporaneous. They cluster together in what was surely an area set aside for such interments. This was a clear break in tradition when compared with the disposal of phase I infants of similar age. The association of these infants with such imported items as bronze bracelets and blue-glass beads suggests that at least inherited wealth remained a feature of the Ban Na Di society during the later prehistoric period.



FIGURES 8-4 AND 8-5: The mortuary phase two (upper) and phase three burials in squares A1-4

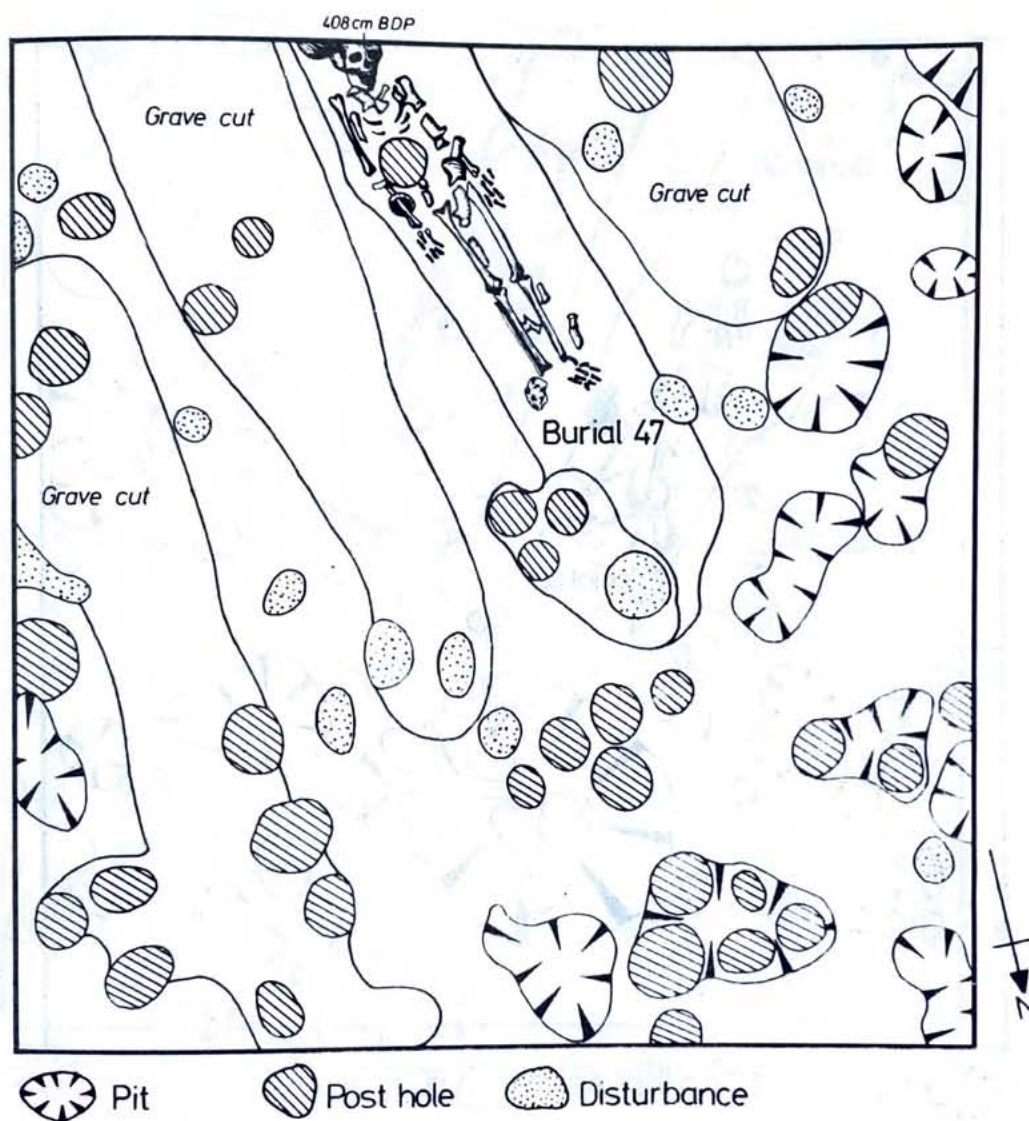


FIGURE 8-6

Ban Na Di: The MP 1a burial 47 in square F6

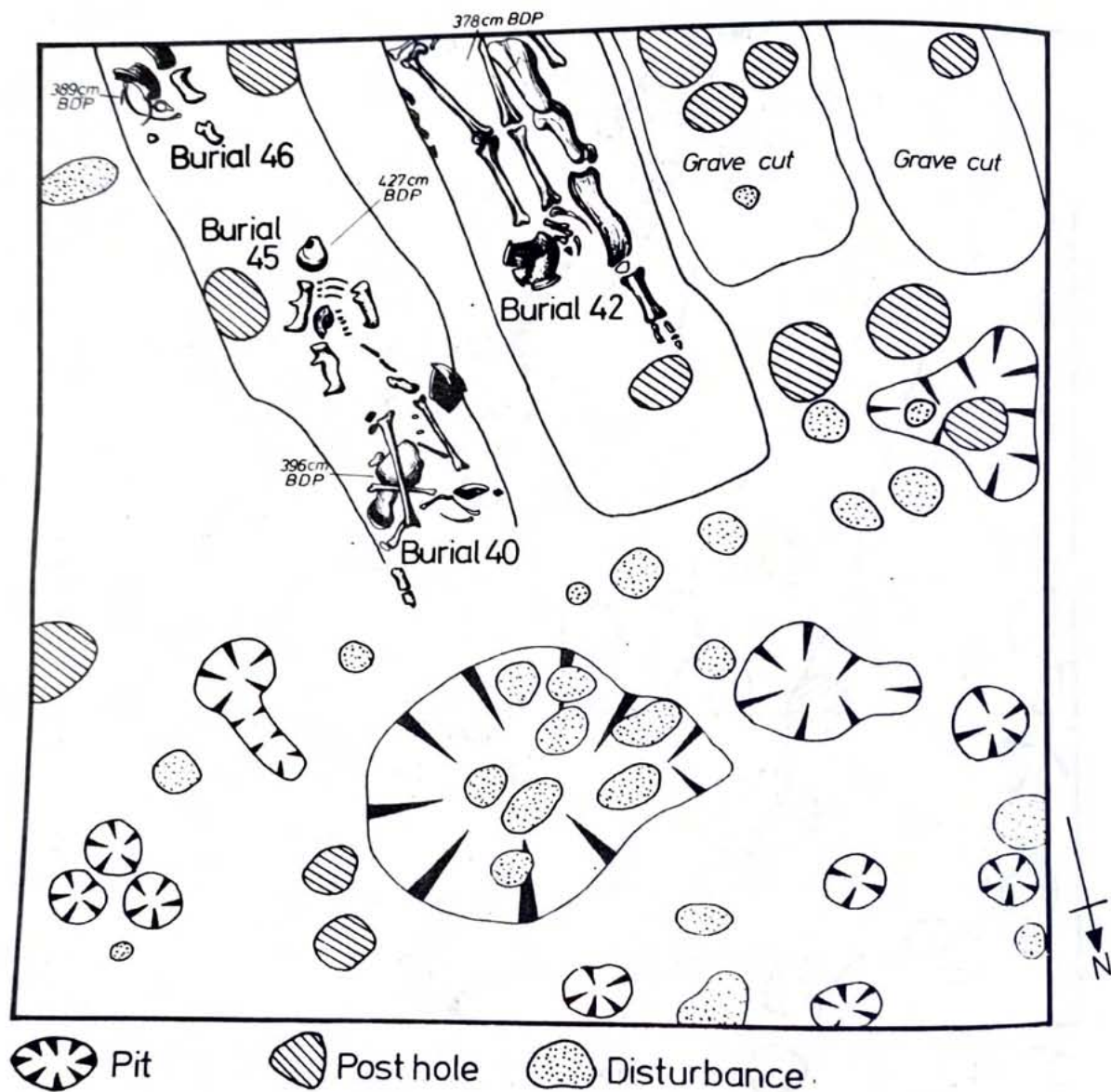


FIGURE 8-7

Ban Na Di: burials 40, 45 and 46 (MP 1a) and burial 42 (MP 1b) in square F6



FIGURE 8-8

Ban Na Di: burials 41 and 44 (MP 1a) and
burials 37-8 (MP 1b)

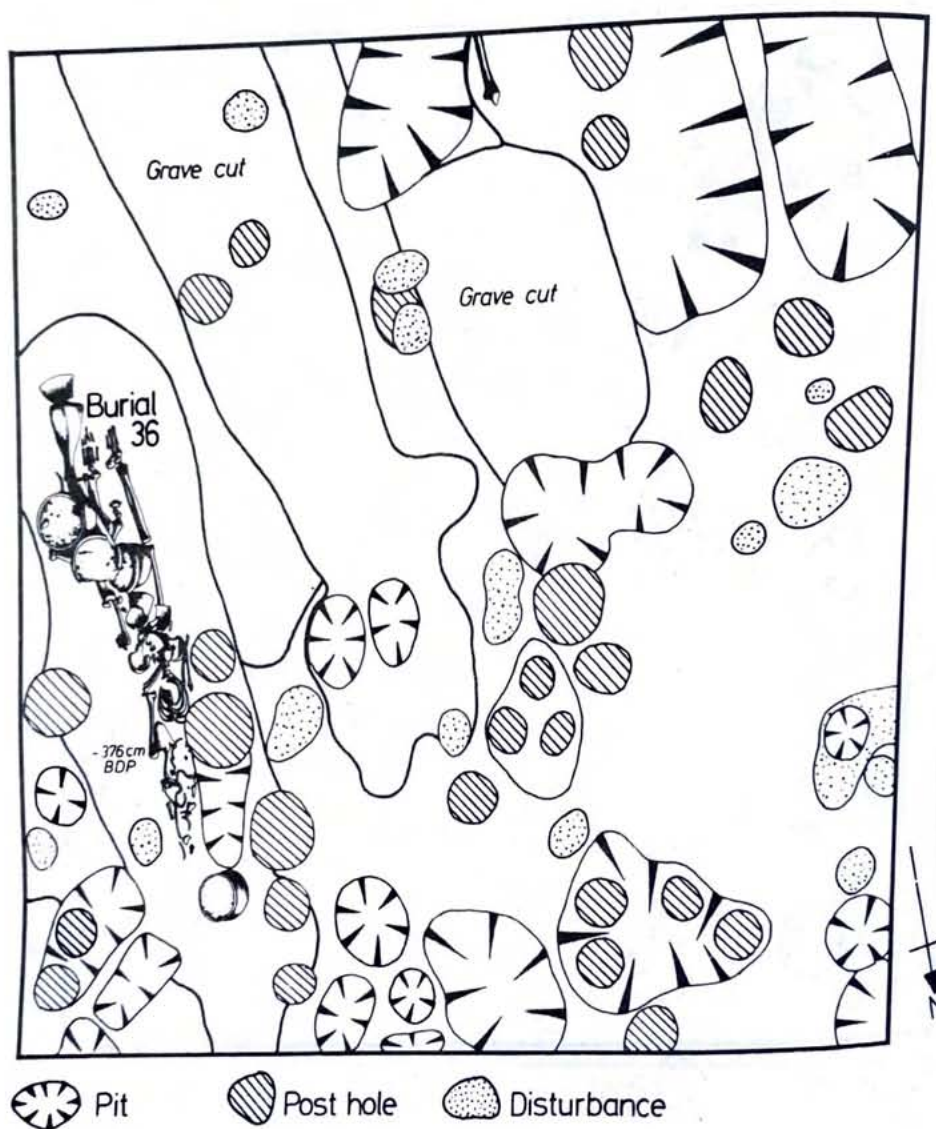


FIGURE 8-9

Ban Na Di: burial 36 (MP 1b) in square F6

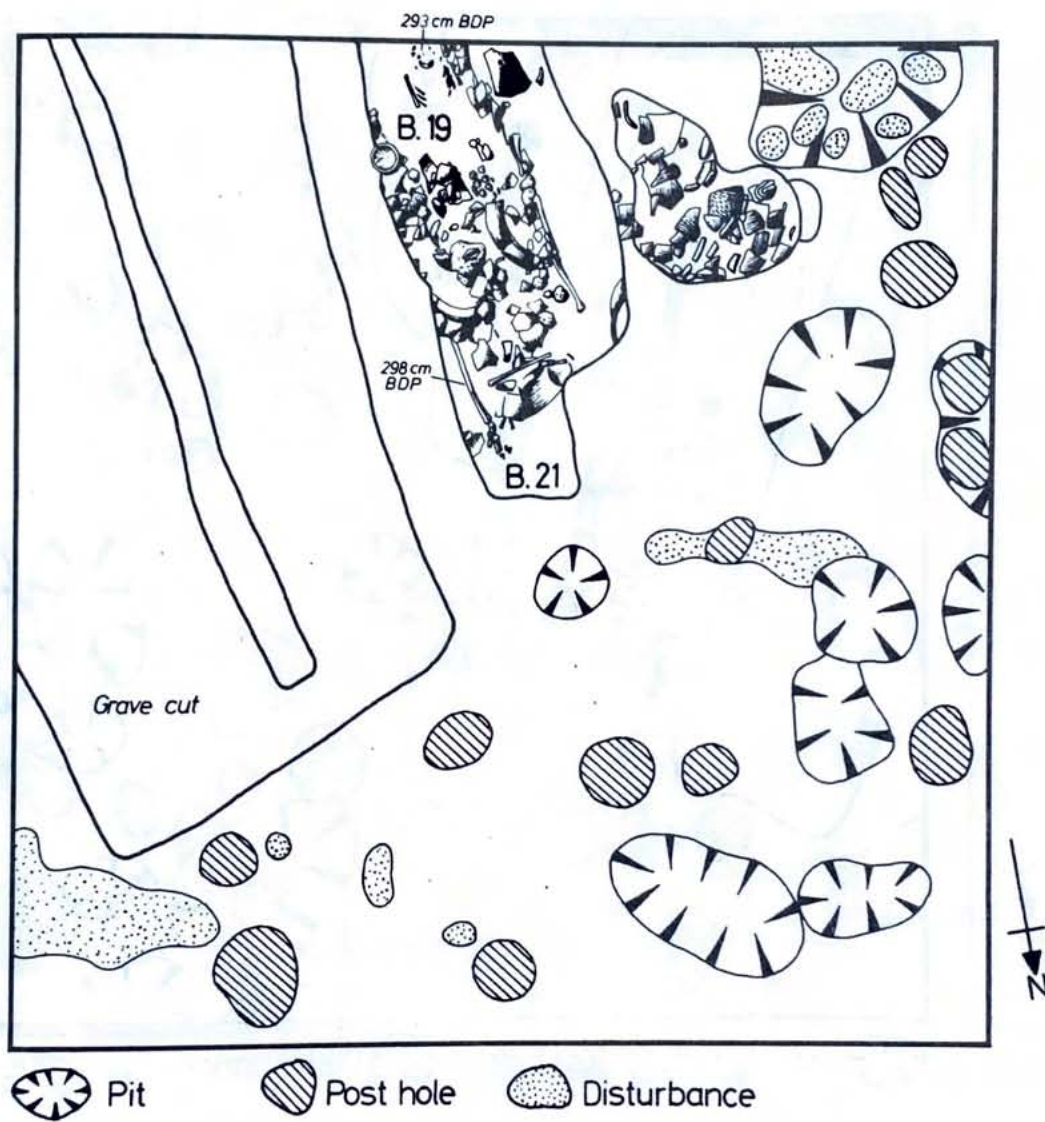


FIGURE 8-10

Ban Na Di: burials 19 and 21 (MP 1b) in square F6

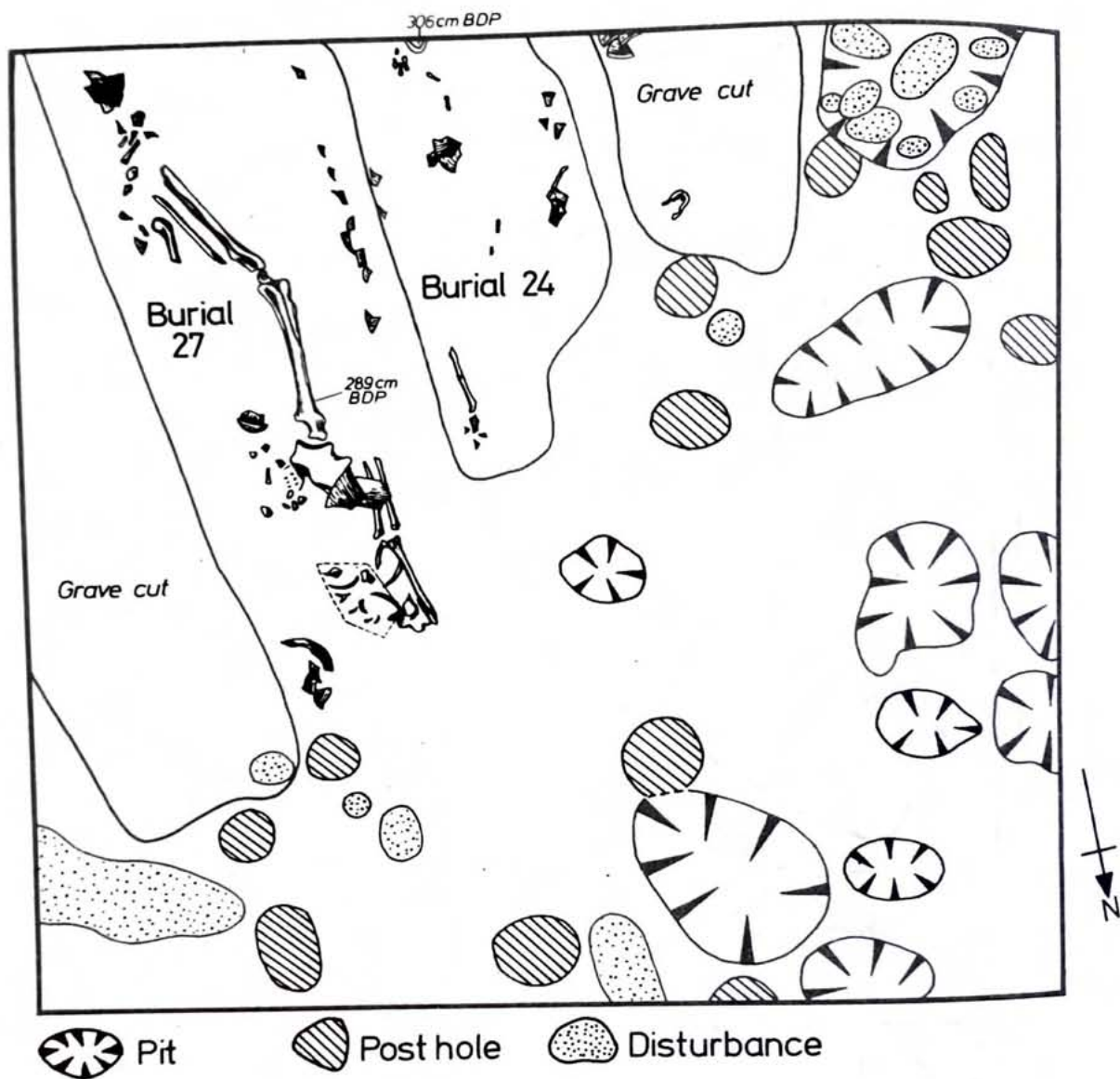


FIGURE 8-11

Ban Na Di: burials 24 (MP 1b) and 27
(MP 1c) in square F6

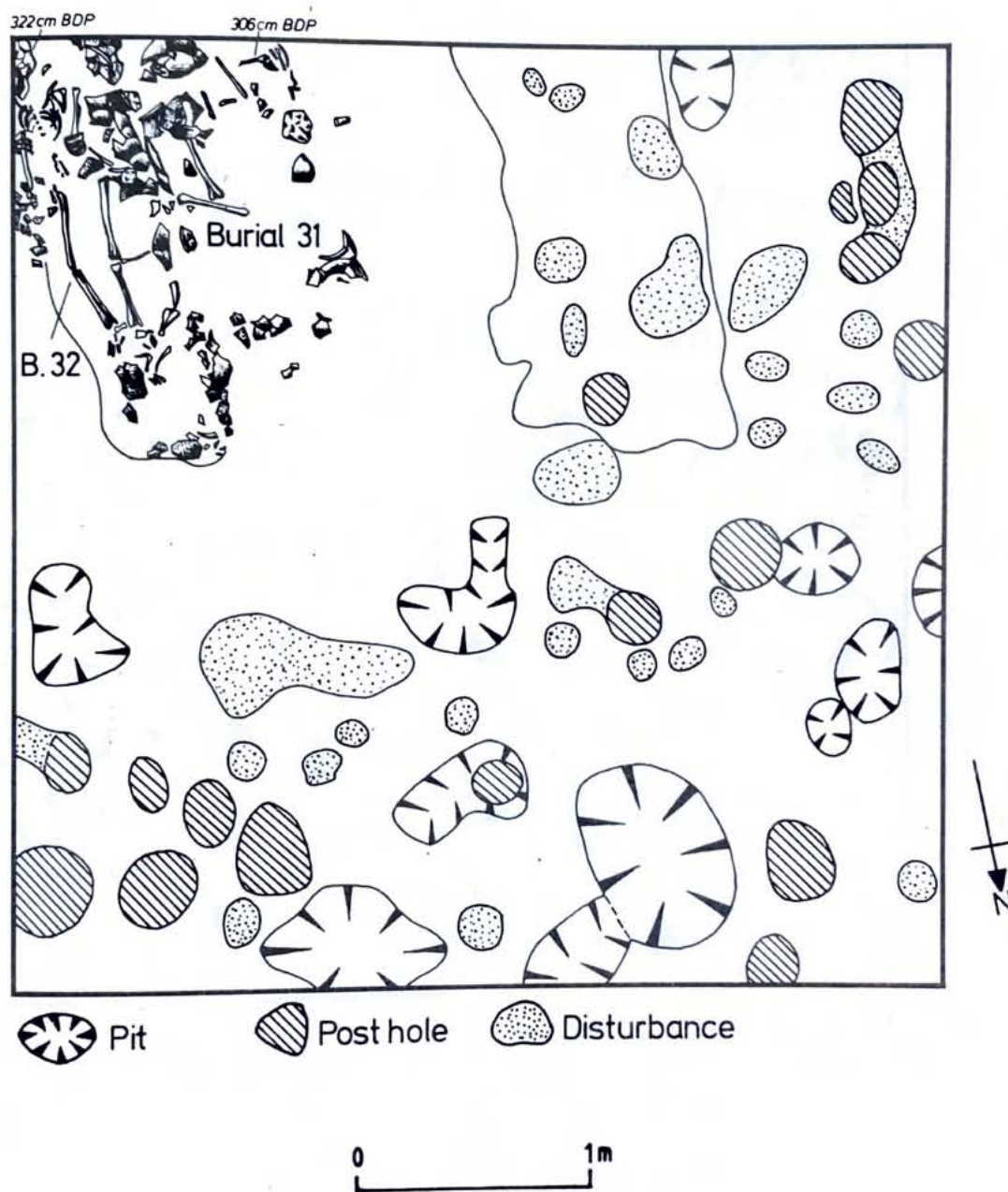


FIGURE 8-12

Ban Na Di: burials 31 and 32 (MP 1c) in square F6

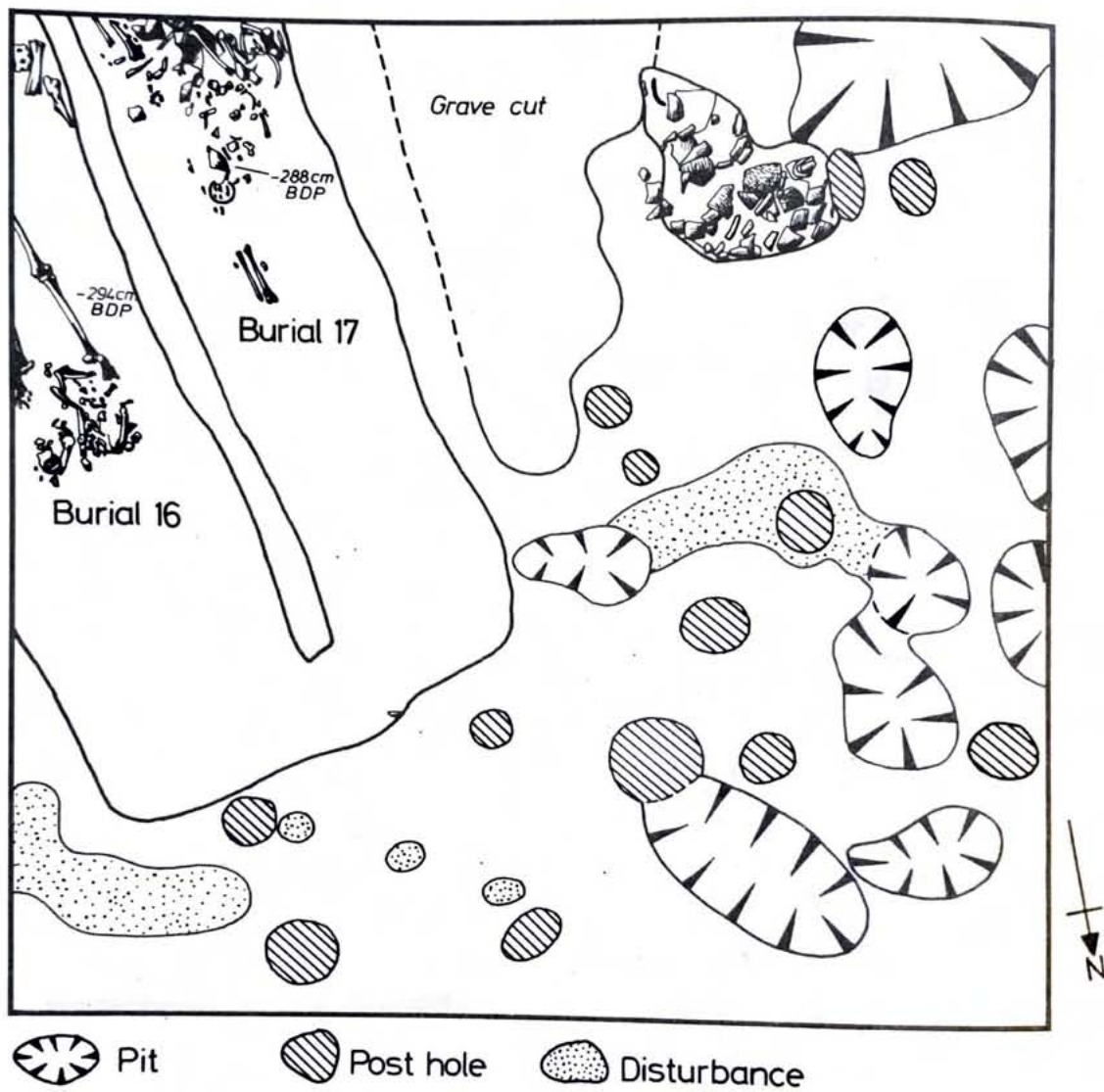


FIGURE 8-13

Ban Na Di: burials 16 and 17 (MP 1c) in square F6

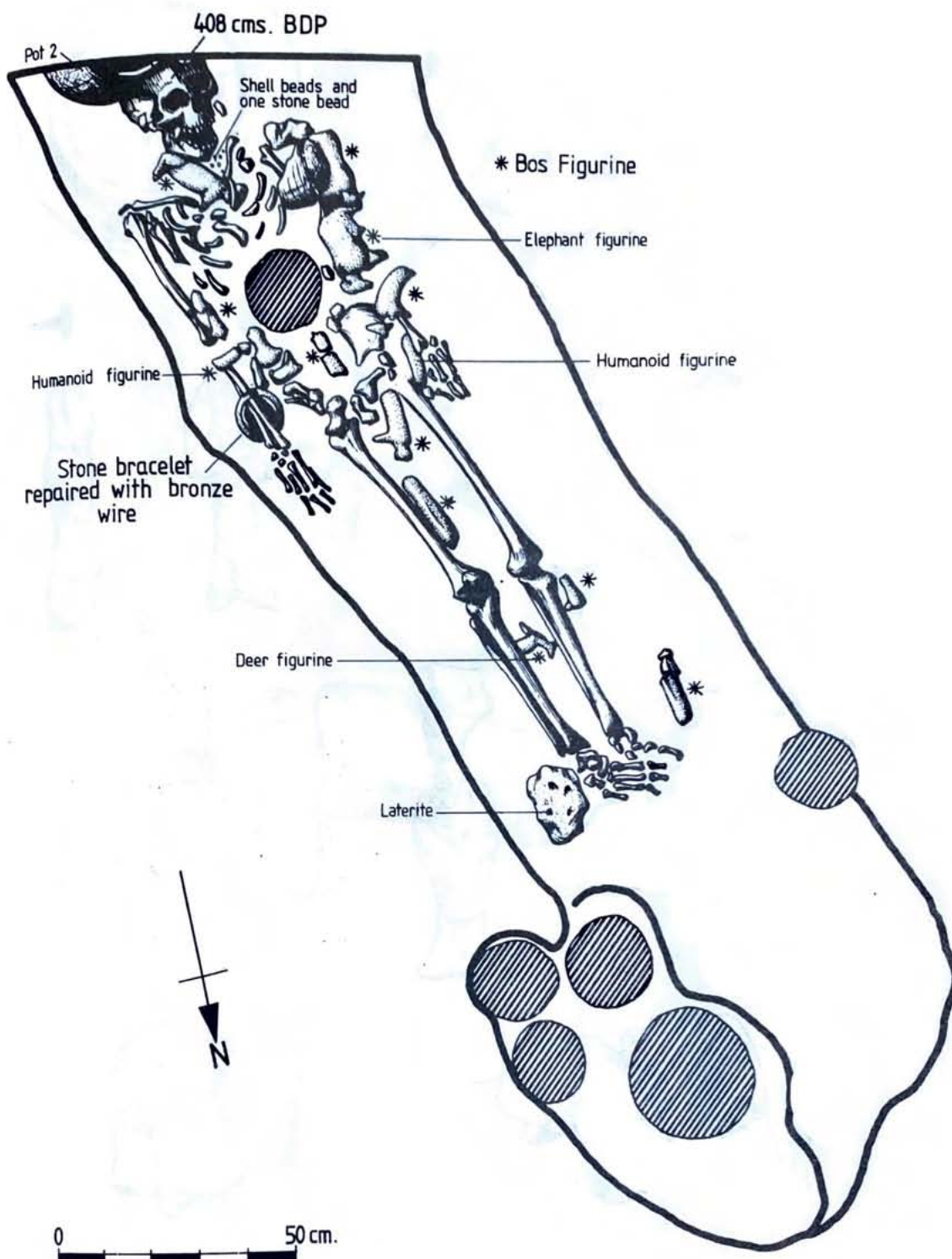


FIGURE 8-14

Ban Na Di burial 47 square F6 MP 1a

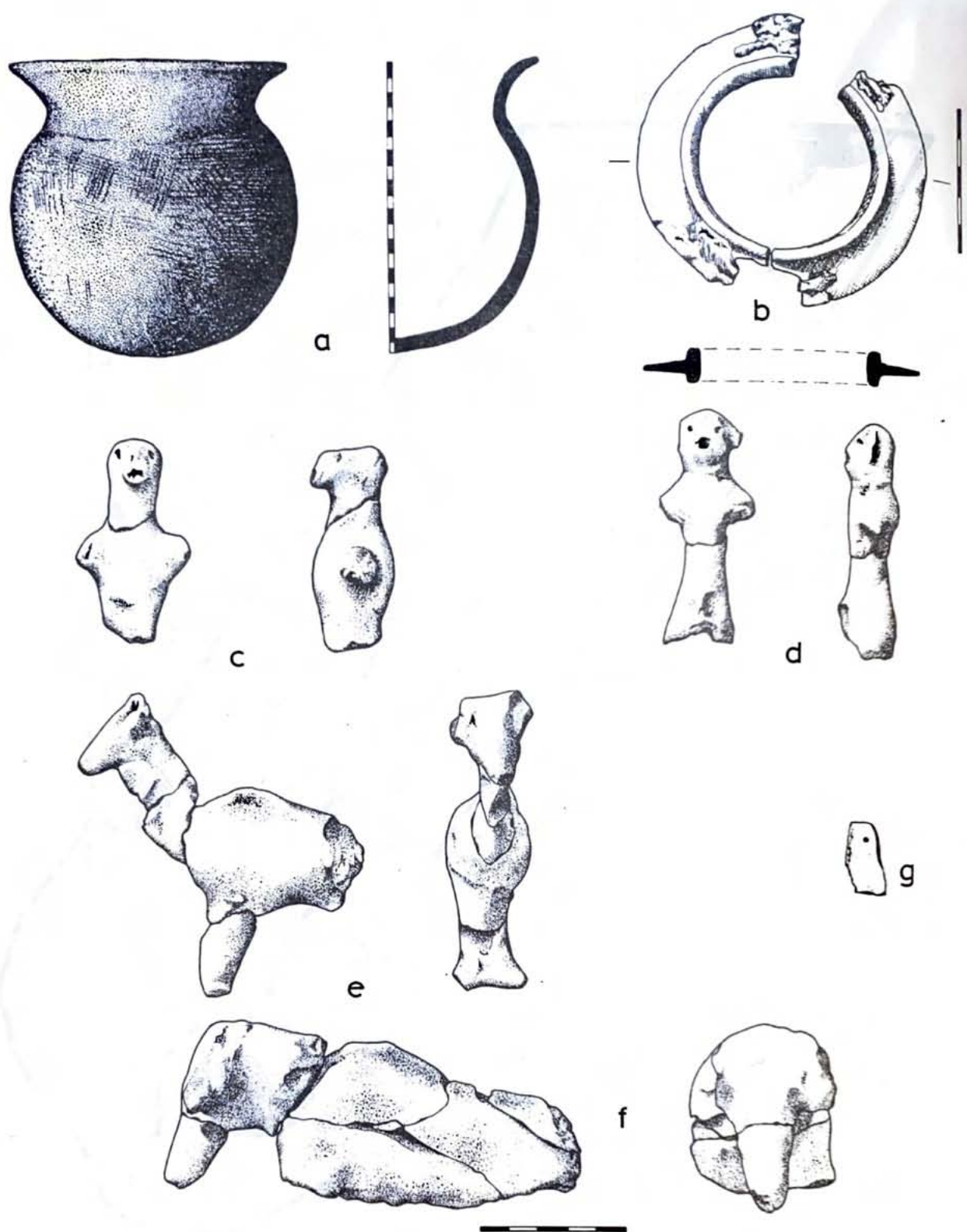


FIGURE 8-15

The grave assemblage from burial 47 (MP 1a)
 A. pot no.2 B. marble bracelet Cat.1307 C and D. human figurines
 cats.1394 and 1404 E. deer figurine Cat.1402 F. elephant figurine Cat.1405
 G. stone bead Cat.1297

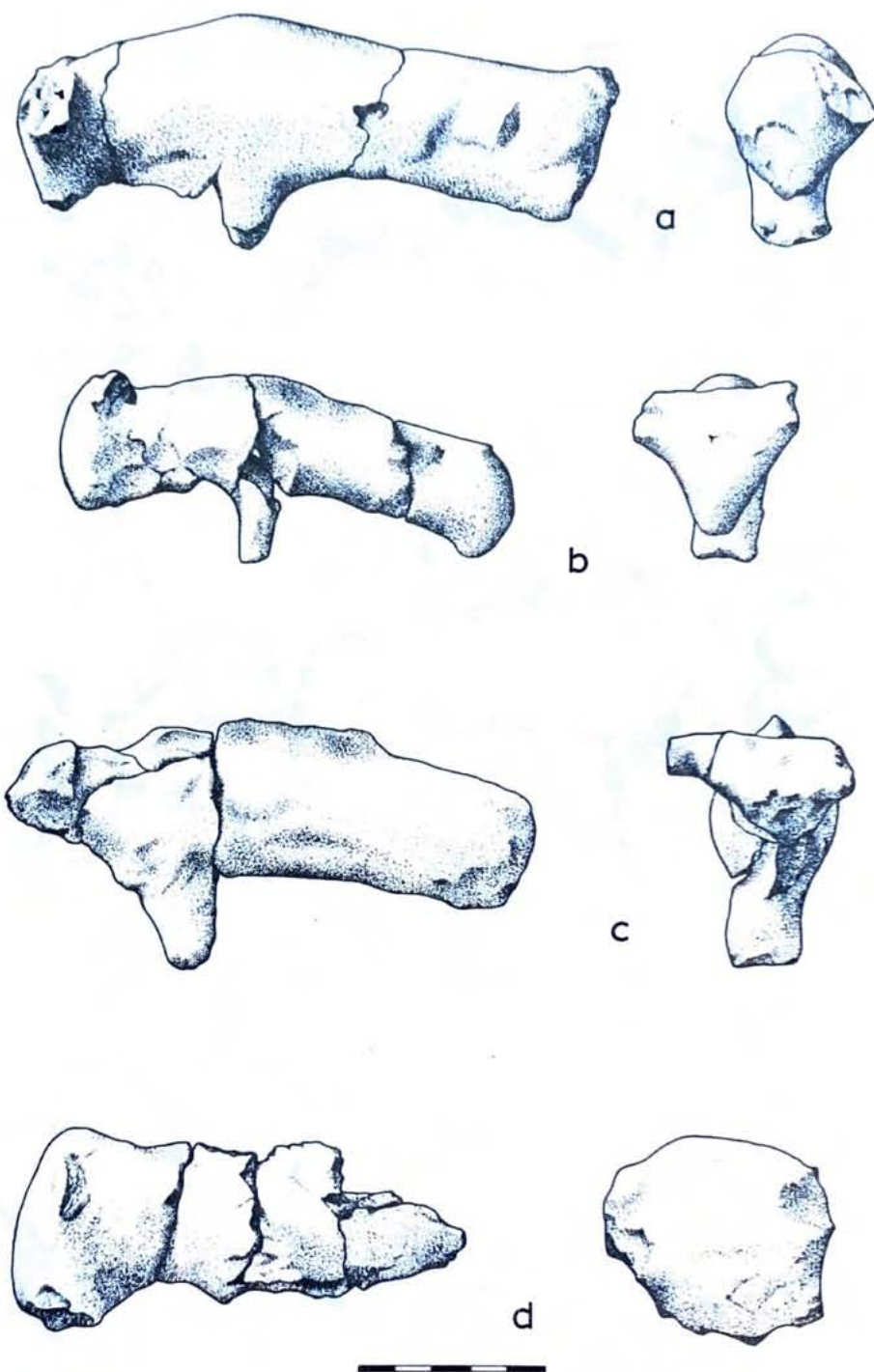


FIGURE 8-16

The cattle figurines from burial 47
A. Cat.1396 B. Cat.1397 C. Cat.1401 D. Cat.1403

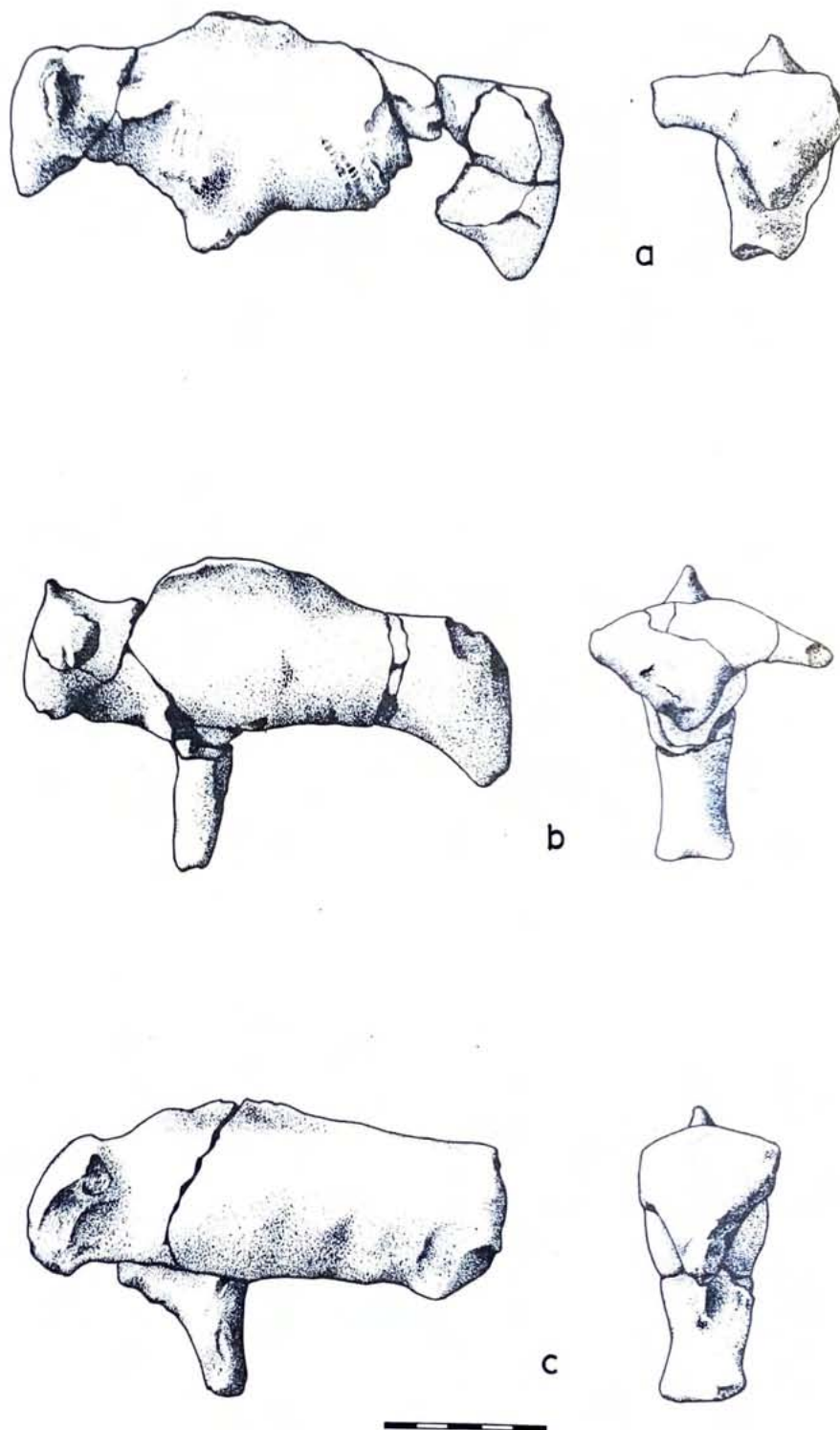


FIGURE 8-17

Cattle figurines from burial 47 (cont.)
 A. Cat.1388 B. Cat.1389 C. Cat.1399

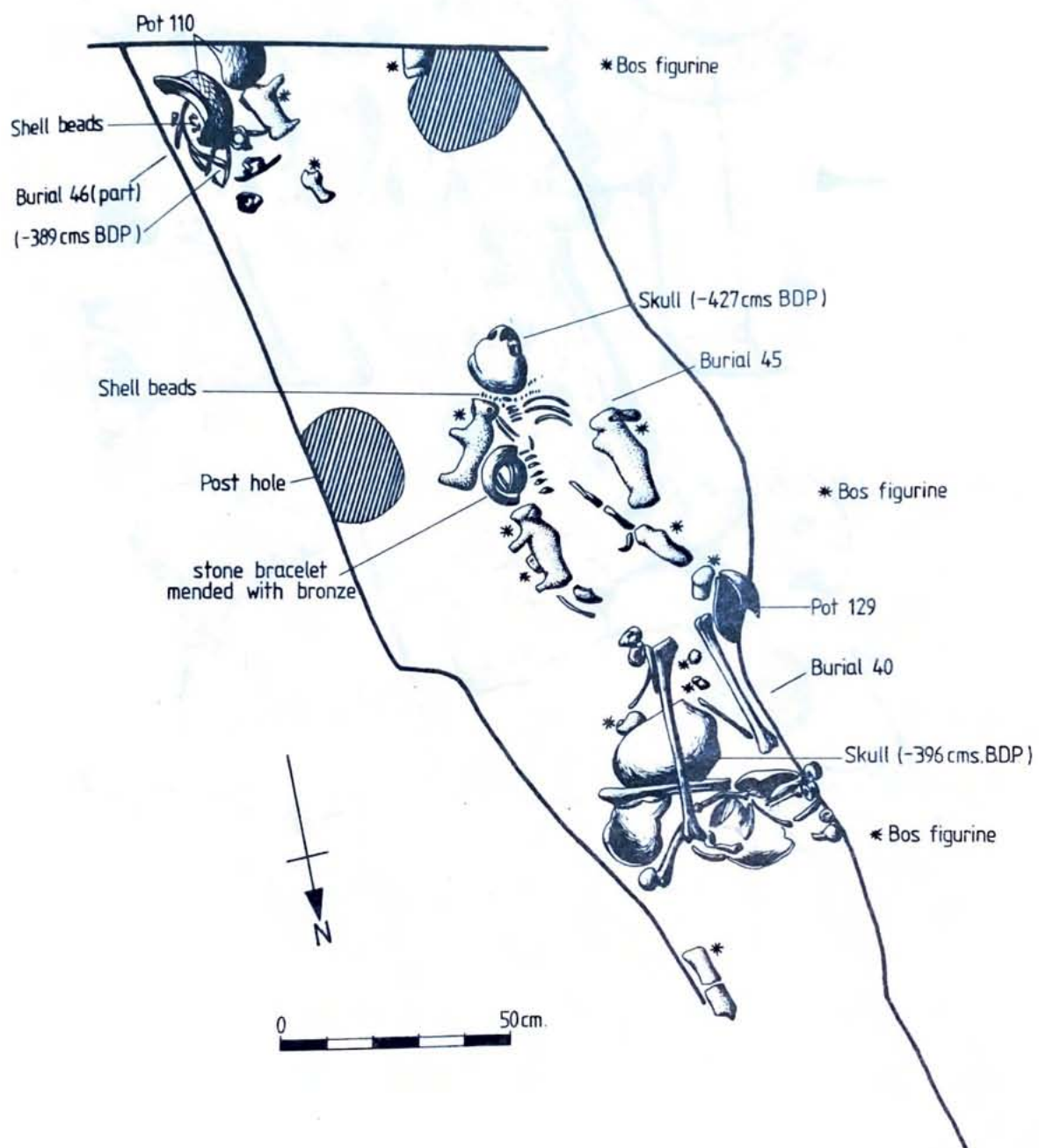


FIGURE 8-18 Ban Na Di burials 40, 45 and 46. Sq.F6, MP 1a

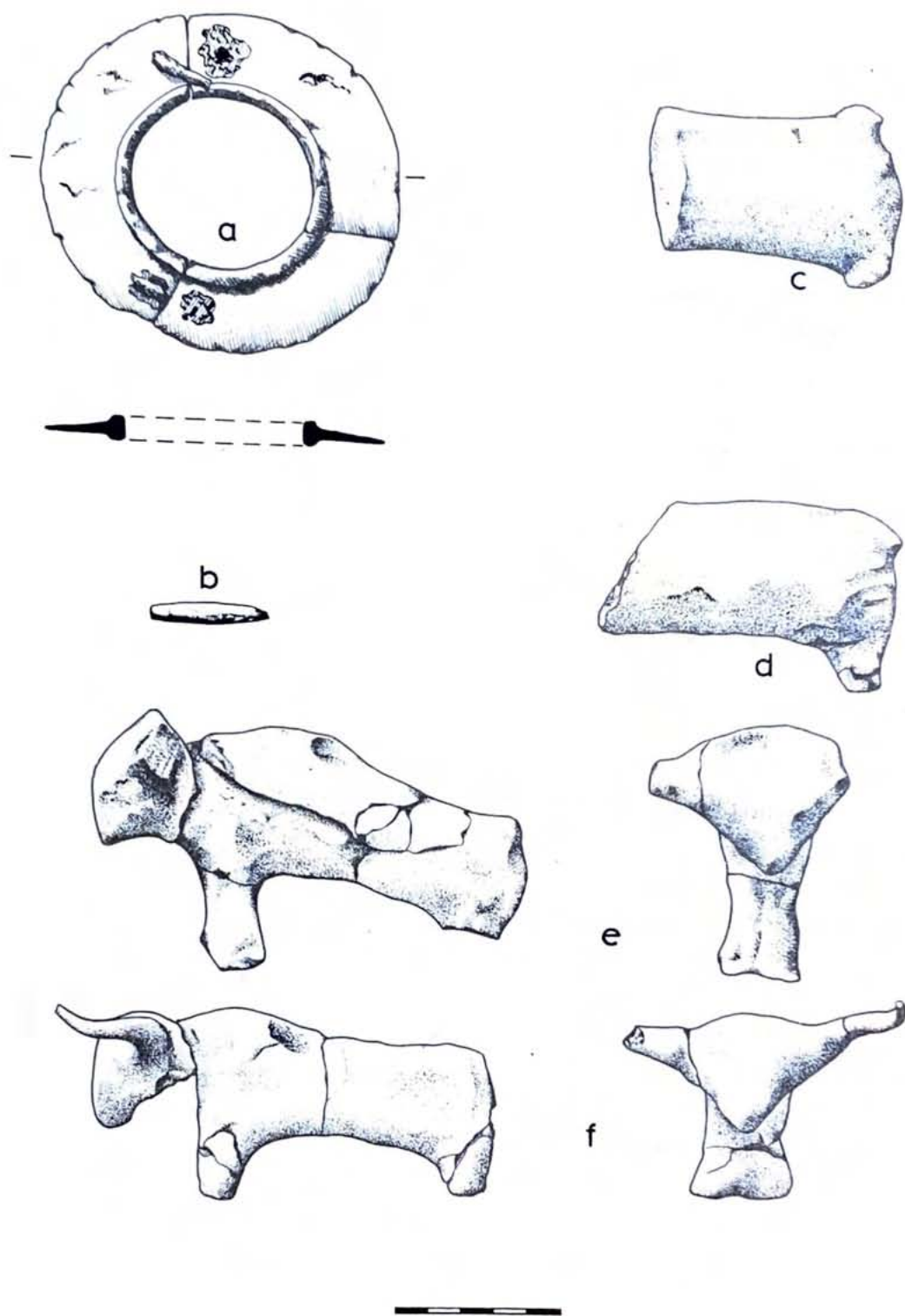


FIGURE 8-19

The grave assemblage from burial 45
 A. marble bracelet Cat.1417 B. large shell bead Cat.1863
 C-F. cattle figurines Cats.1387, 1384b, 1384a, and 1383

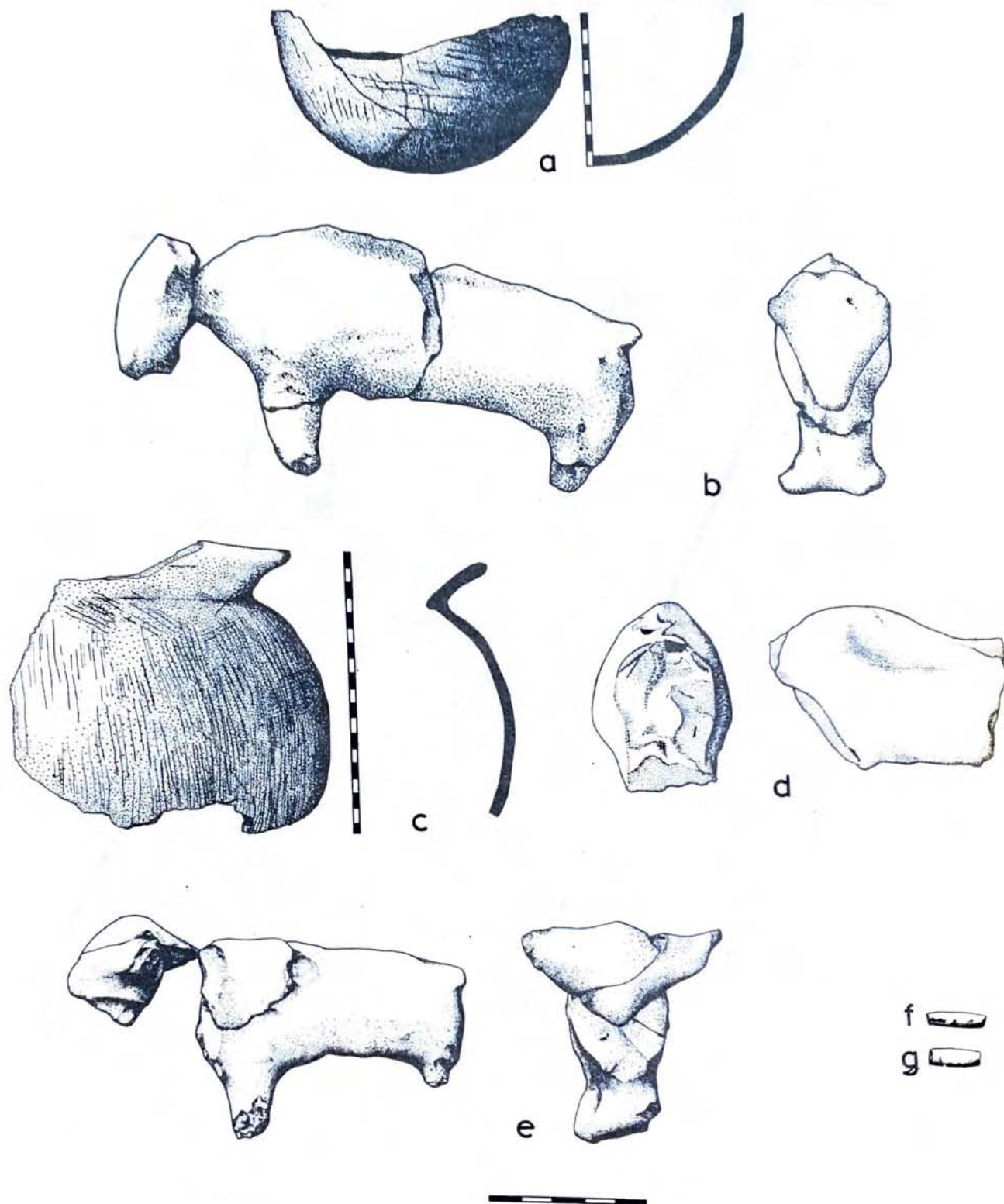


FIGURE 8-20

The grave assemblages from burials 40 (a-b) and 46 (c-g)
 A. pot no.129 B. cattle figurine Cat.1439 C. pot no.110 D and E.
 cattle figurines Cats.1436 and 1437 F and G. large shell beads
 Cats.1862a and 1862b

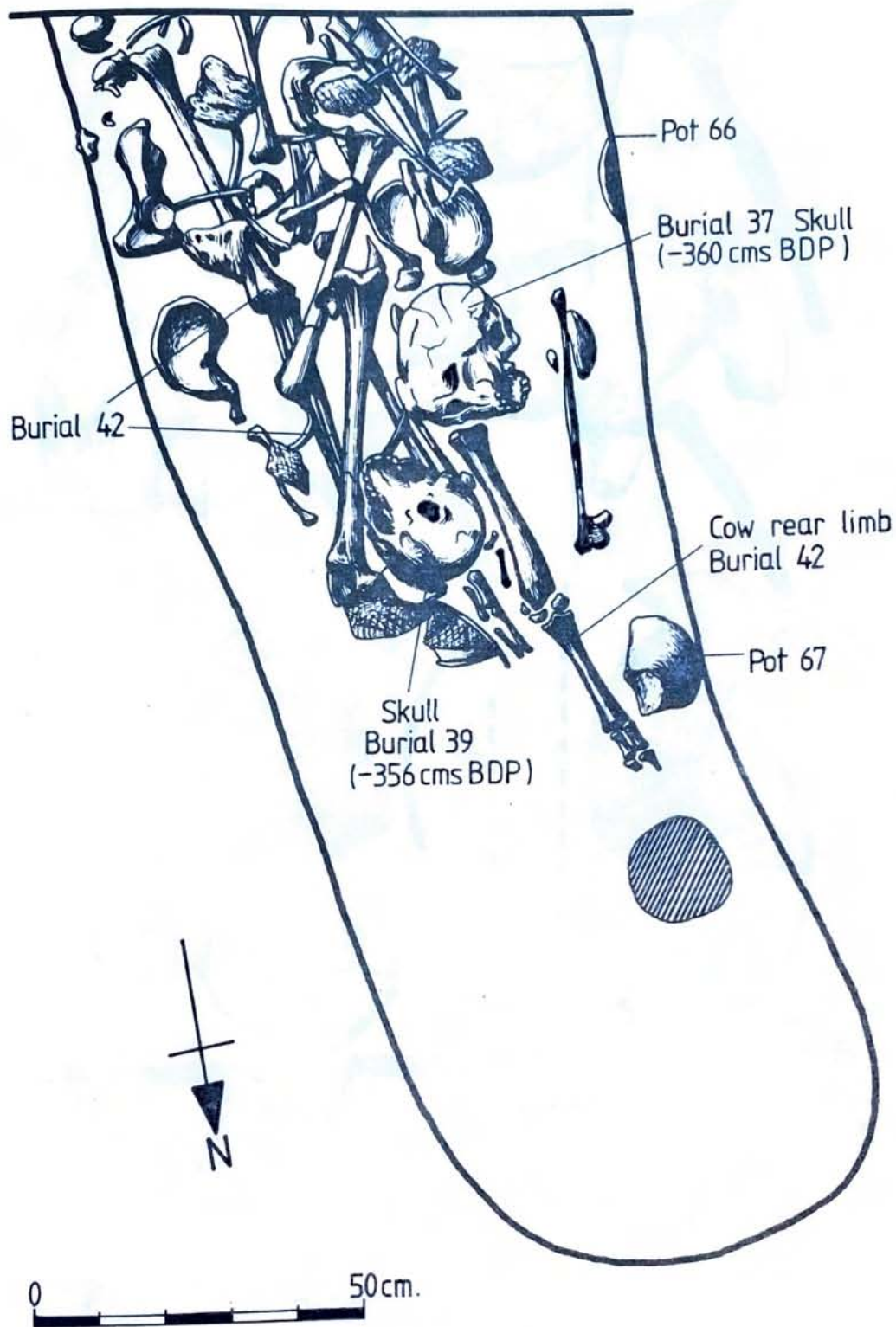


FIGURE 8-21

Ban Na Di burials 37 and 39 square F6 MP 1b

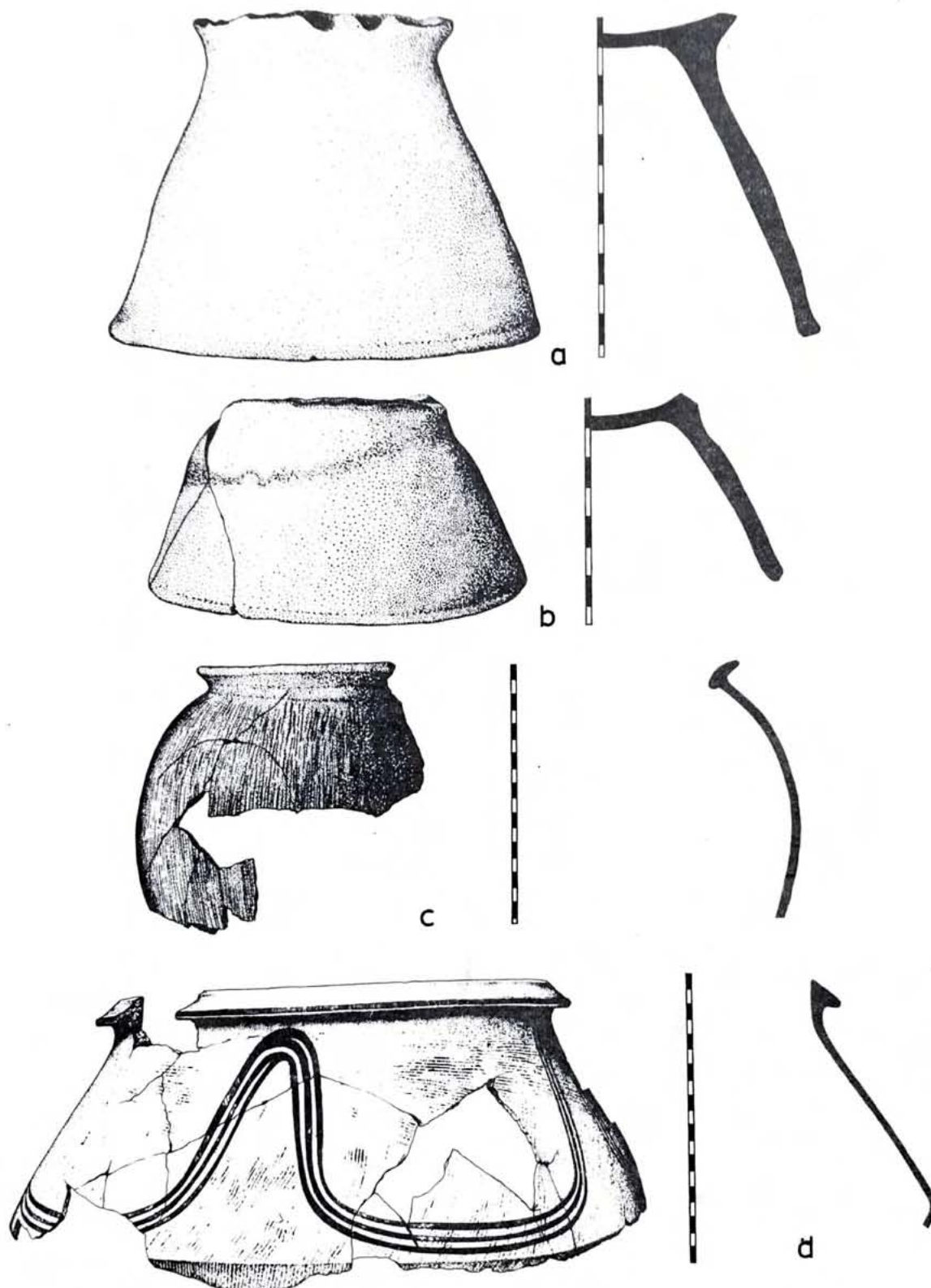


FIGURE 8-22

The grave assemblage from burials 37 and 39 (a-b)
and burial 21 (c-d)

A. pot no.66 B. pot no.67 C. pot no.121 D. pot no. 97

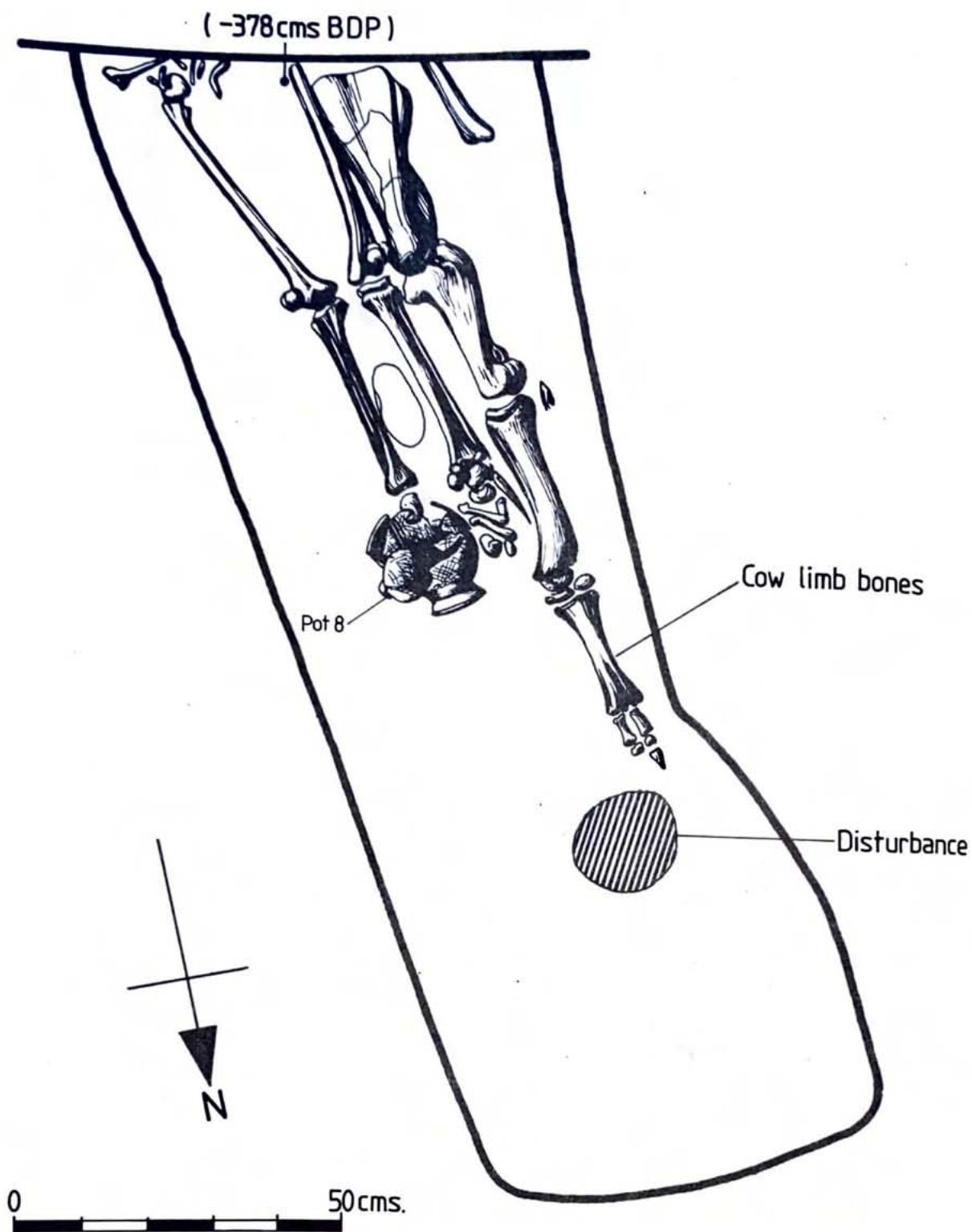


FIGURE 8-23

Ban Na Di burial 42 square F6 MP 1b

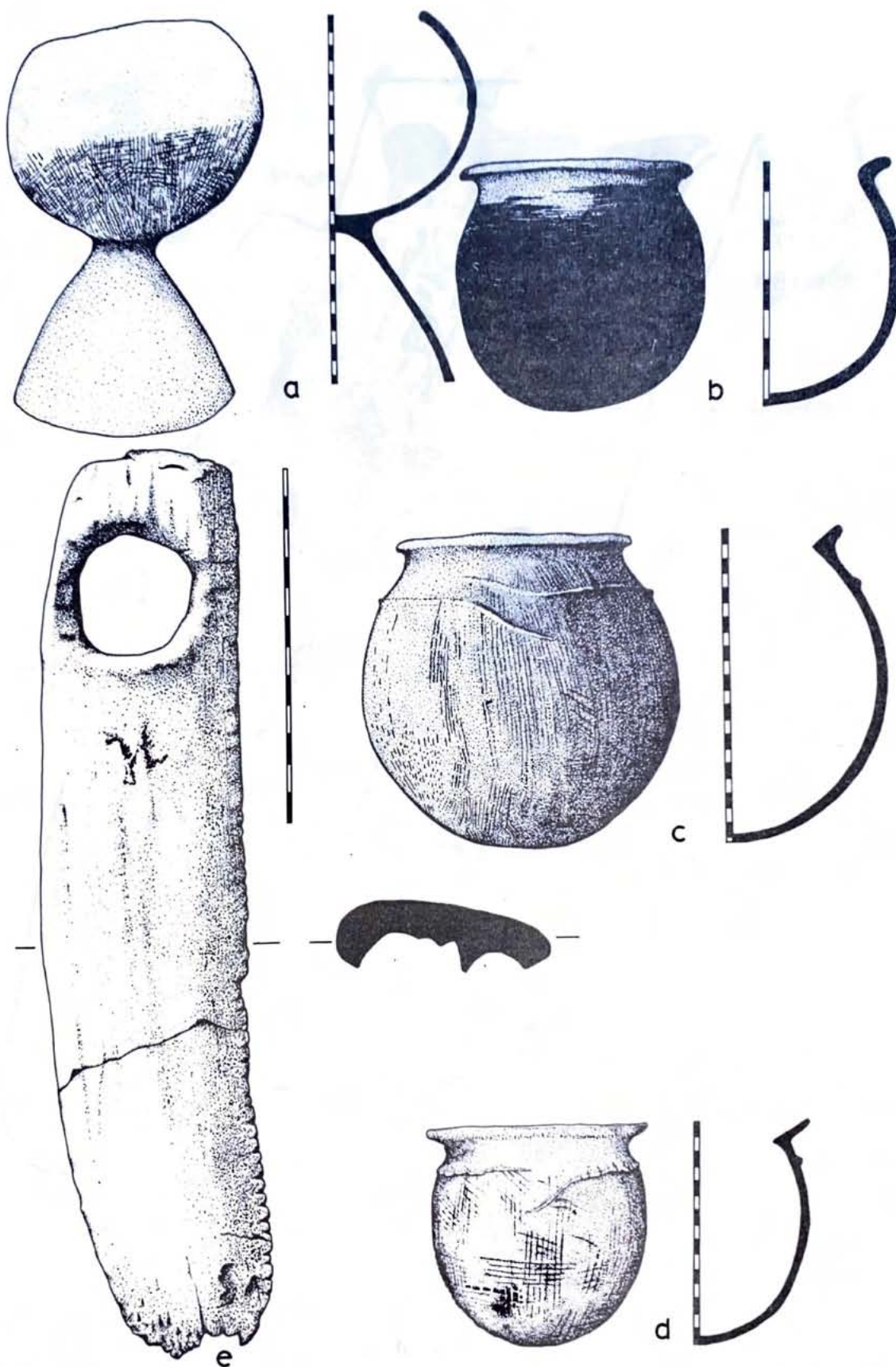


FIGURE 8-24 Ban Na Di: the grave assemblage from burial 50 (a-c) and burial 42 (d-e). A. pot no. 46 B. pot no. 90 C. pot no. 23 D. pot no. 8 E. bone implement cat.1383

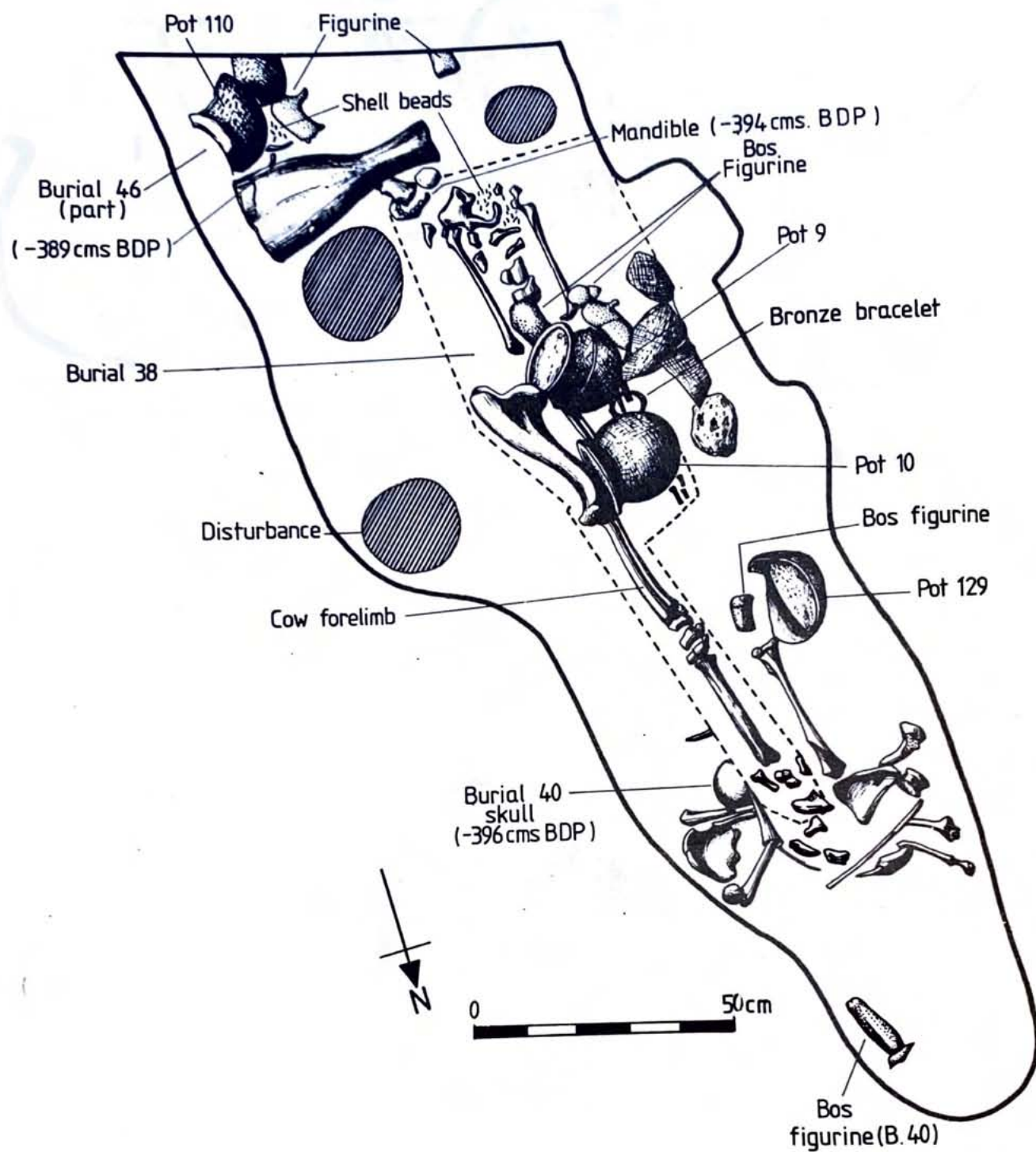


FIGURE 8-25

Ban Na Di burial 38 square F6 MP 1b

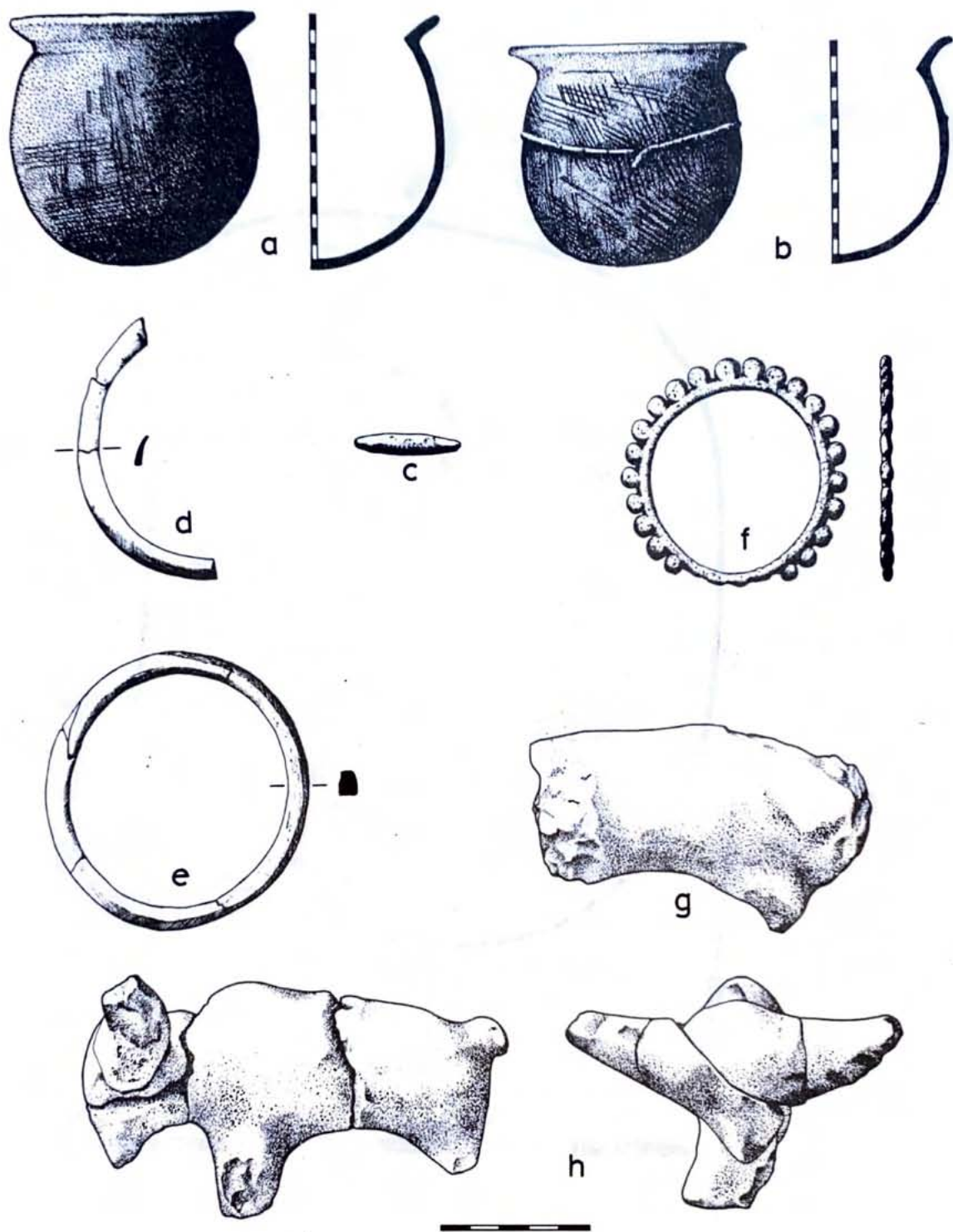


FIGURE 8-26

The grave assemblage from burial 38

A. pot no. 10 B. pot no. 9 C. large shell bead cat.1861 D-E trochus shell bracelets cats.1194a-b F. bronze bracelet Cat.1193 G-H cattle figurines cats.1419a-b.

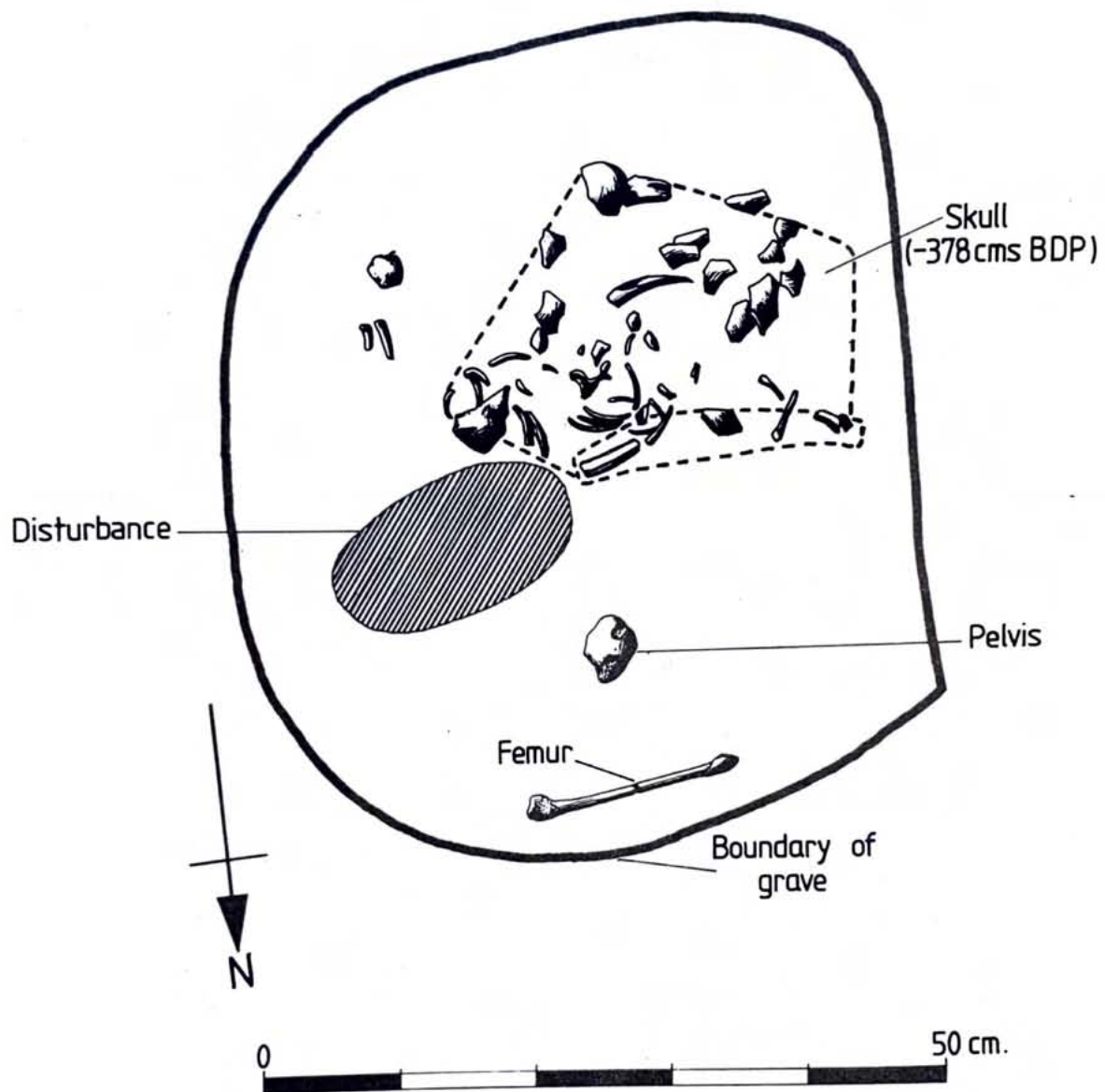


FIGURE 8-27

Ban Na Di burial 41 square F6 MP 1a

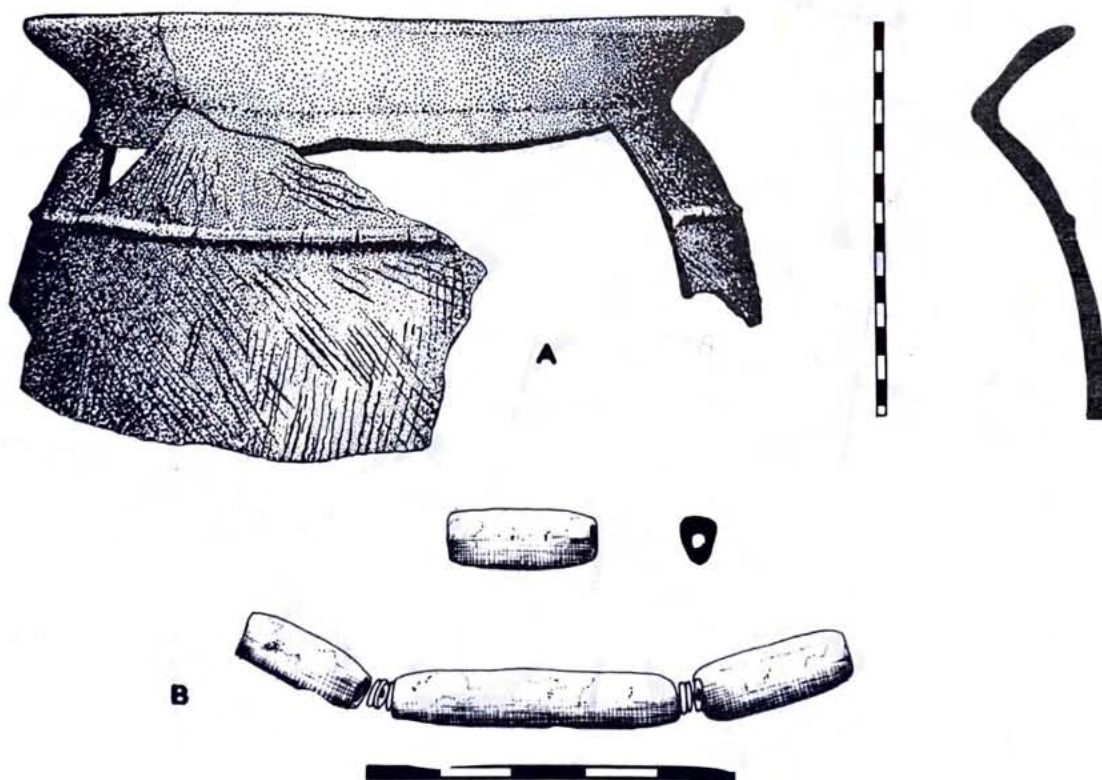
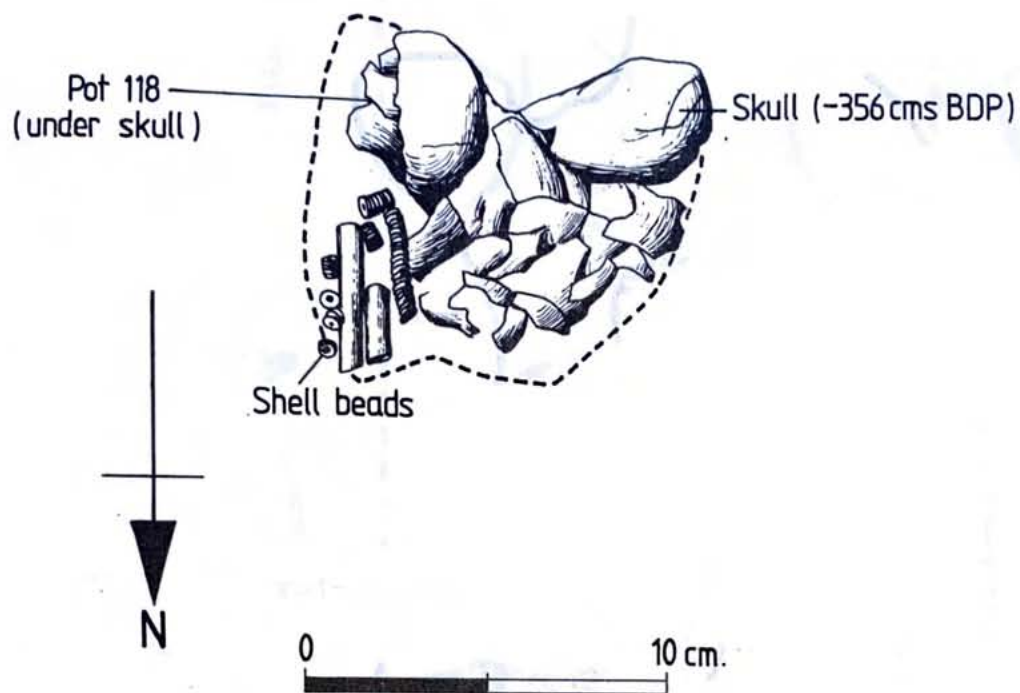


FIGURE 8-28

Ban Na Di burial 44 square F6 MP 1a and the grave assemblage. a. pot no. 118 b. large shell beads Cats.1210a-b

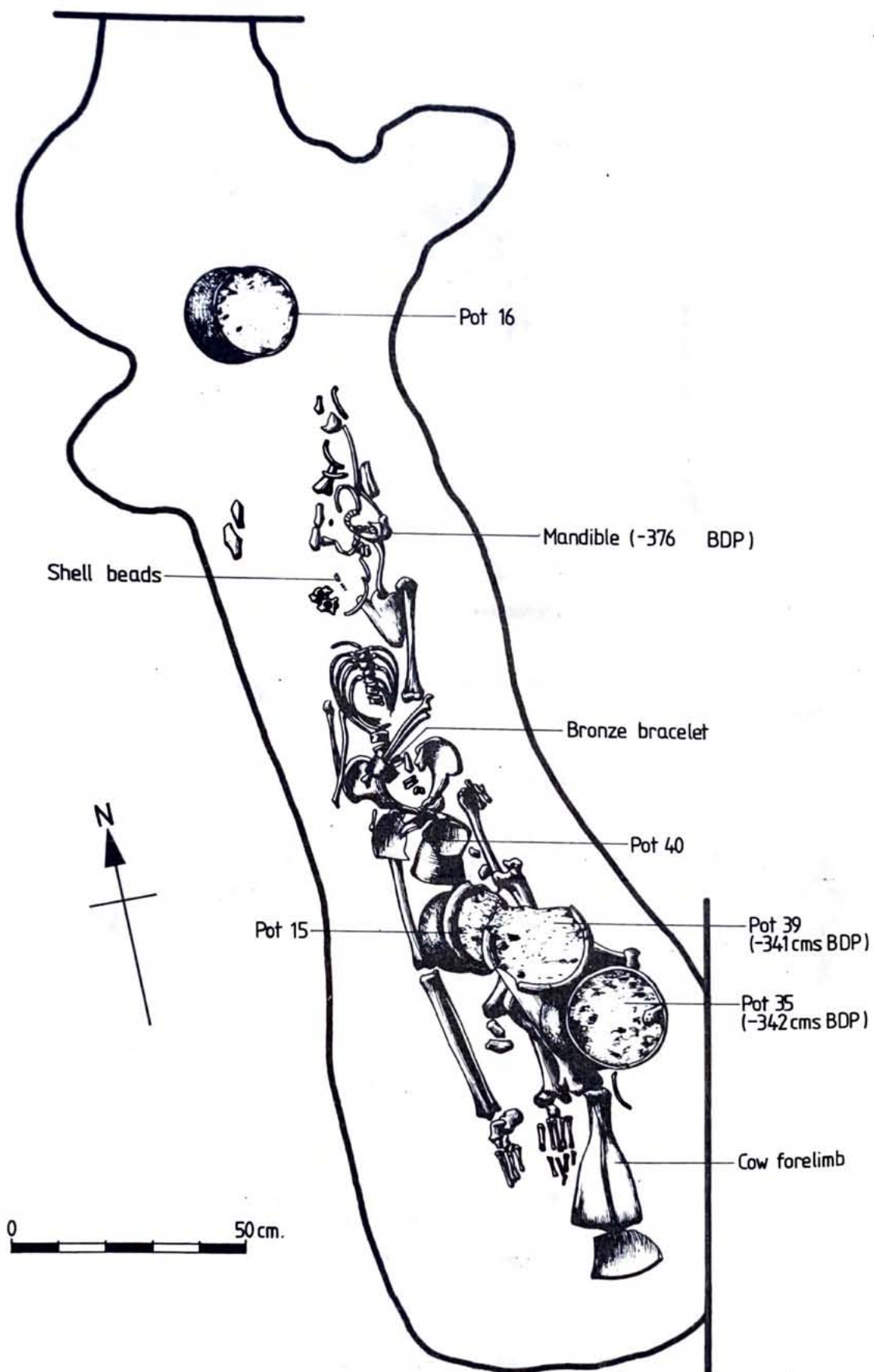


FIGURE 8-29 Ban Na Di burial 36, square F6 MP 1b

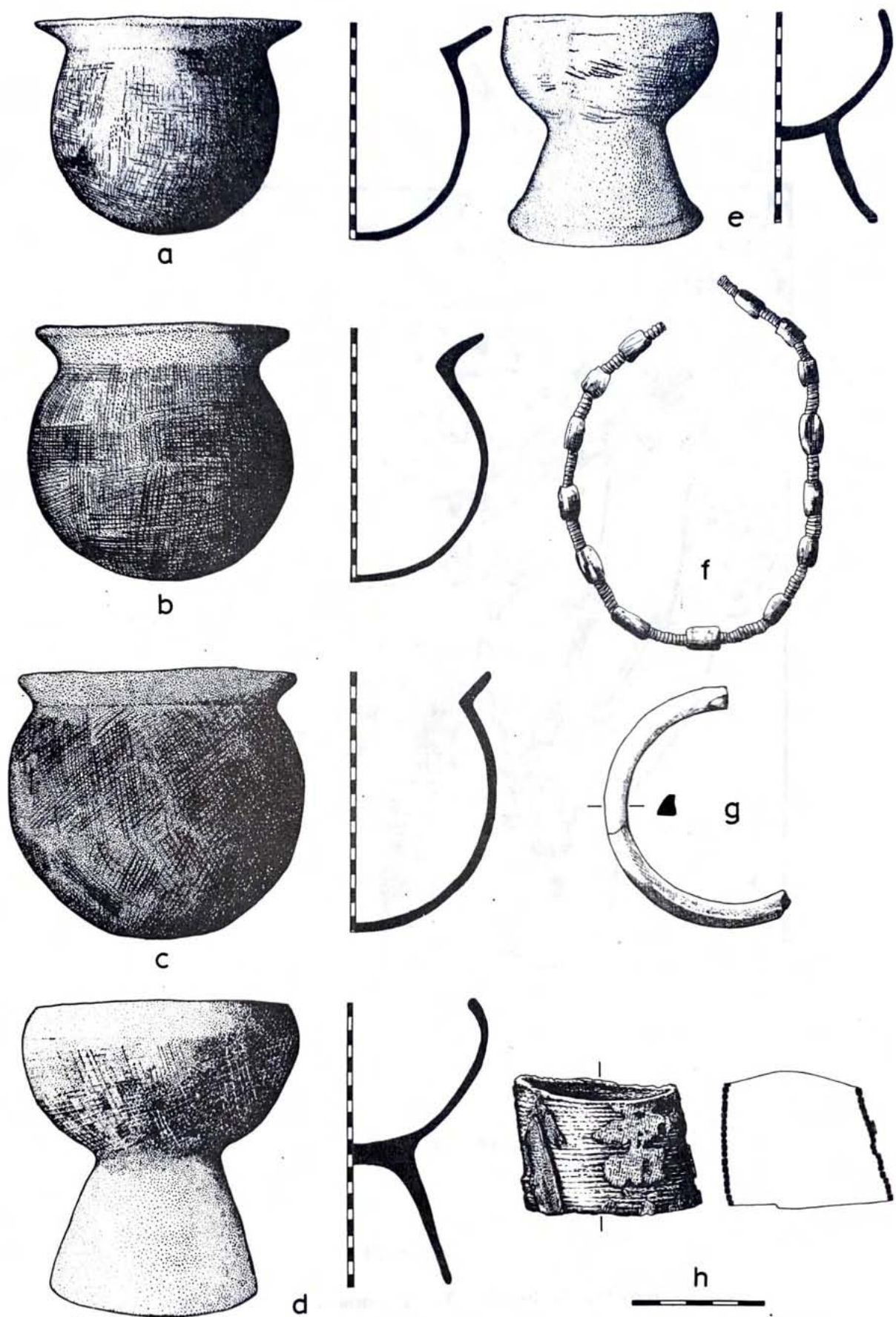


FIGURE 8-30 Ban Na Di: the grave assemblage from burial 36
A. pot no. 15 B. pot no. 16 C. pot no. 35 D. pot no. 39
E. pot no. 40 F. large shell beads Cats.1147a-n G. trochus shell
bracelet Cat 1146 H. bronze bracelets Cat.1228

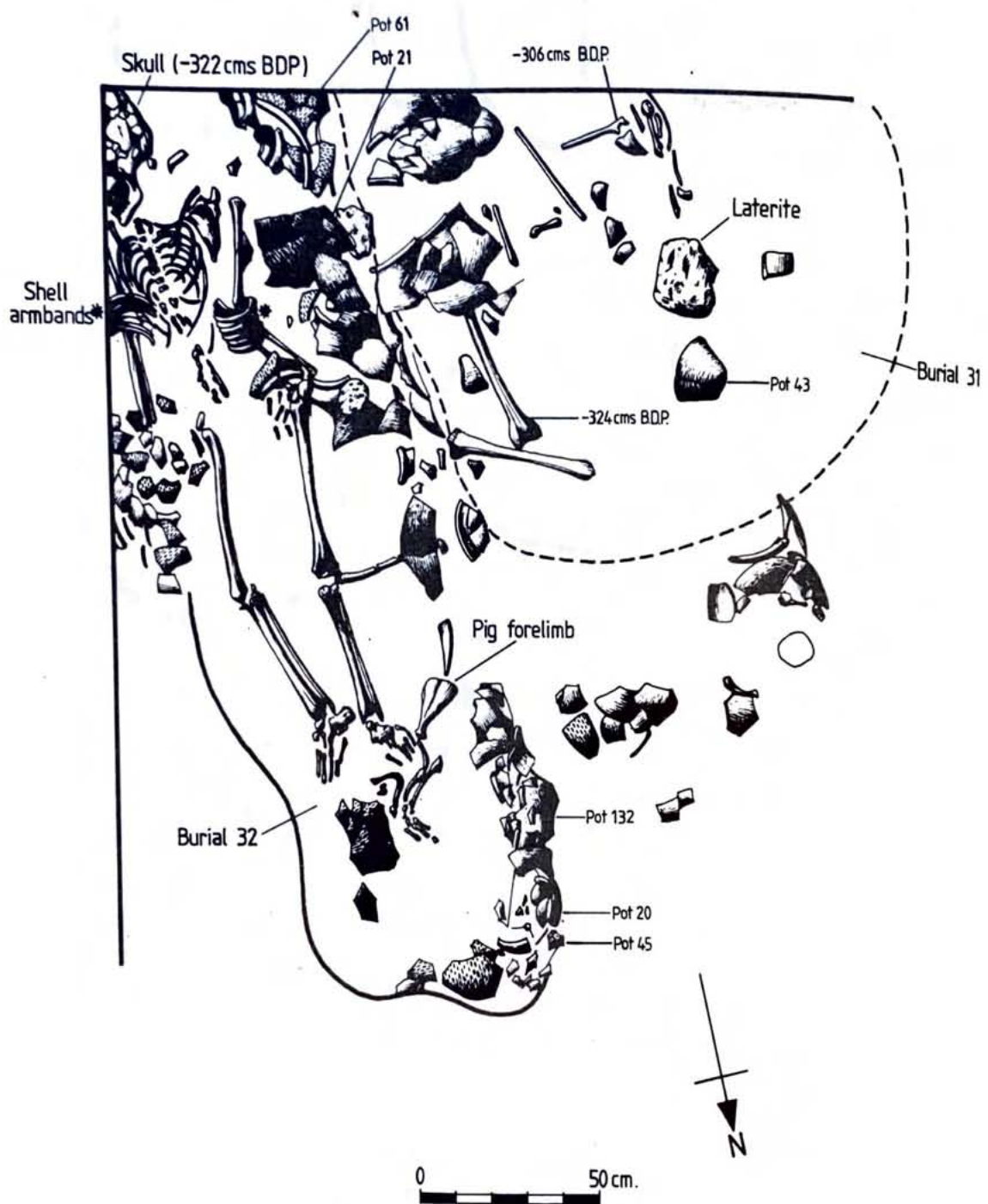


FIGURE 8-31

Ban Na Di: burials 31-32 square F6 MP 1c

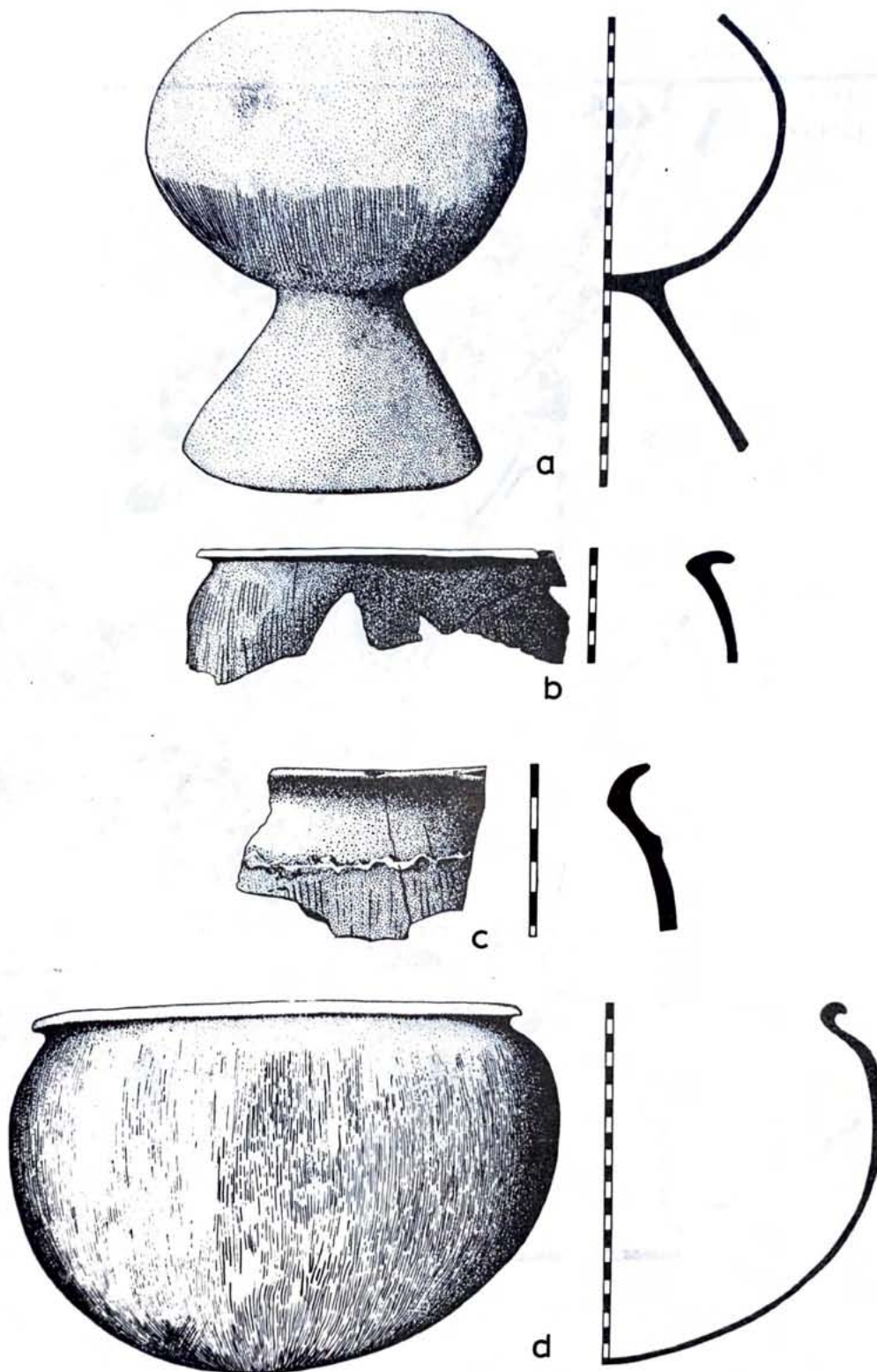


FIGURE 8-32

Ban Na Di: The grave assemblage from burial 31
A. pot no. 43 B. pot no. 134 C. pot no. 133 D. pot no. 79

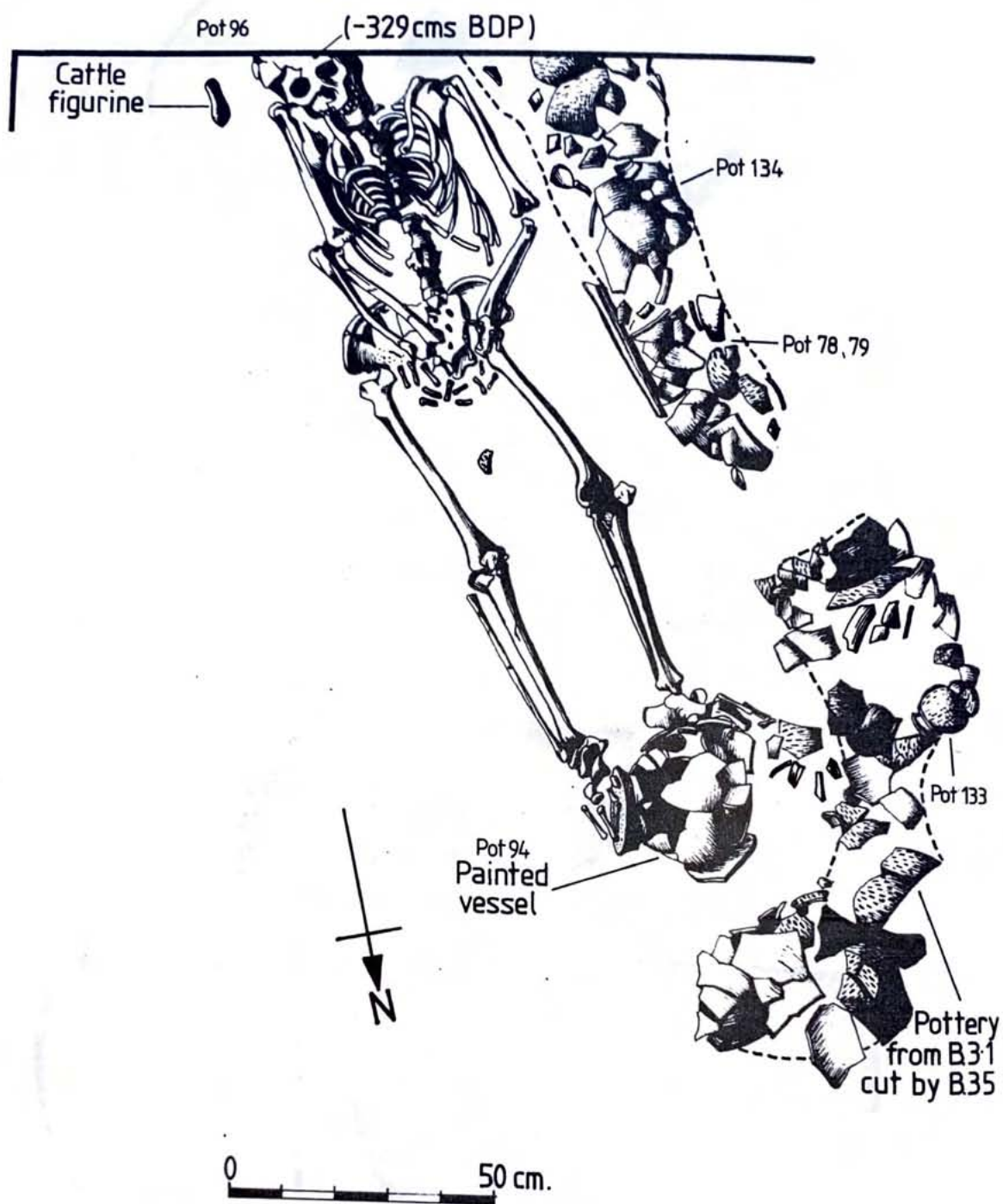


FIGURE 8-33

Ban Na Di burial 35 square F6 MP 1c

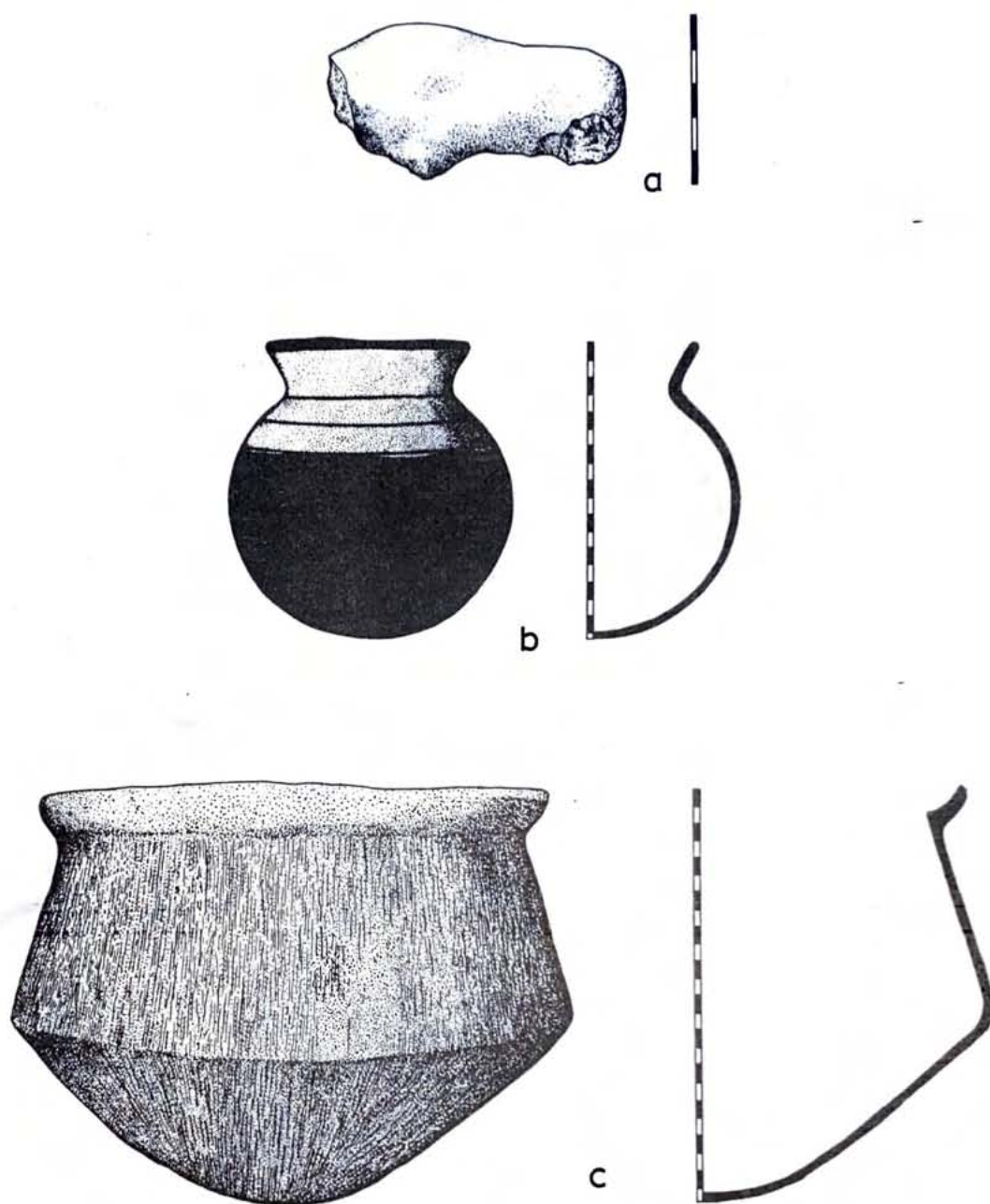


FIGURE 8-34

Ban Na Di: The grave assemblage from burial 35
 A. cattle figurine Cat.1280 B. pot no. 94 C. pot no. 96

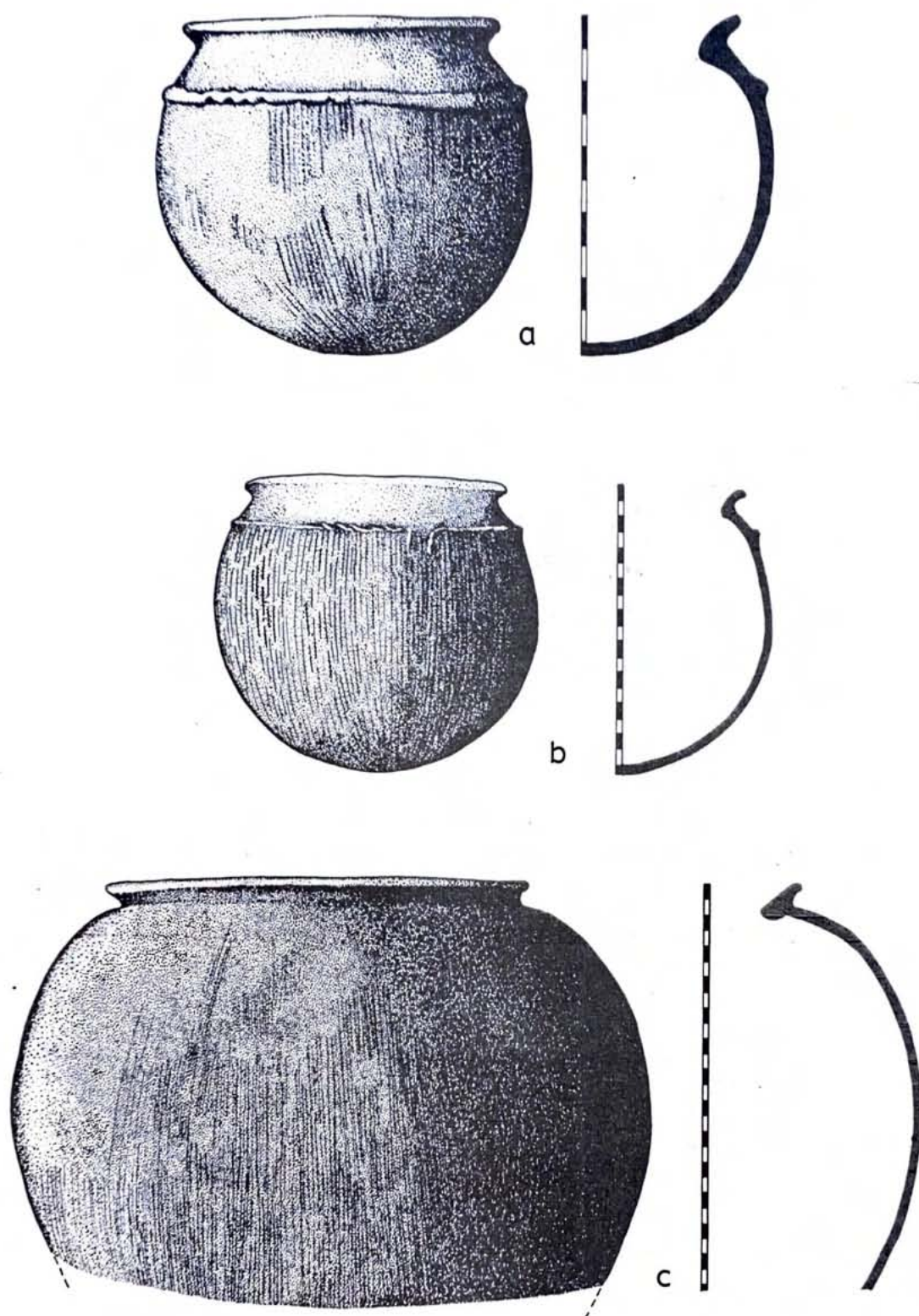


FIGURE 8-35

Ban Na Di: The grave assemblage from burial 32
 A. pot no. 20 B. pot no. 21 C. pot no. 61

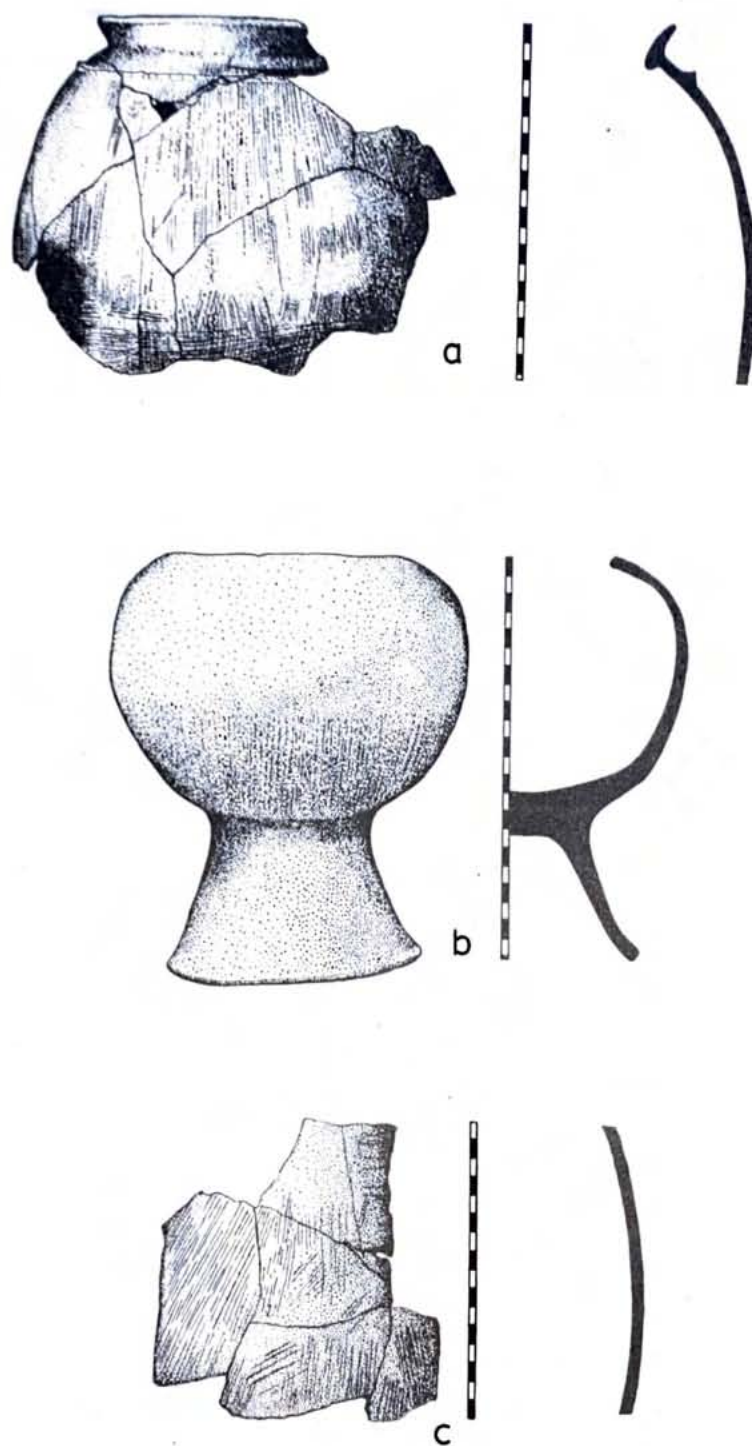


FIGURE 8-36

Ban Na Di: The grave assemblage from burial 30 (A)
and burial 32 (B-C)

A. pot no. 74 B. pot no. 45 C. pot no. 132

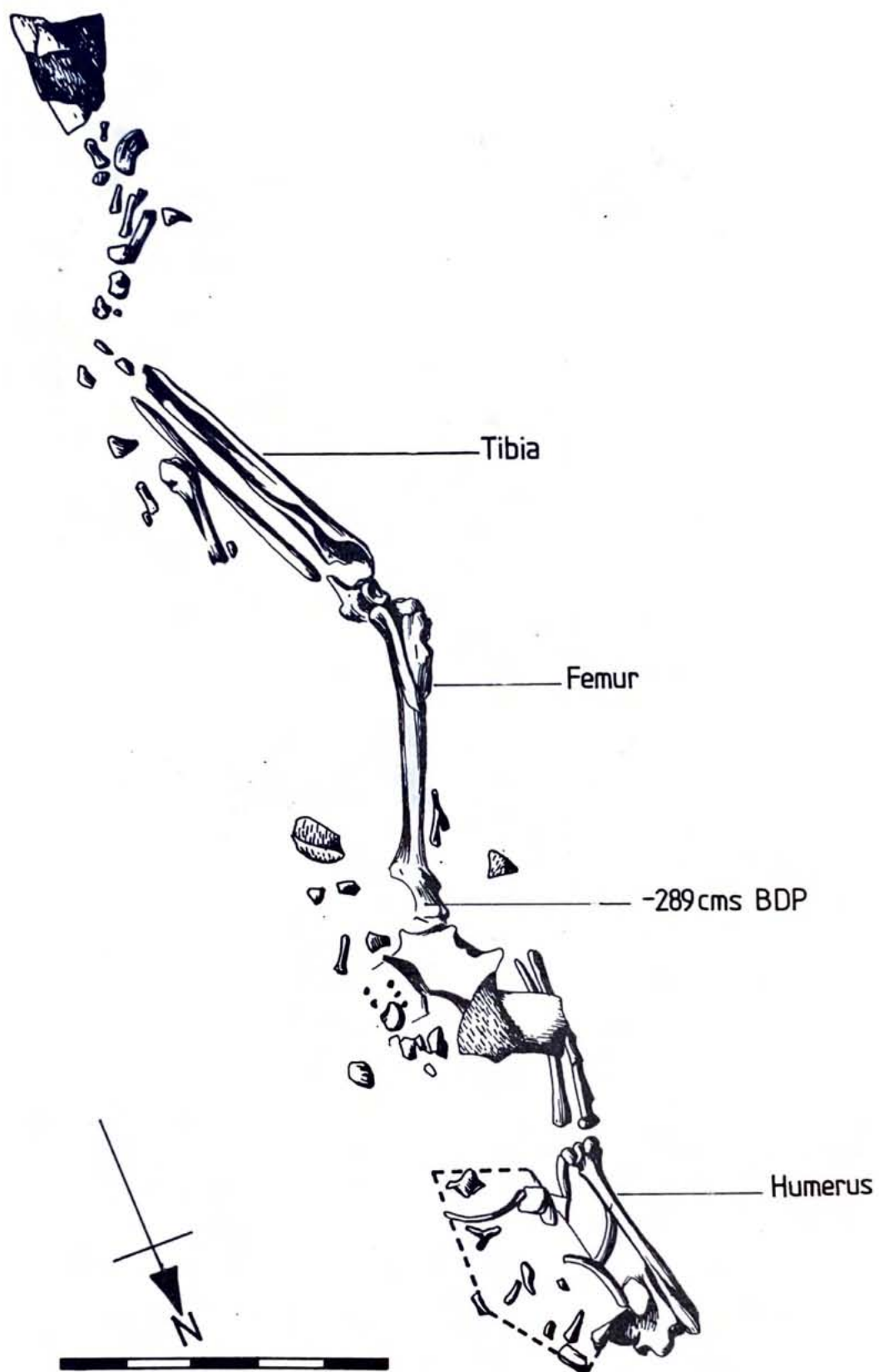


FIGURE 8-37

Ban Na Di burial 27 square F6 MP 1c

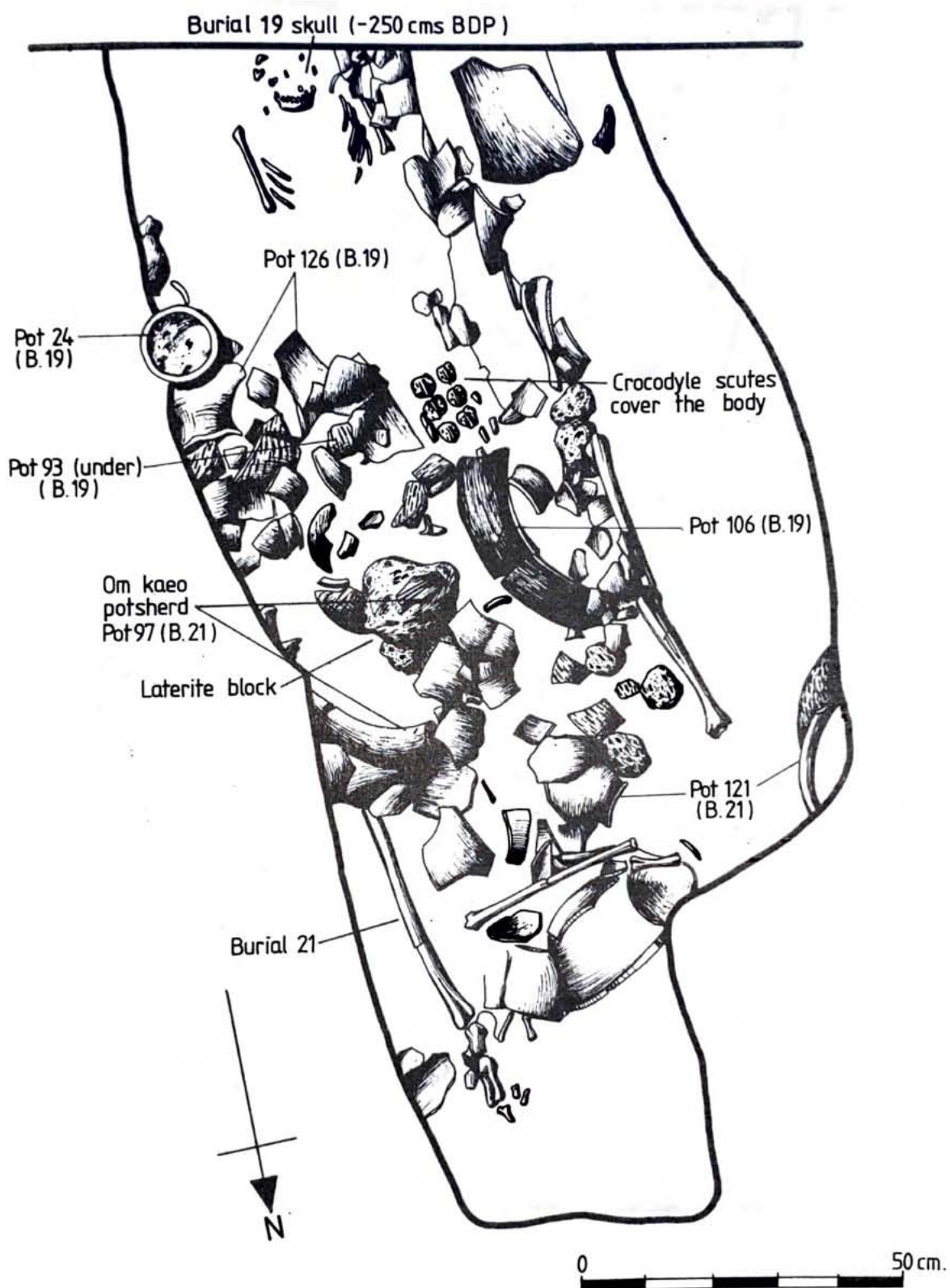


FIGURE 8-38

Ban Na Di burials 19 and 21 square F6 MP 1b

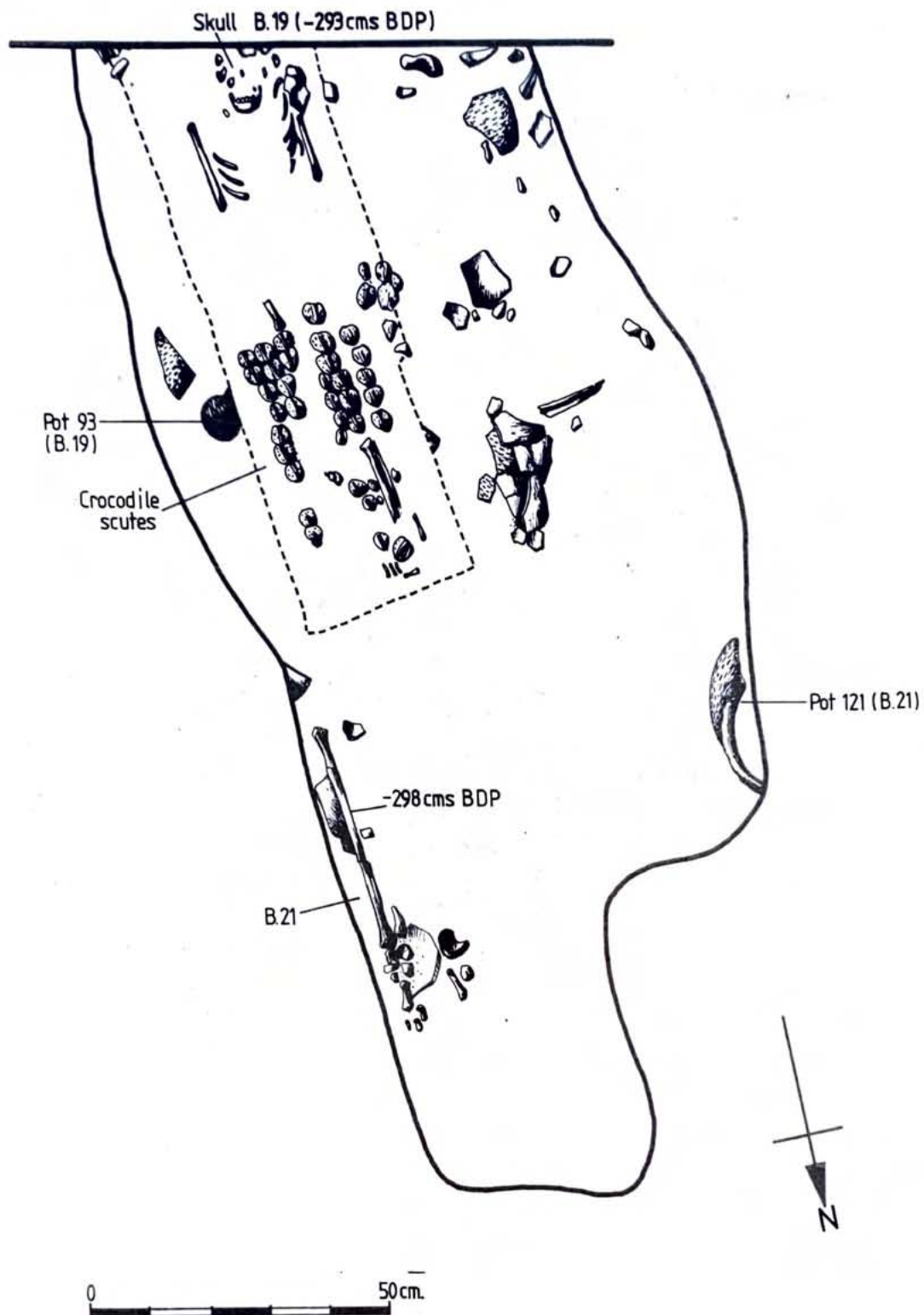


FIGURE 8-39

Ban Na Di burials 19 and 21 square F6 MP 1b
 nb. this figure is a later stage of excavation than fig 8-38

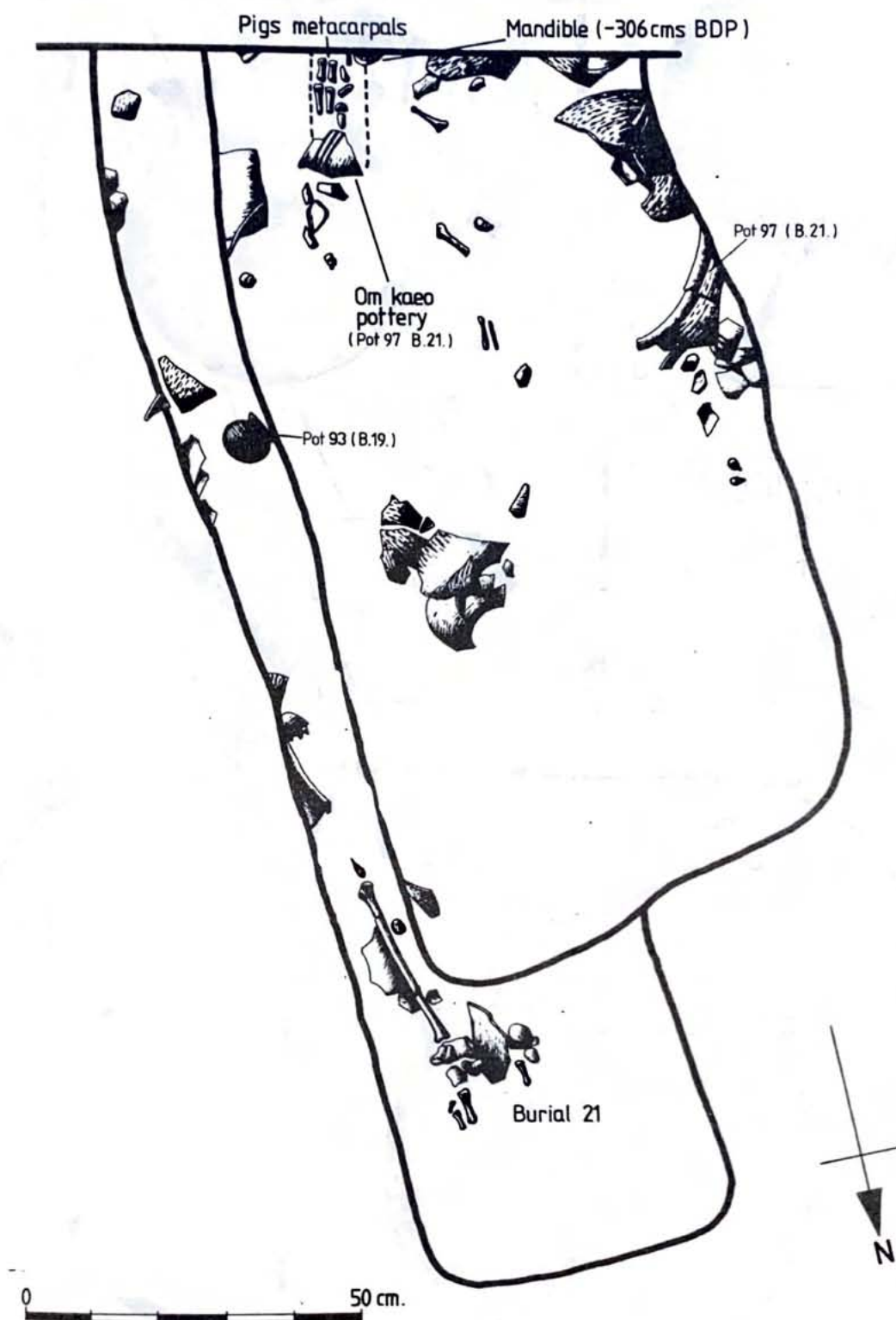


FIGURE 8-40

Ban Na Di burial 24 square F6 MP 1b

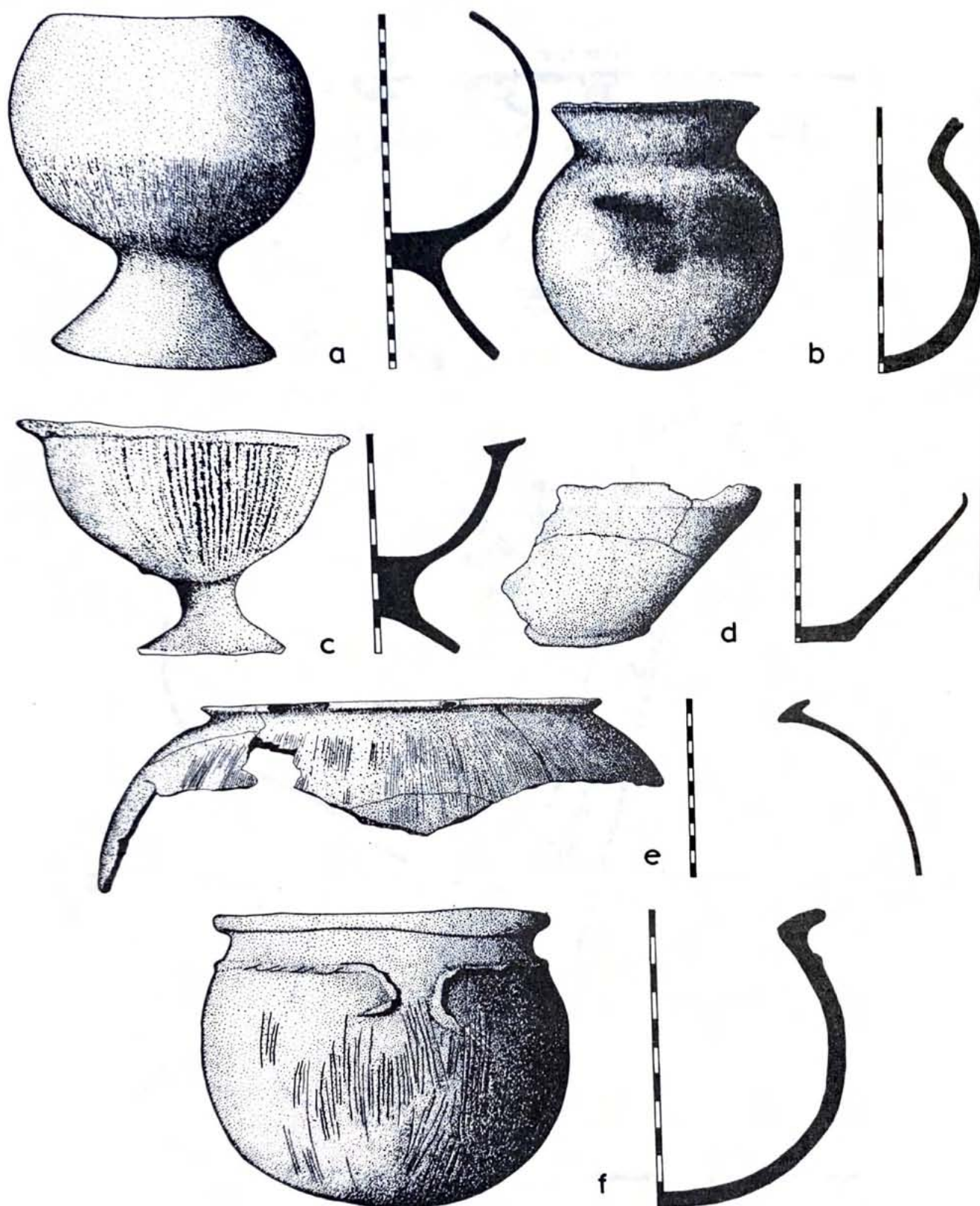


FIGURE 8-41

Ban Na Di: The grave assemblage from burial 19
 A. pot no. 49 B. pot no. 93 C. pot no. 86 D. pot no. 122
 E. pot no. 106 F. pot no. 24

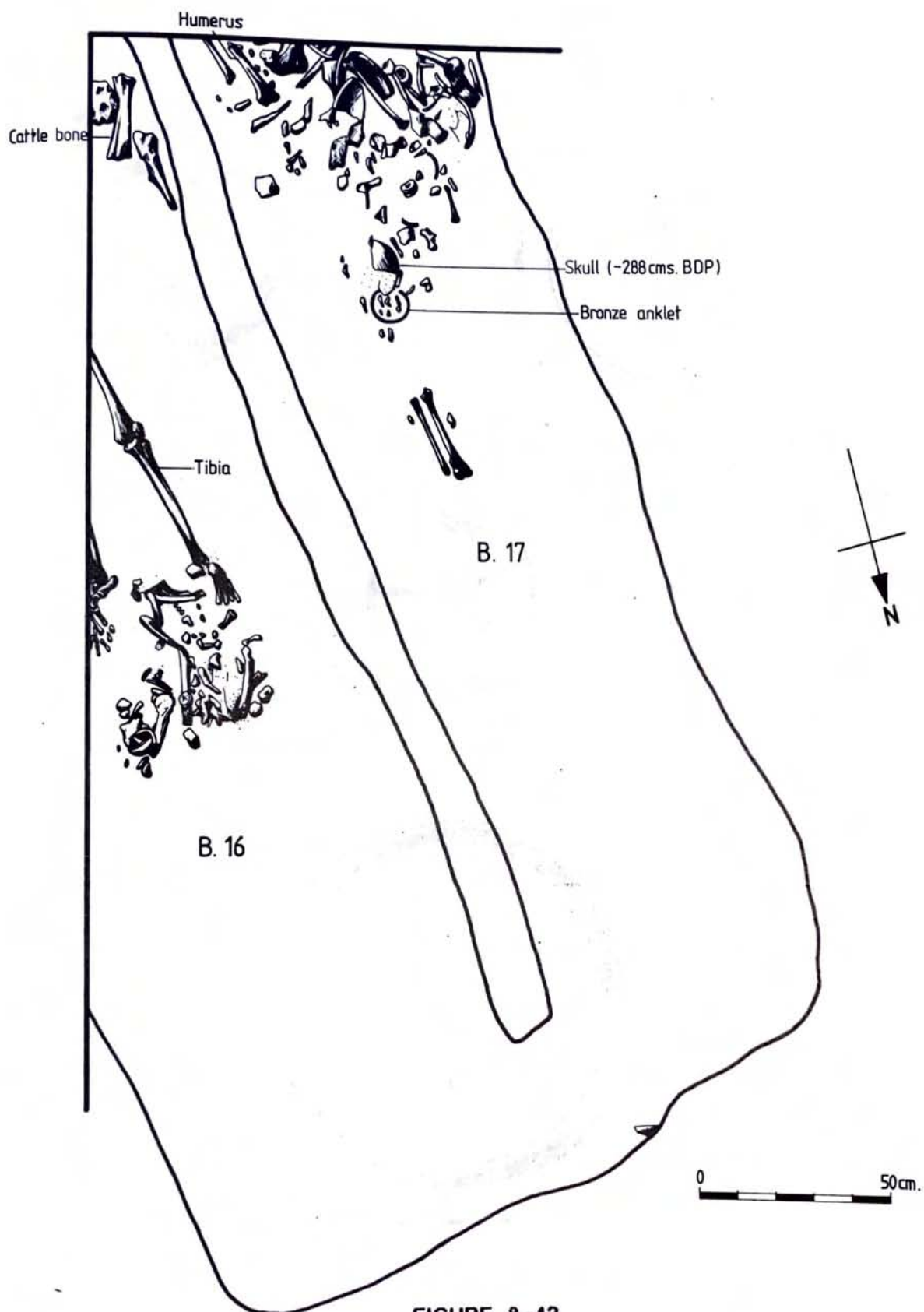


FIGURE 8-42

Ban Na Di burials 16 and 17 square F6 MP 1c

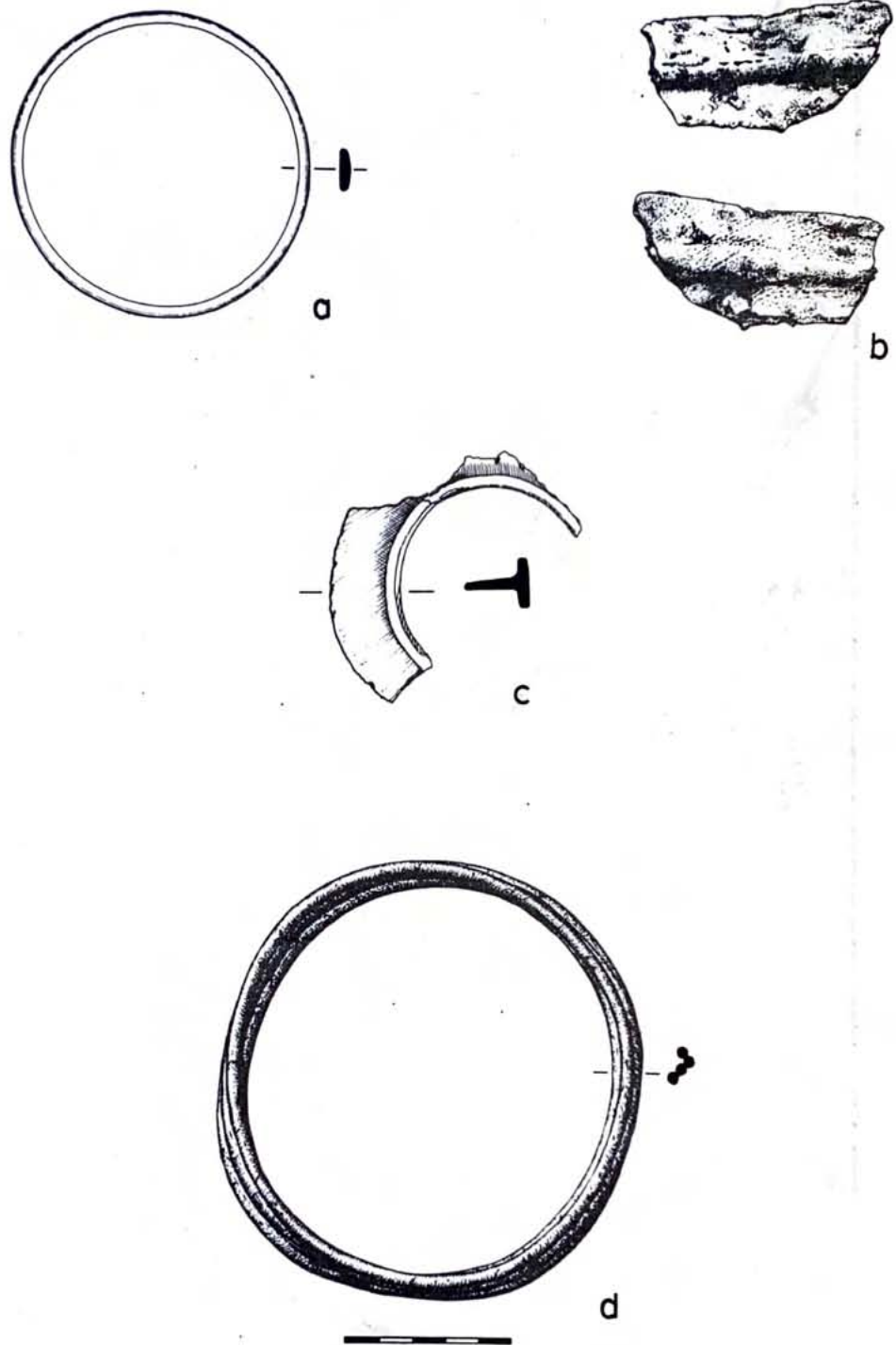


FIGURE 8-43

- Ban Na Di: the grave assemblage from burial 16
- A. iron ring, possibly a bracelet Cat.1883 B. iron spearhead Cat.1442
 C. limestone bracelet cat.1441 D. four iron circlelets Cat.1444a-d

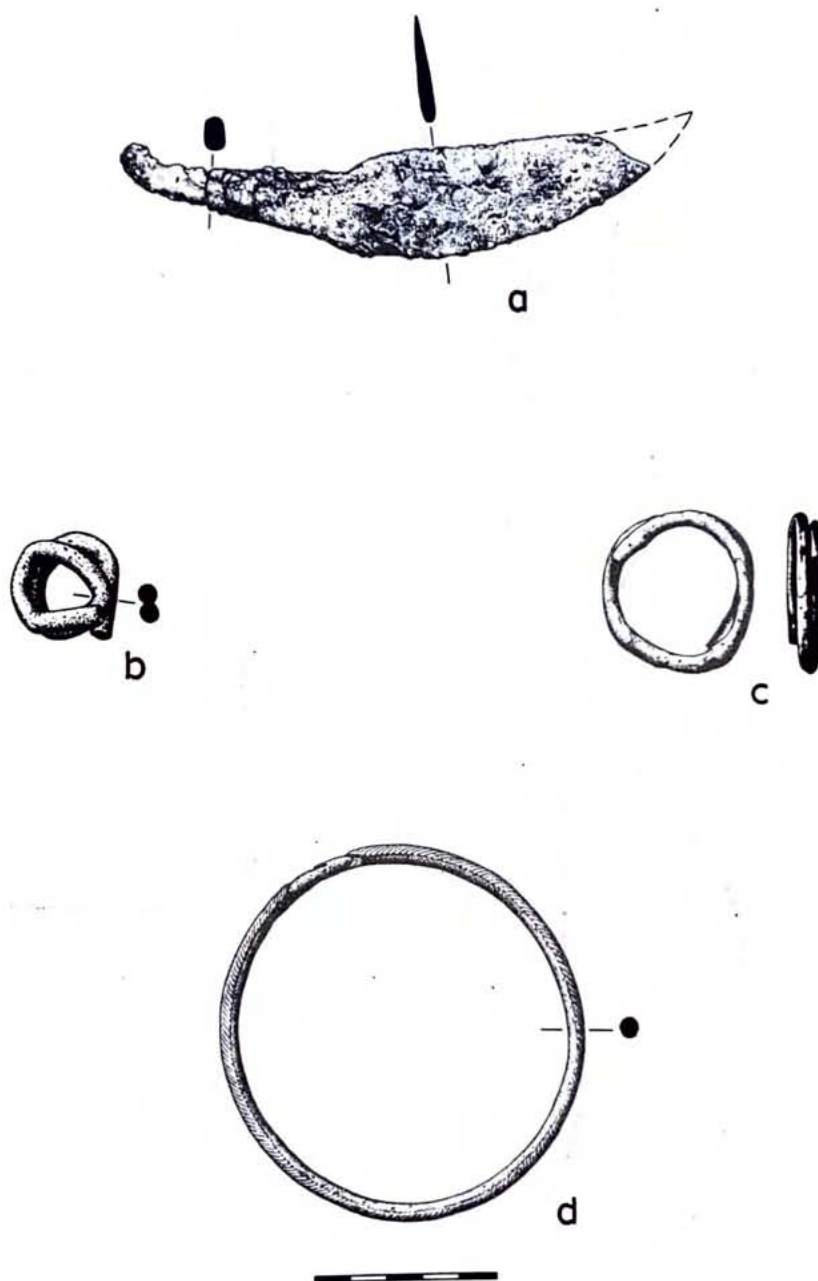


FIGURE 8-44

Ban Na Di: The grave assemblage from burial 17
 A. iron knife Cat.991B B. iron coil Cat.992 C. bronze coil Cat.1348
 D. bronze bracelet Cat.941

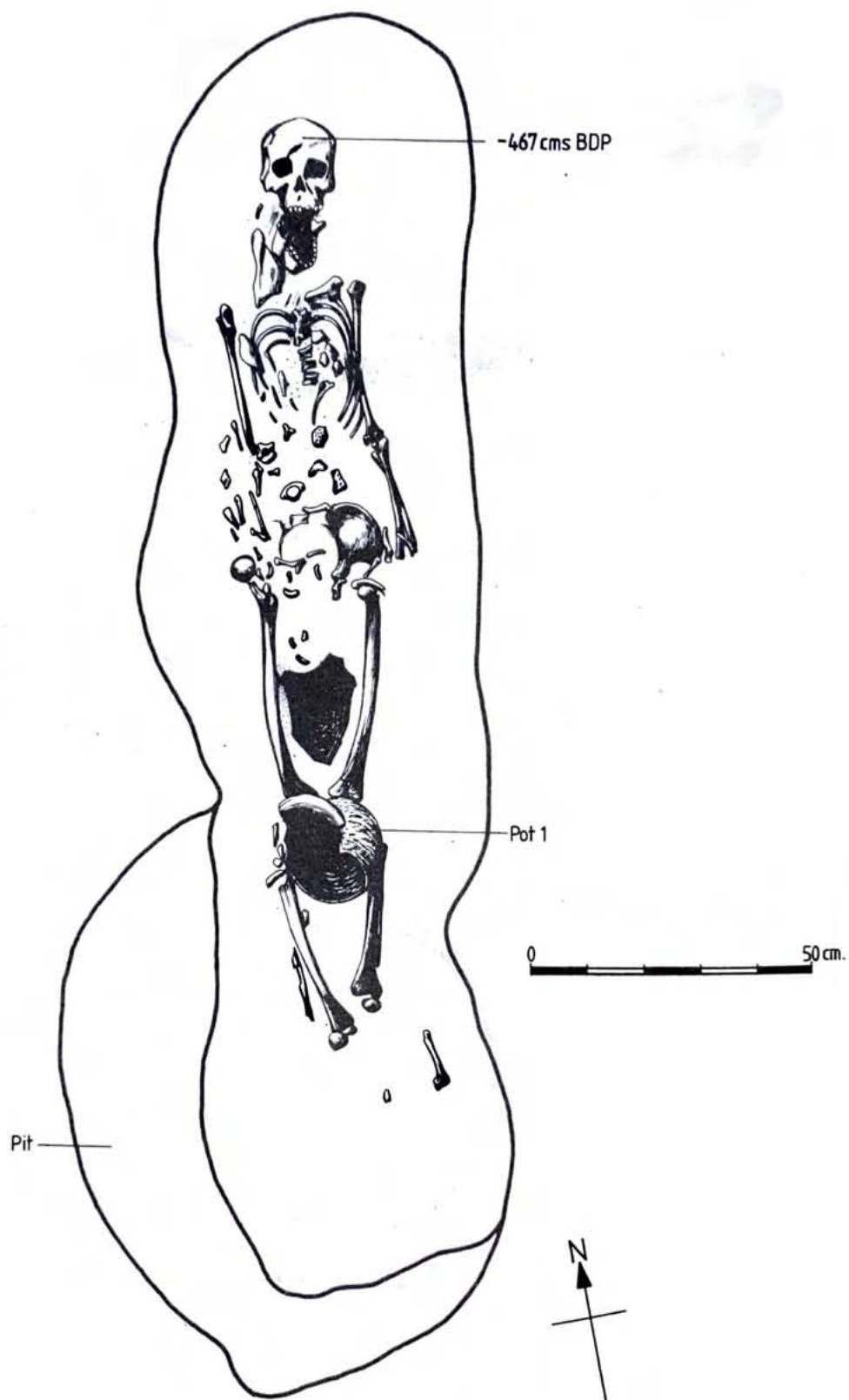


FIGURE 8-45

Ban Na Di: burial 22 square A2 MP 1a

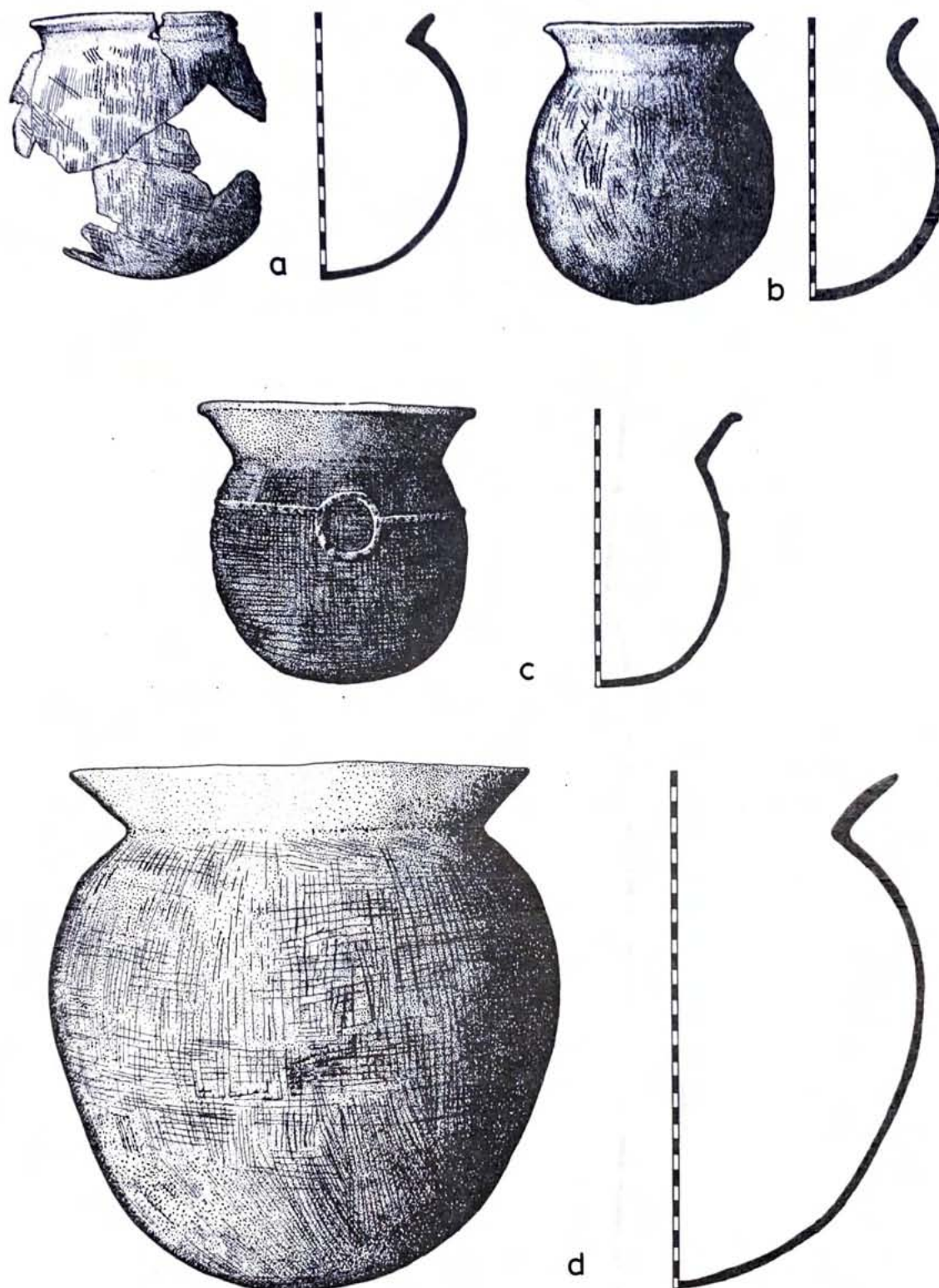


FIGURE 8-46

Ban Na Di: The grave assemblages from burials 20, 22, 34 and 25
 A. burial 20 MP 1c pot no. 100 B. burial 22 MP 1a pot no.1
 C. burial 34 MP 1a pot no. 3 D. burial 25 MP 1b pot no. 107

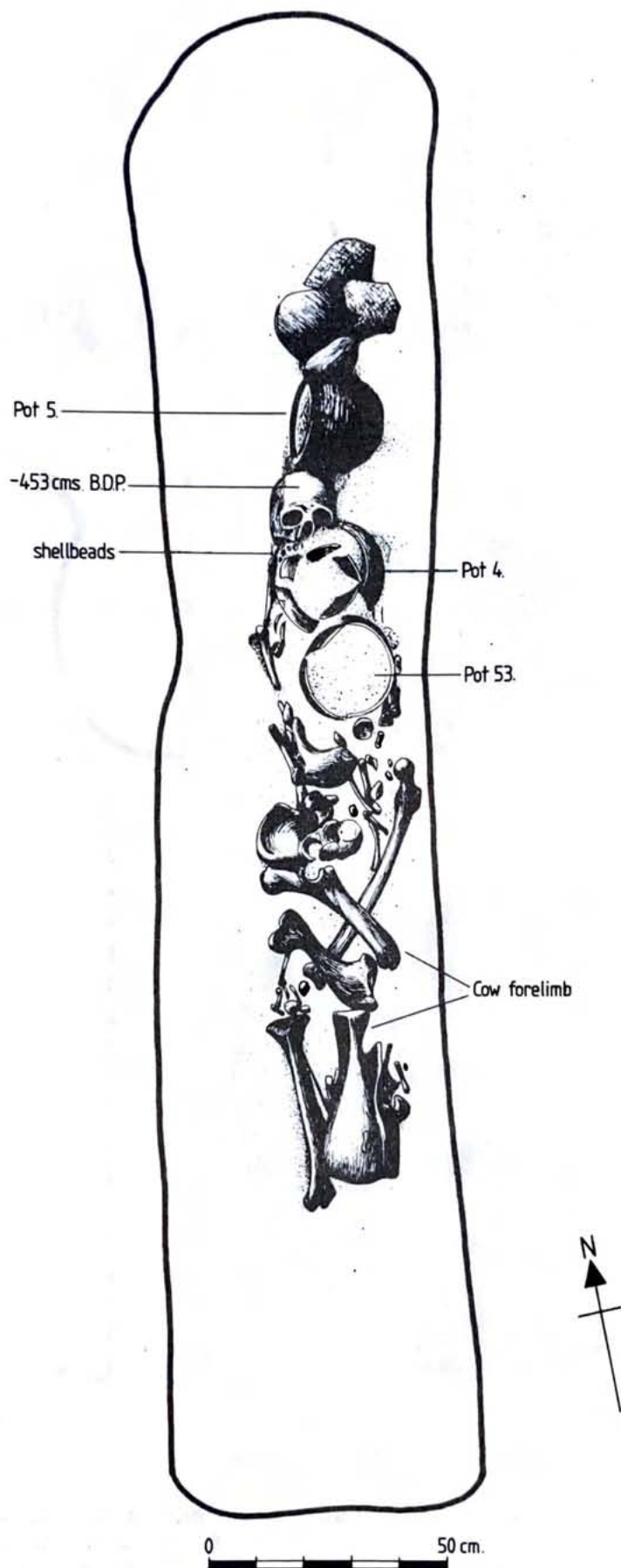


FIGURE 8-47 Ban Na Di: burial 28 square A3 MP 1A

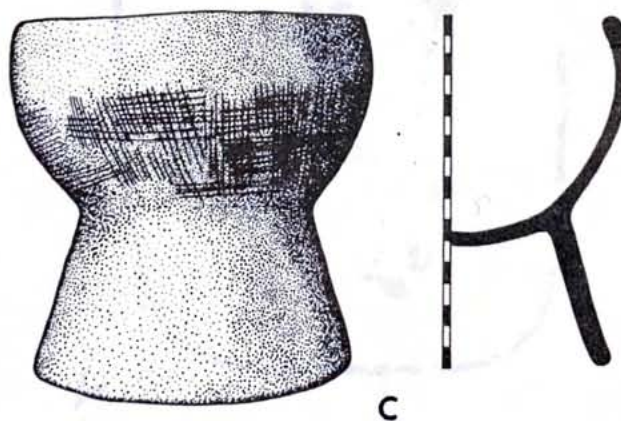
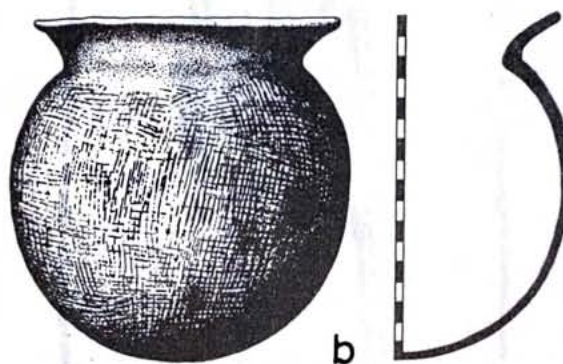
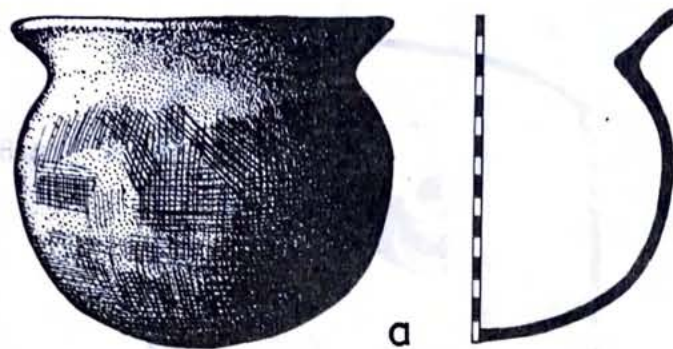


FIGURE 8-48

Ban Na Di: The grave assemblage from burial 26
A. pot no. 4 B. pot no. 5 C. pot no. 53

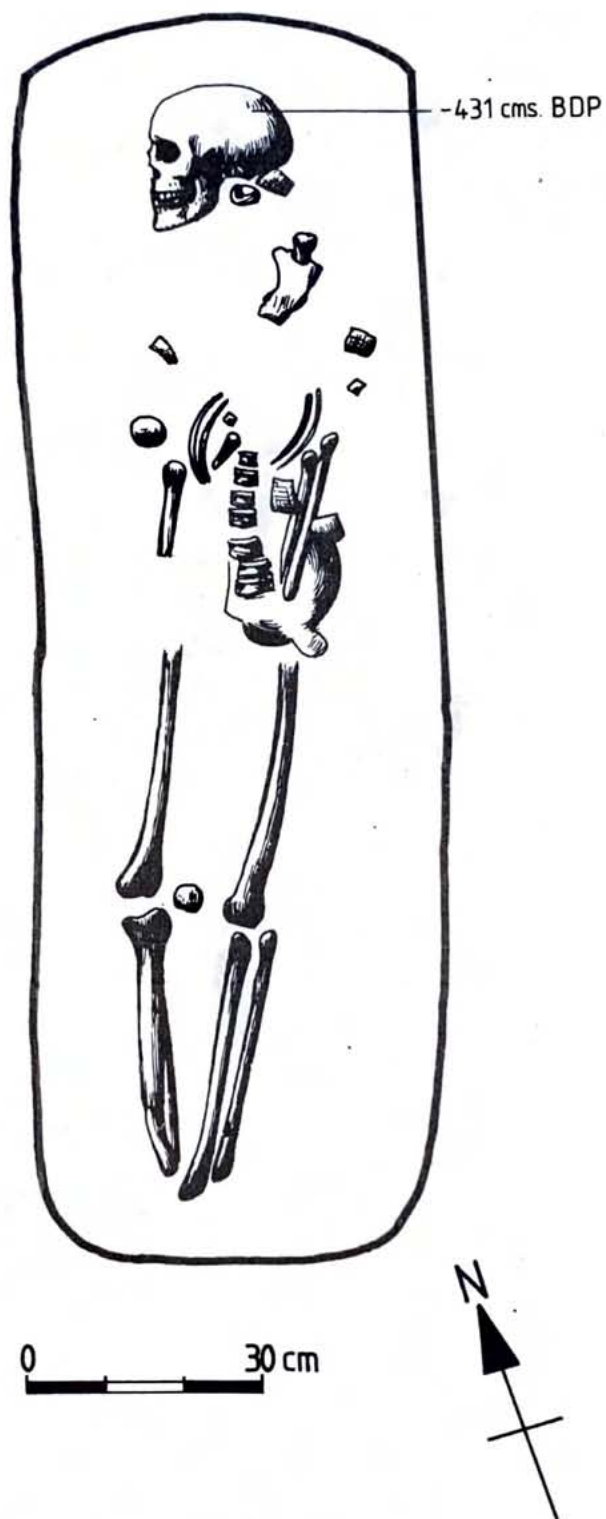


FIGURE 8-49

Ban Na Di: burial 28 baulk A3/A4 MP 1a

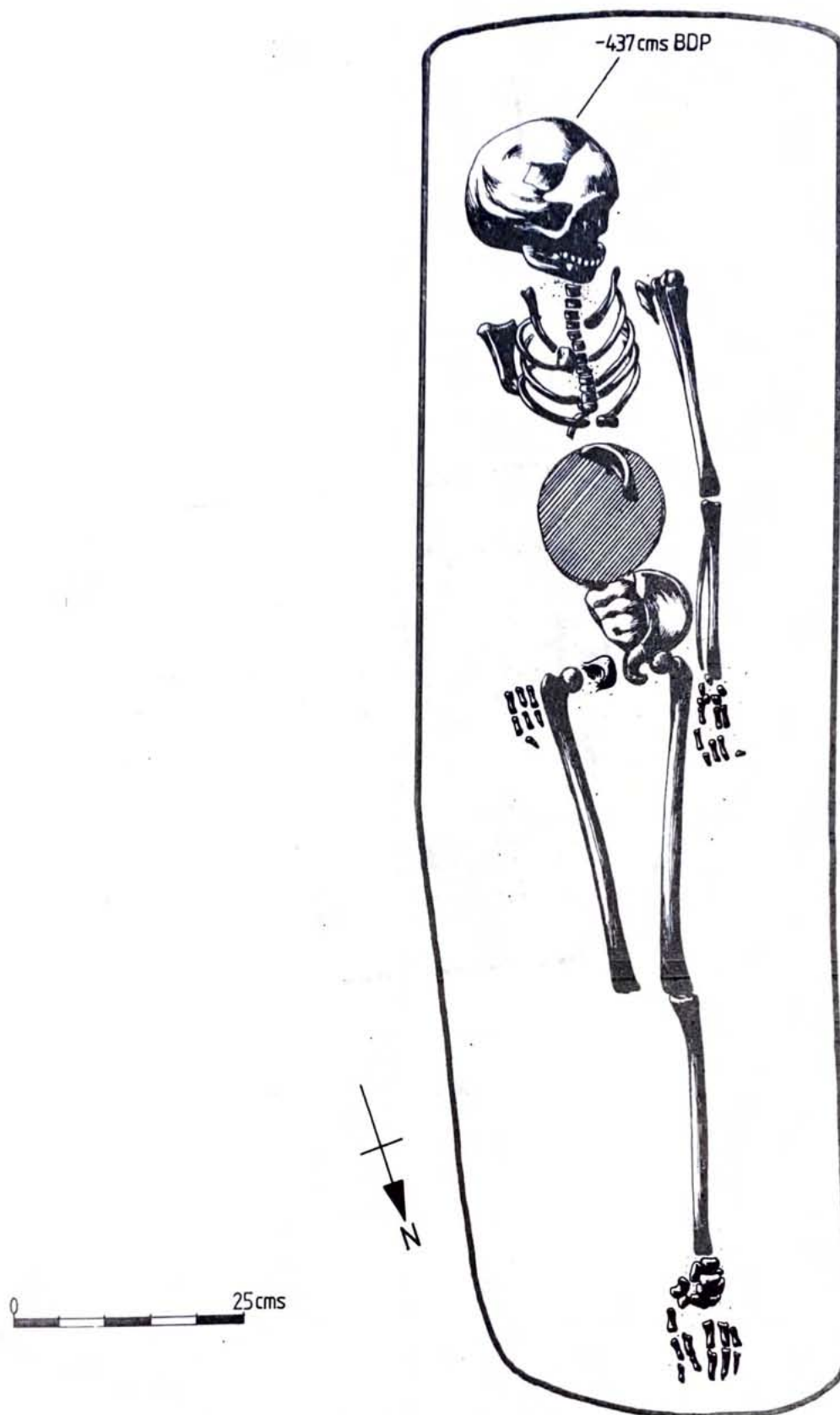


FIGURE 8-50

Ban Na Di: burial 33 baulk A3/A4 MP 1a

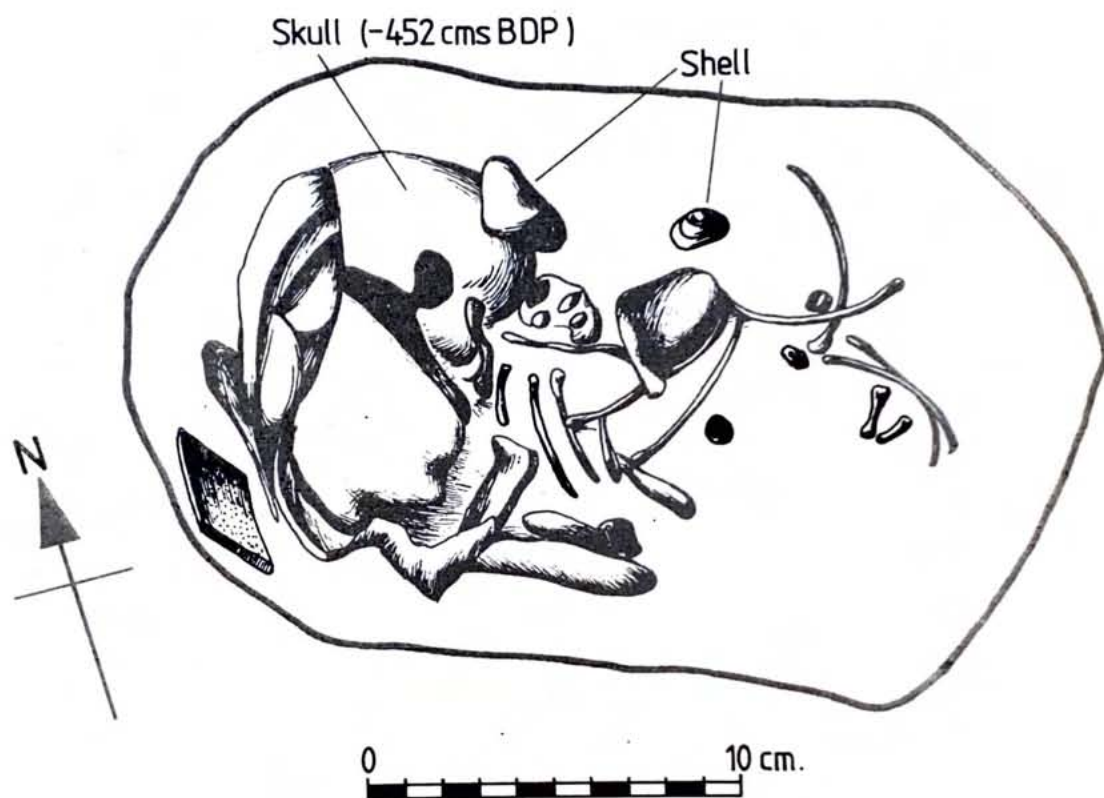


FIGURE 8-51

Ban Na Di: burial 43 square A4 MP 1a

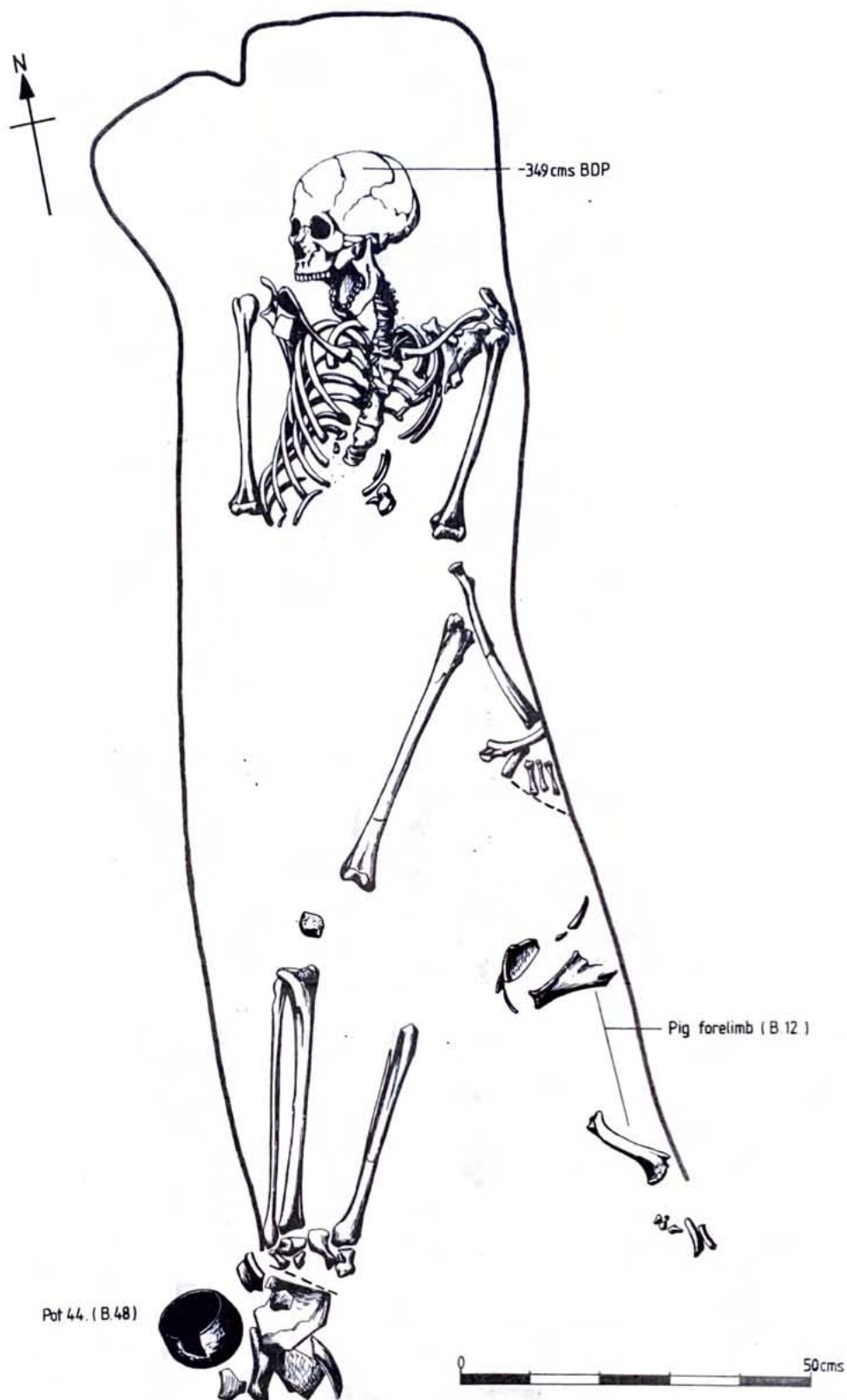


FIGURE 8-52

Ban Na Di: burial 23 baulk A3/A4 MP 1b

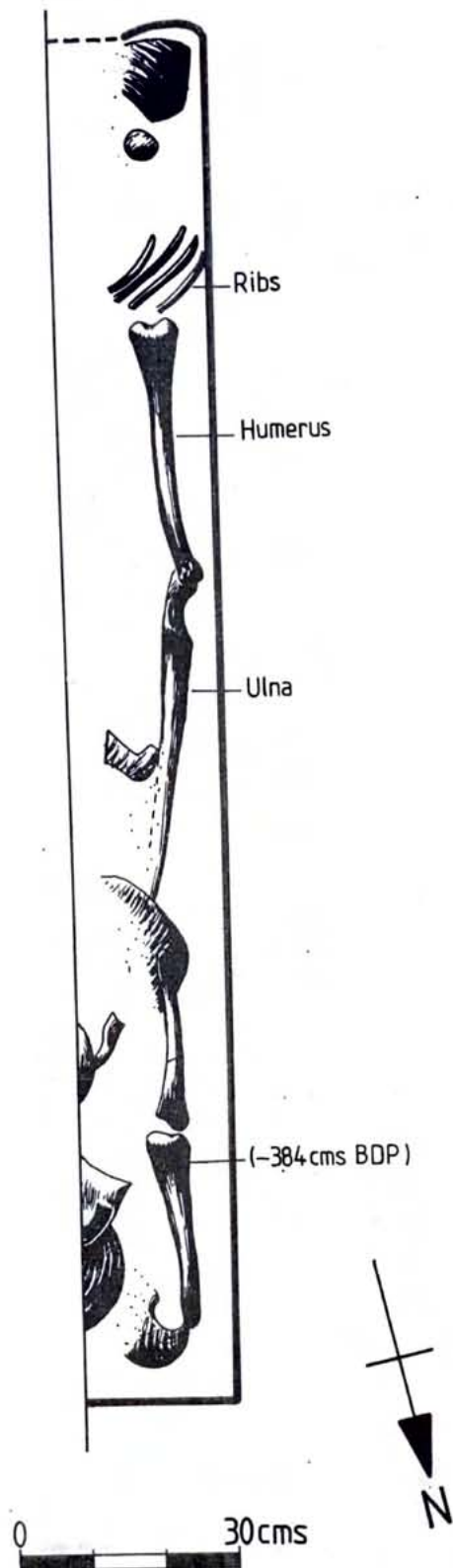


FIGURE 8-53

Ban Na Di: burial 49 square A4 MP 1b

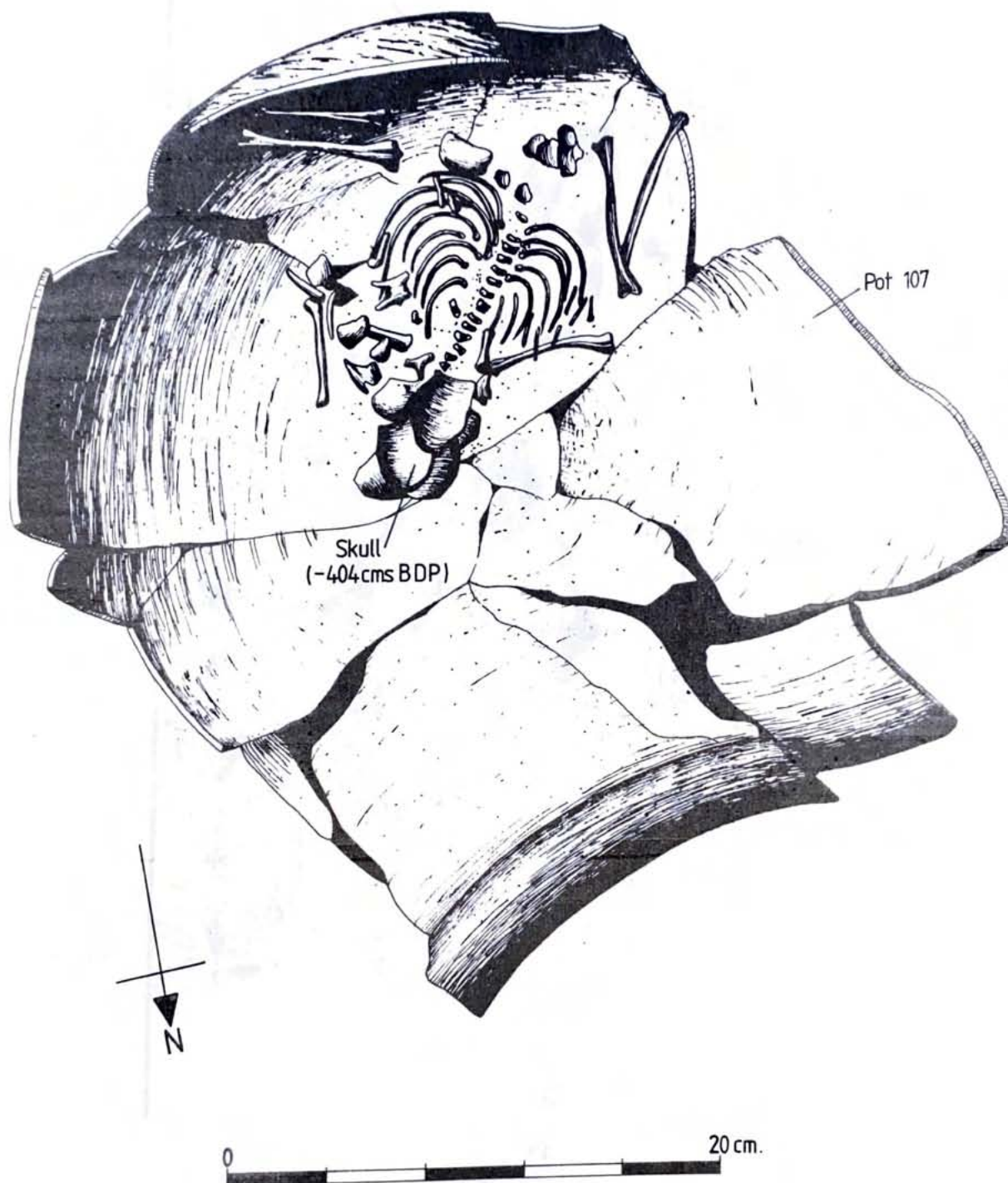


FIGURE 8-54

Ban Na Di: burial 25 square A3 MP 1b

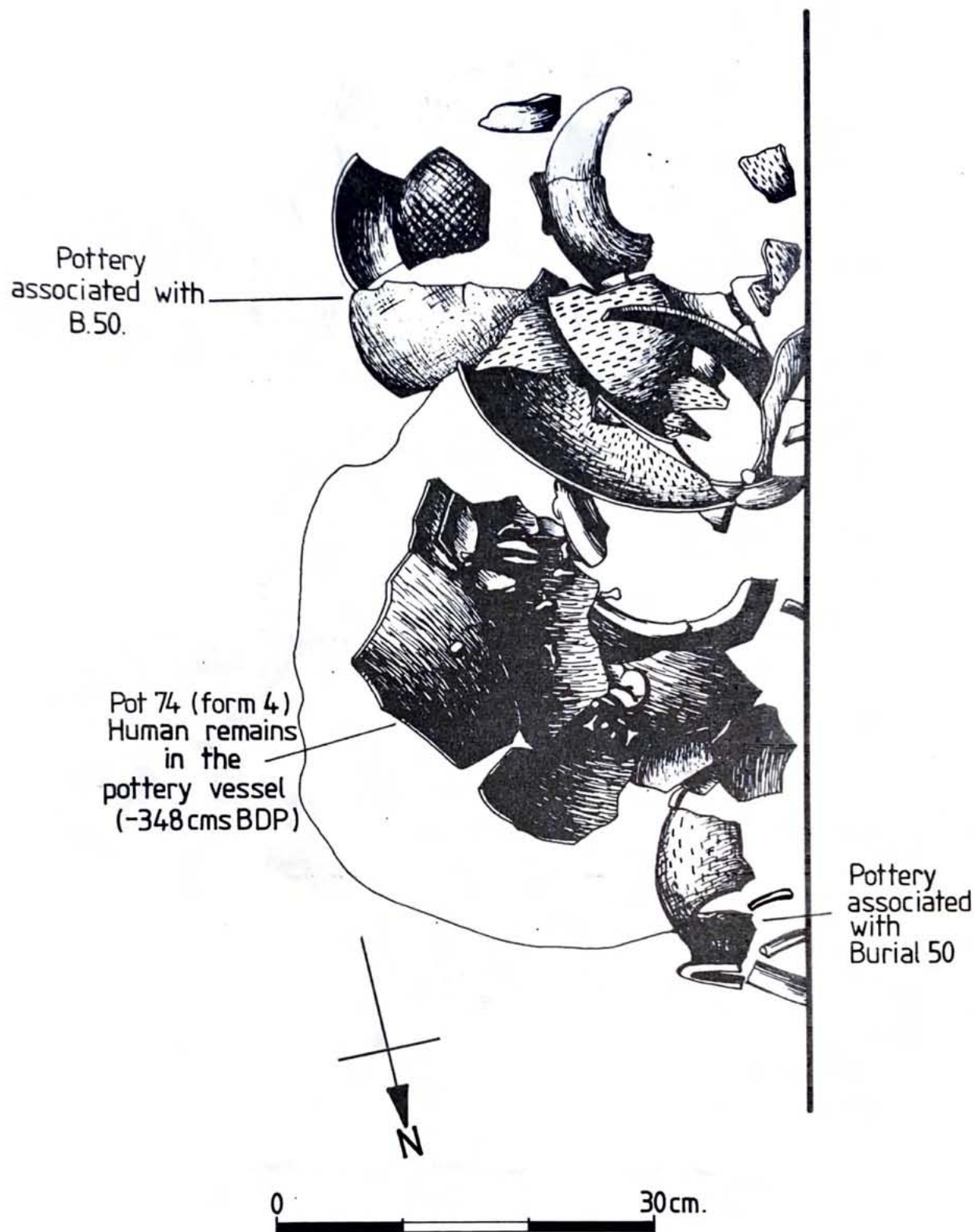


FIGURE 8-55

Ban Na Di: burial 30 square A4 MP 1b

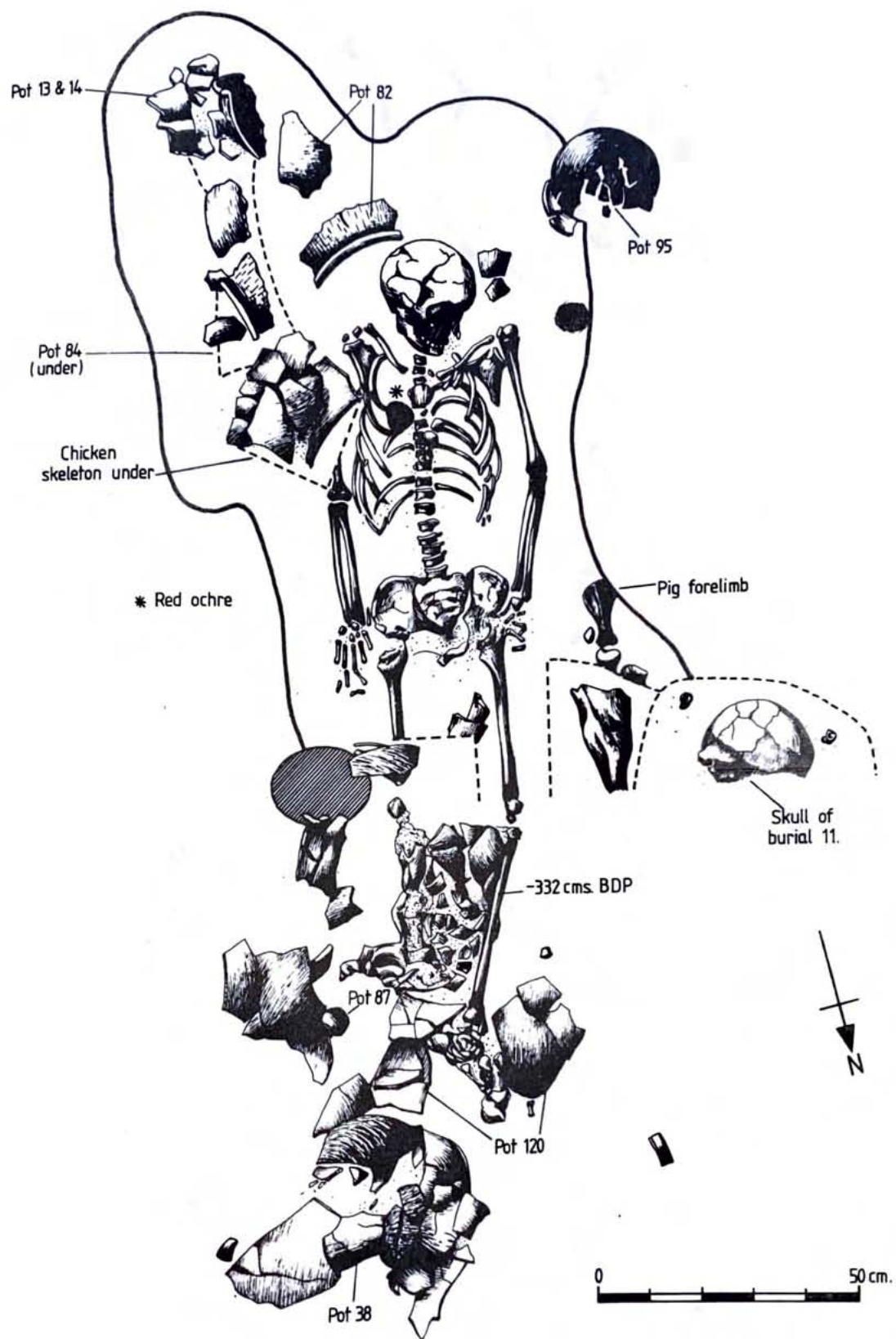


FIGURE 8-58

Ban Na Di: burial 12 square A3 MP 1b

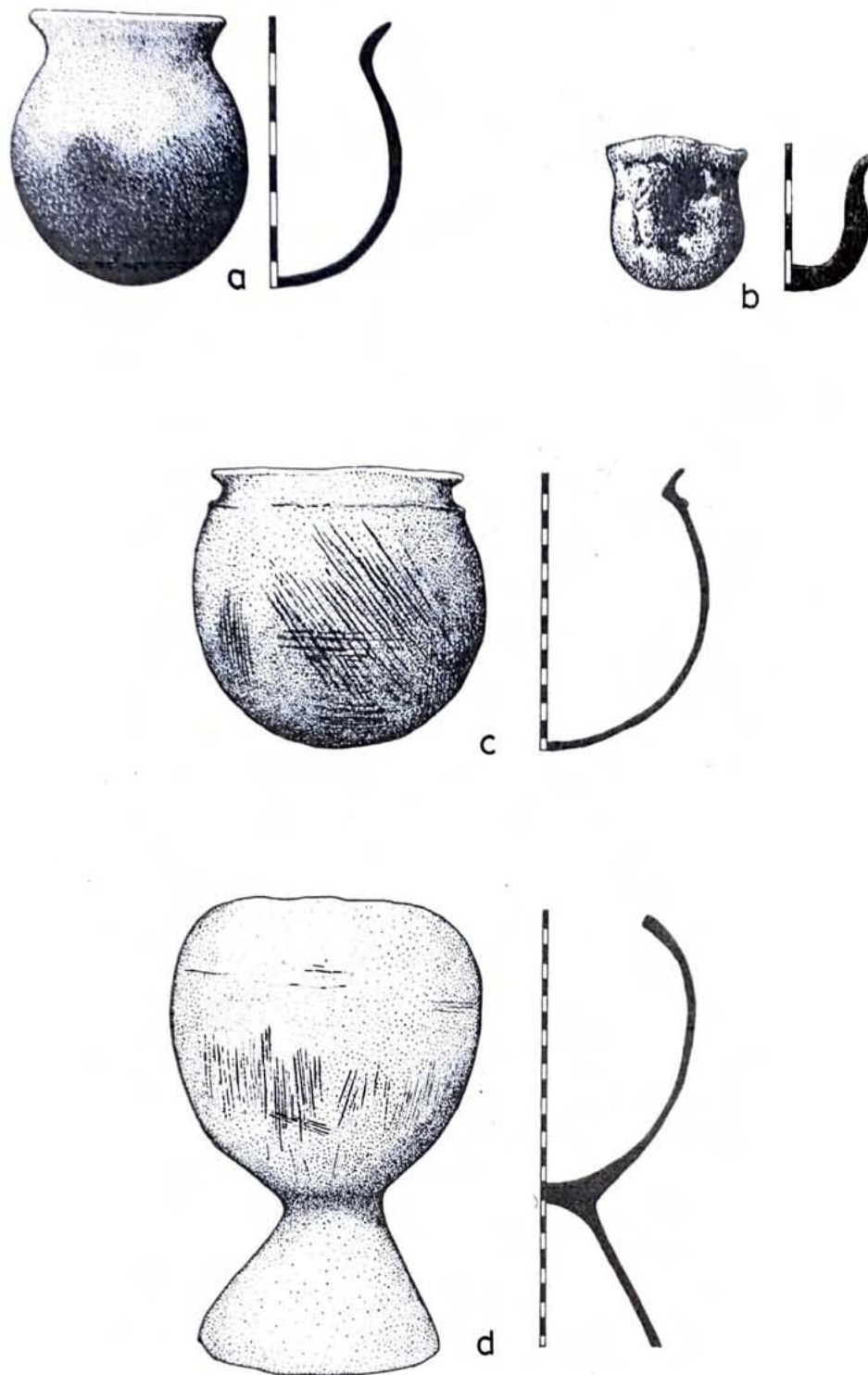


FIGURE 8-57

The grave assemblage from burial 12
A. pot no. 87 B. pot no. 119 C. pot no. 14 D. pot no. 38

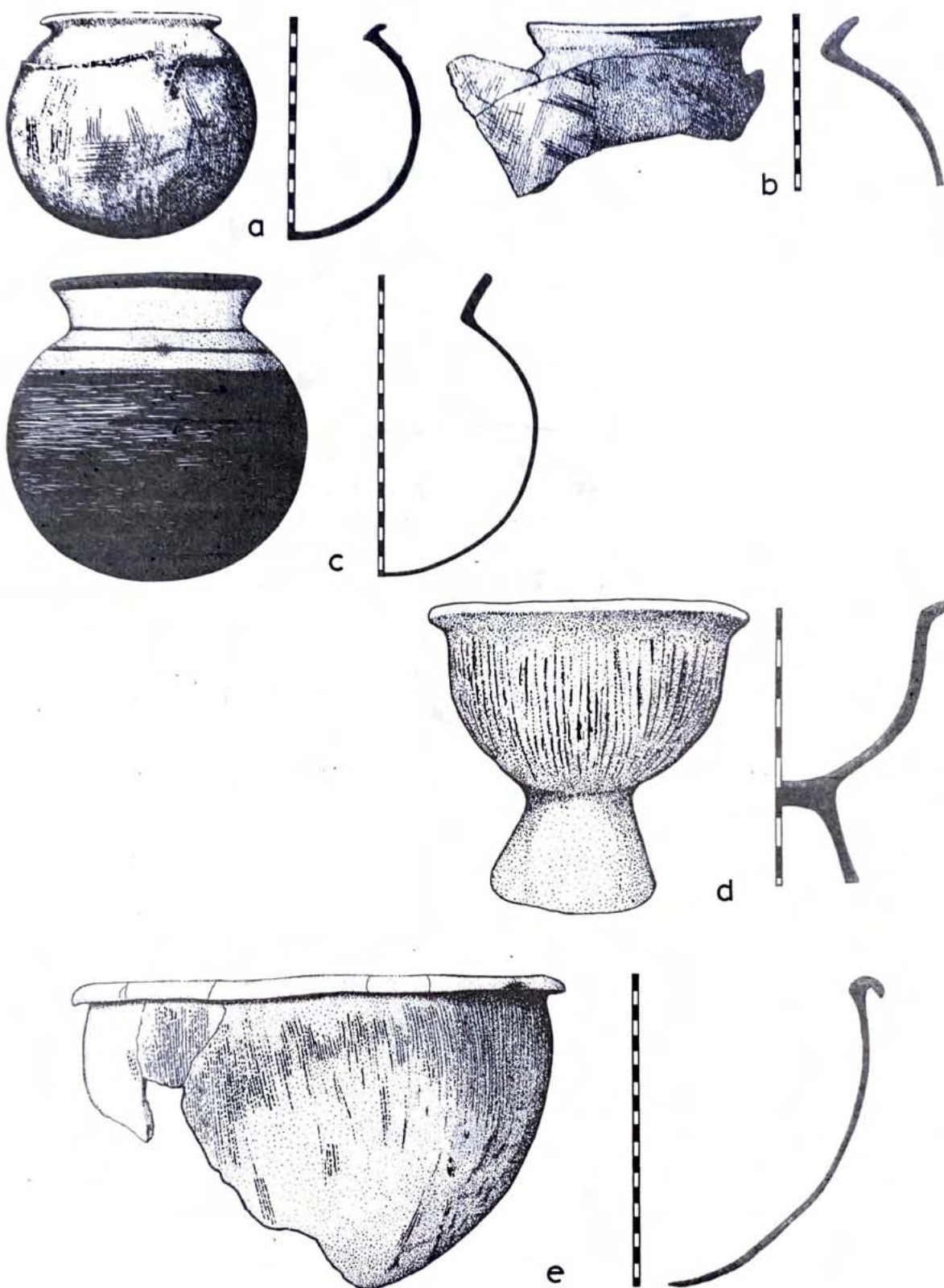


FIGURE 8-58

The grave assemblage from burial 12 (cont.)

A. pot no. 13 B. pot no. 120 C. pot no. 95 D. pot no. 84 E. pot no. 82

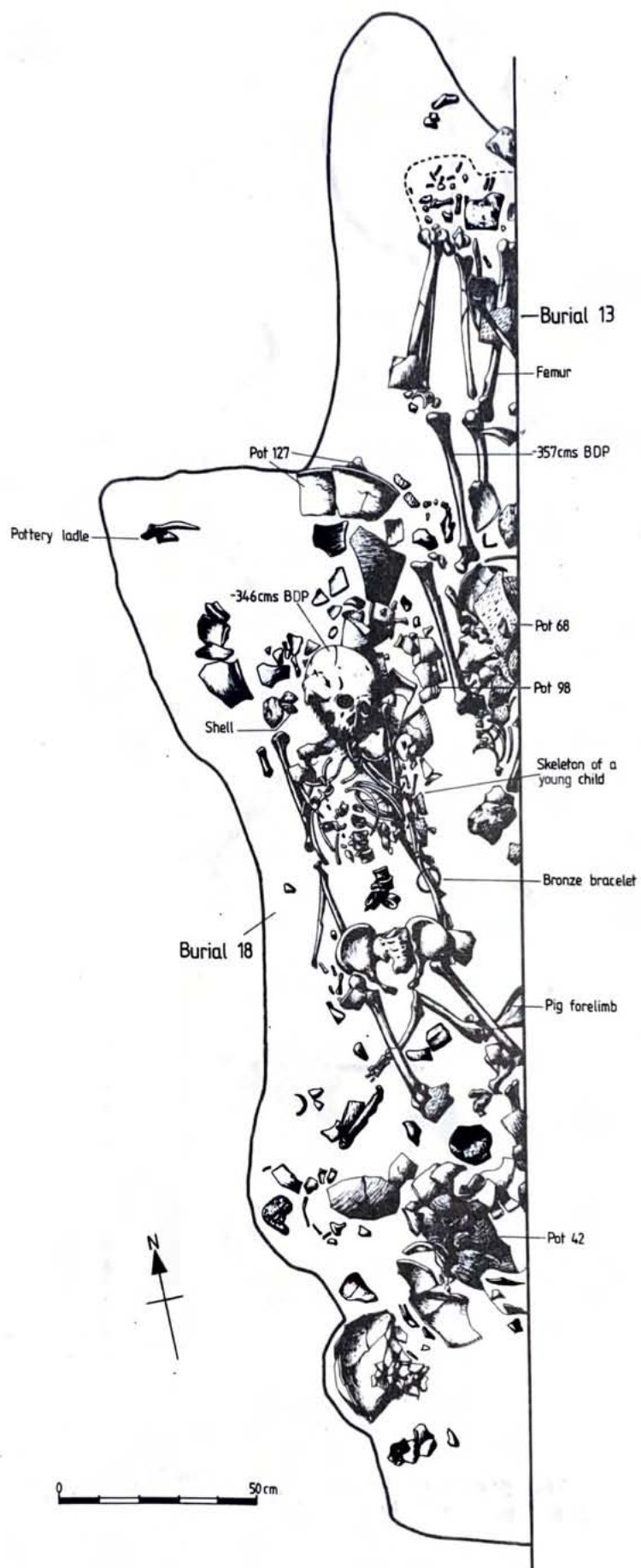


FIGURE 8-59 Ban Na Di: burials 13 (MP 1B) and 18 (MP1C)

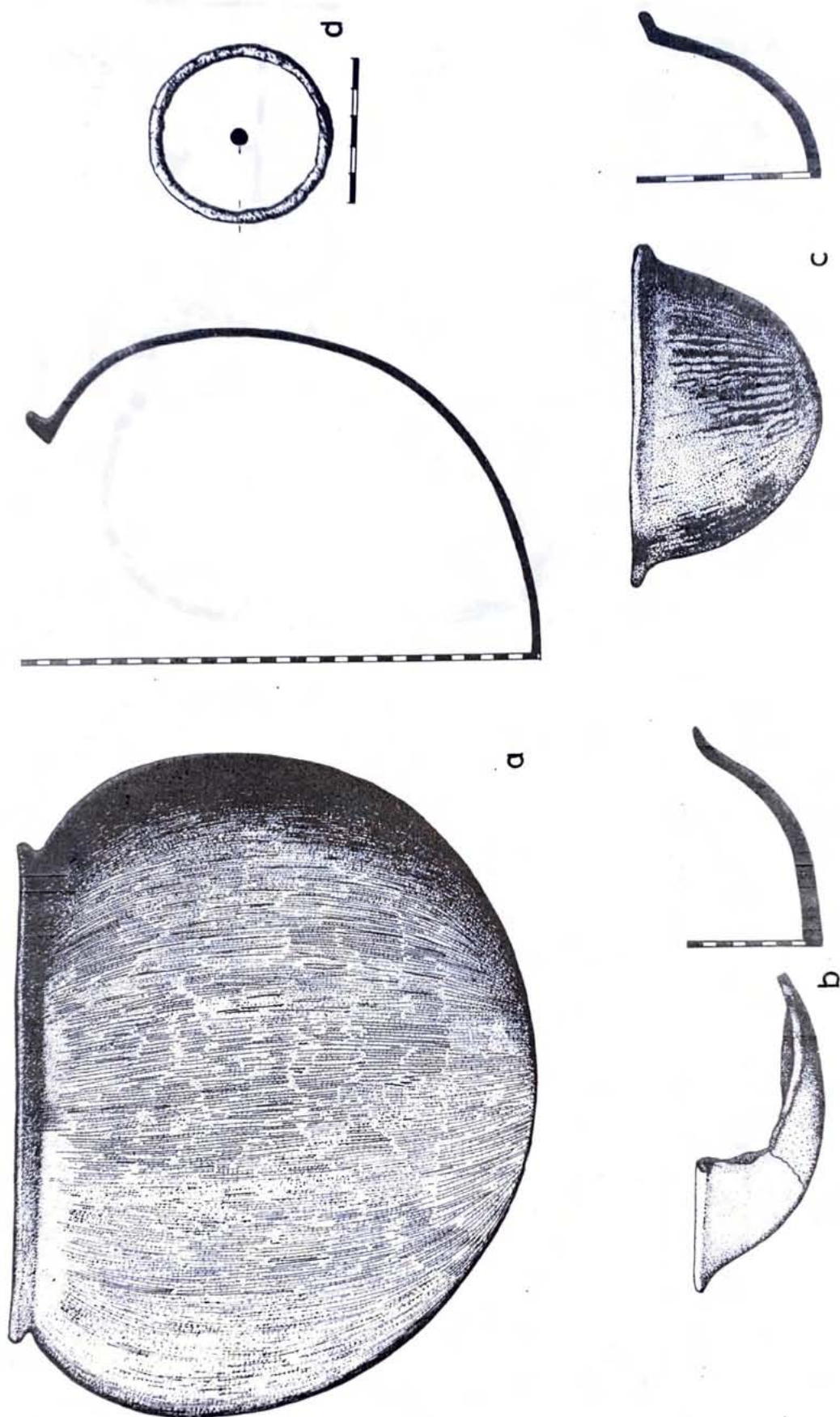


FIGURE 8-60 Ban Na Di: the grave assemblage from burial 18
 A. pot no. 60 B. pot no. 99 C. pot no. 127
 D. bronze bracelet Cat.1061

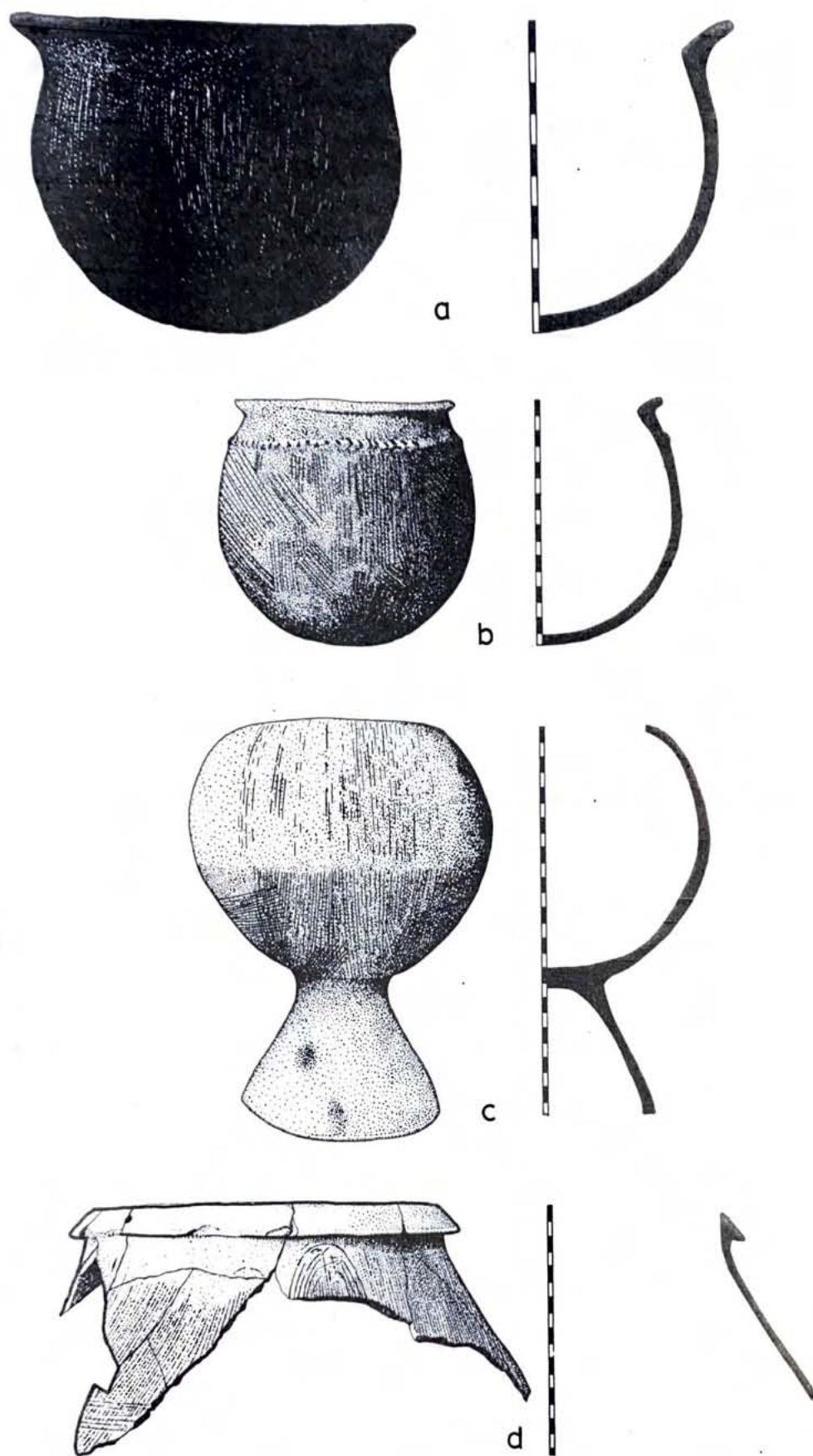


FIGURE 8-61 The grave assemblage from burial 18 (cont.)
 A. pot no. 65 B. pot no. 36 C. pot no. 42 D. pot no. 98

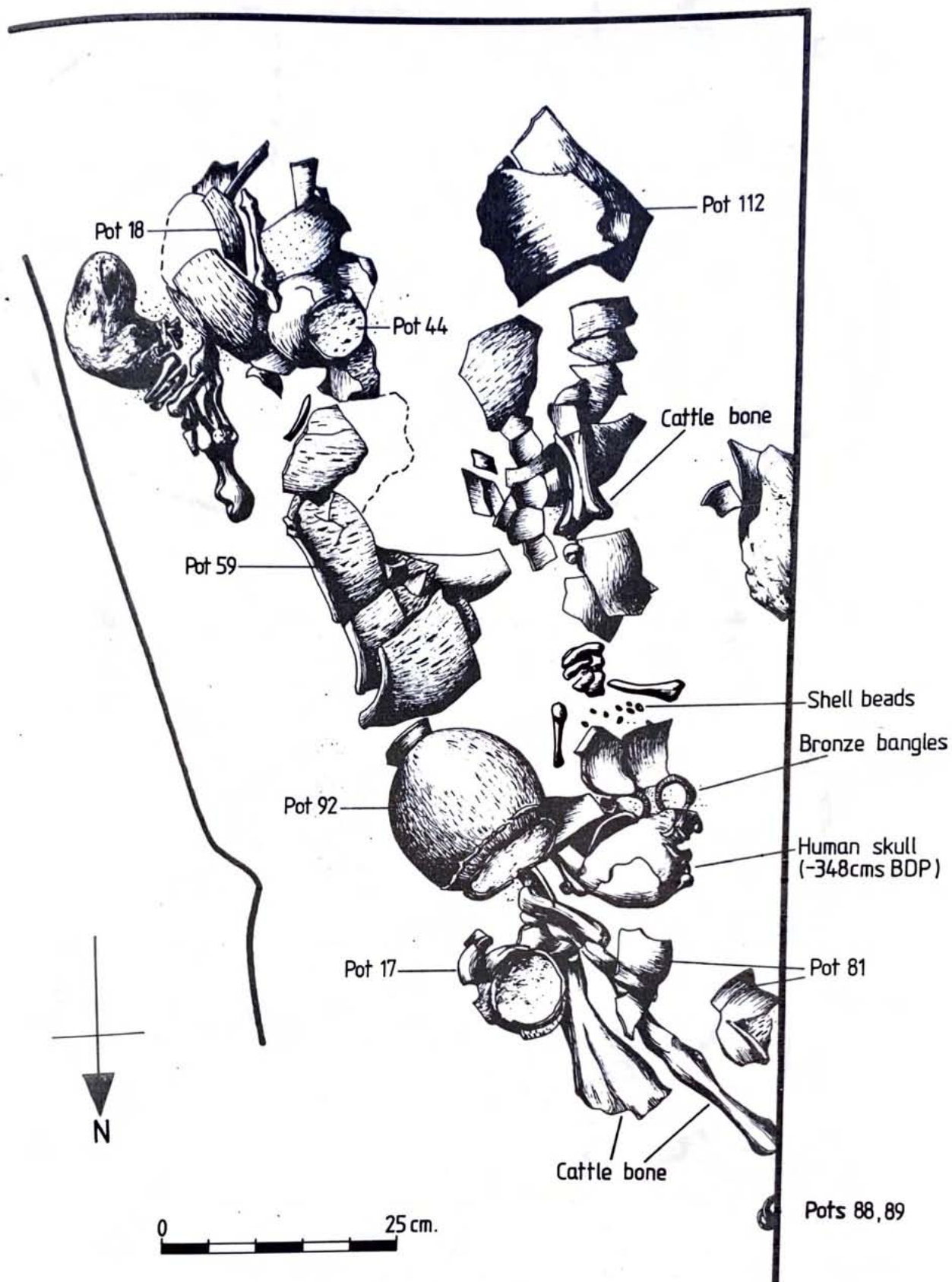


FIGURE 8-62

Ban Na Di: burial 48 baulk A3/A4 MP 1c

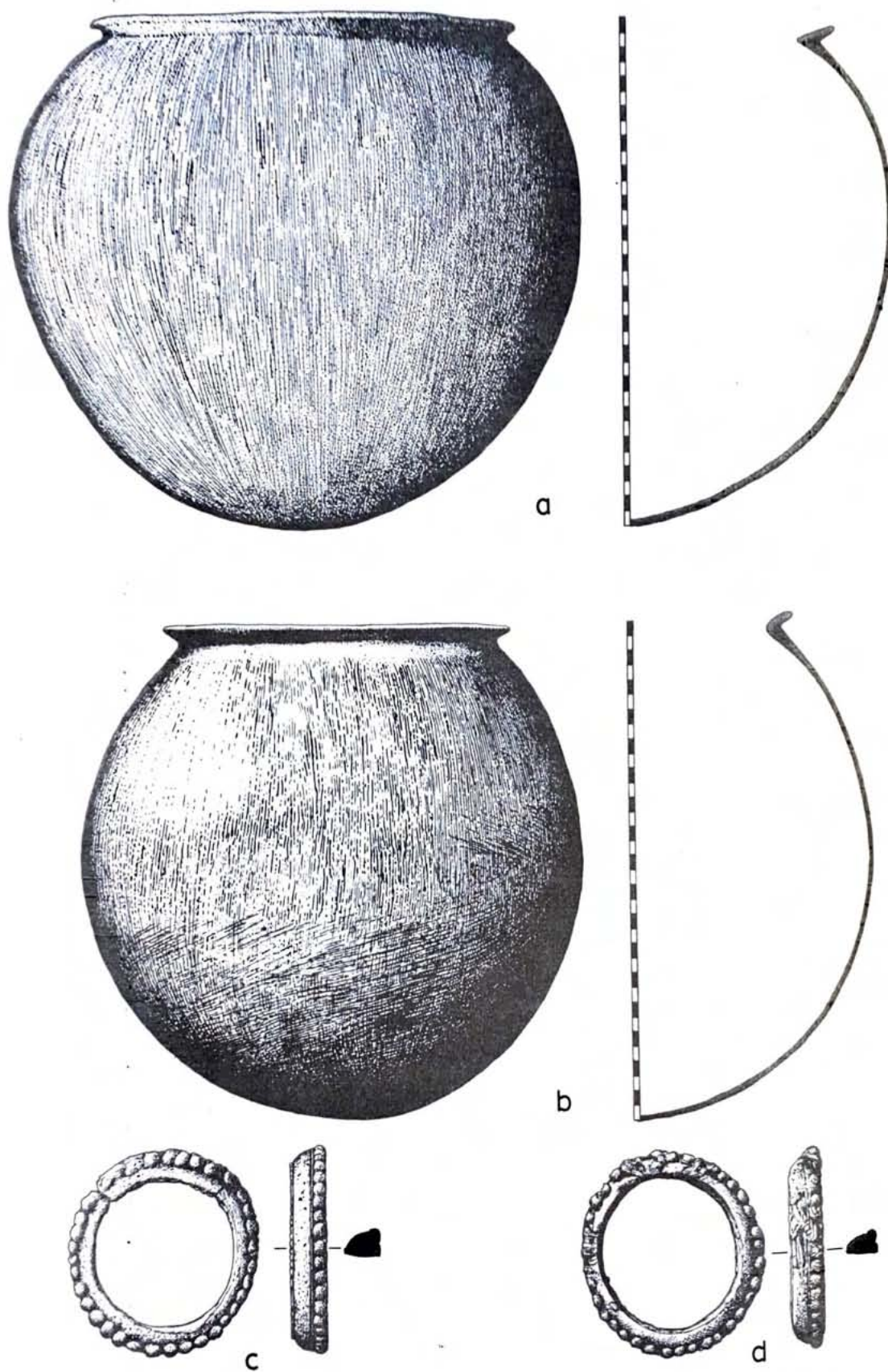


FIGURE 8-63 Ban Na Di: the grave assemblage from burial 48
 A. pot no. 59 B. pot no. 81 C-D. bronze bracelets Cats.1378a-b

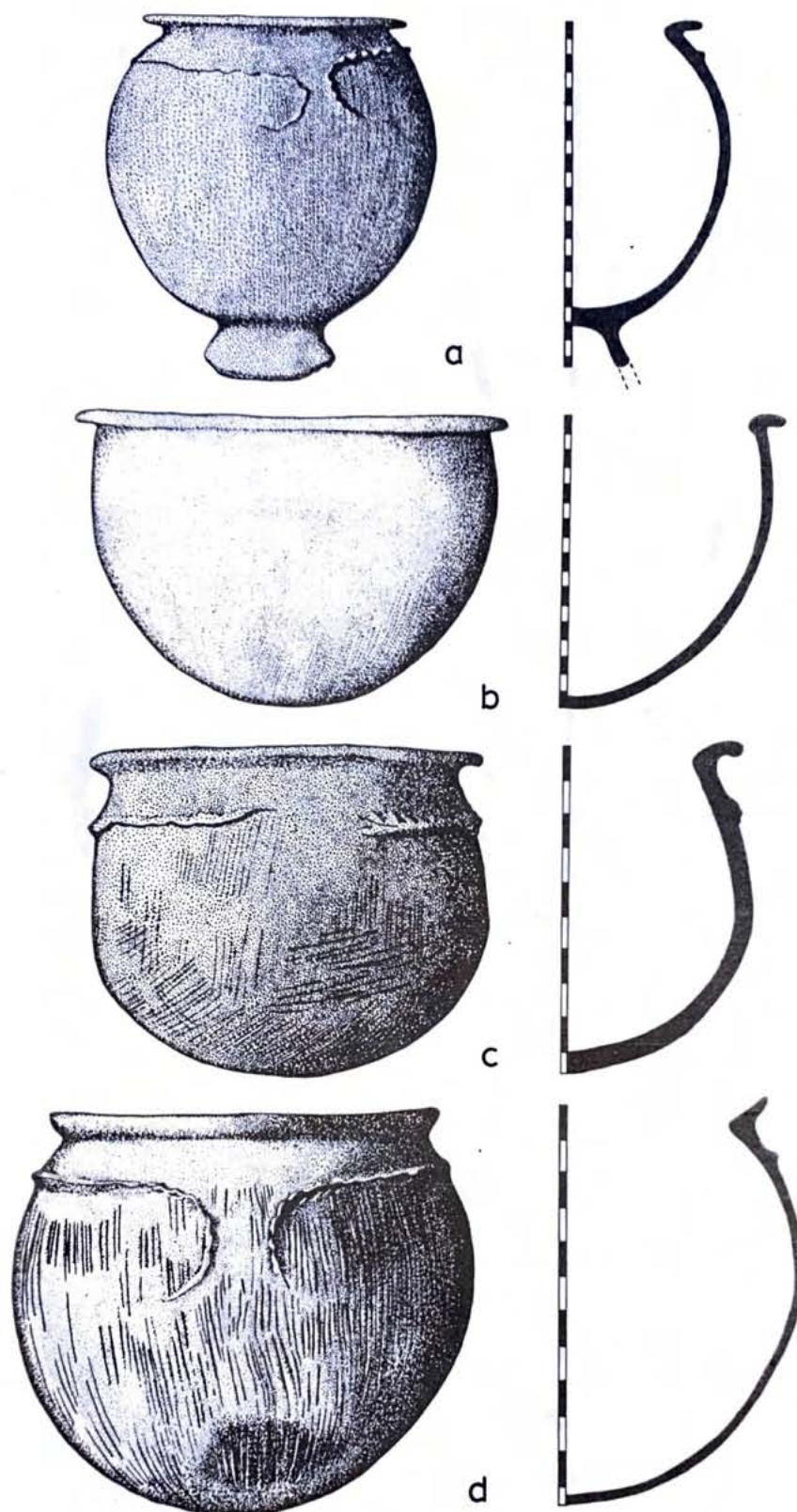


FIGURE 8-64

Ban Na Di: The grave assemblage from burial 48 (cont.)
 A. pot no. 92 B. pot no. 18 C. pot no. 19 D. pot no. 17

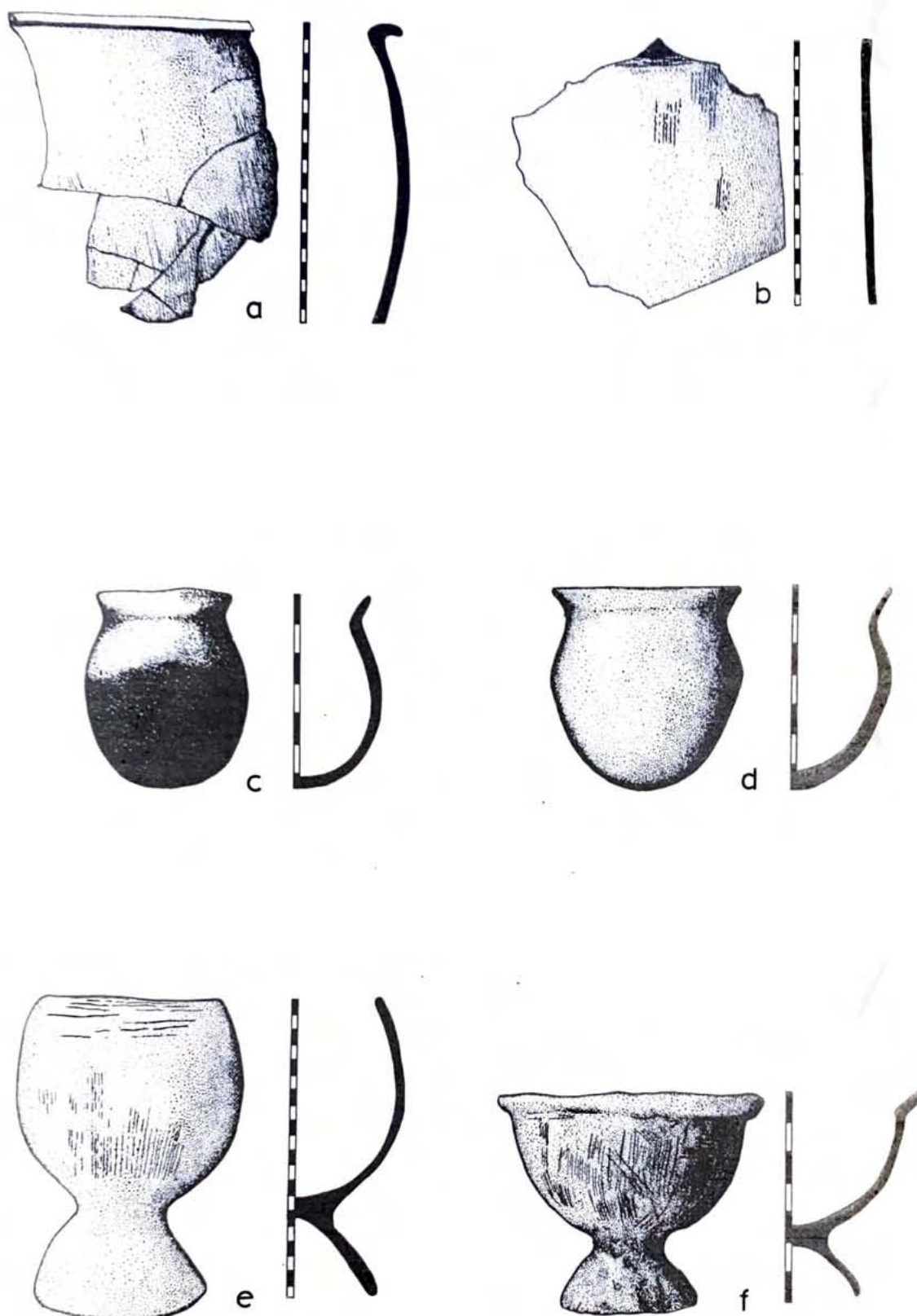


FIGURE 8-65

Ban Na Di: The grave assemblage from burial 48 (cont.)
 A. pot no. 112 B. pot no. 131 C. pot no. 88 D. pot no. 89
 E. pot no. 44 F. pot no. 85

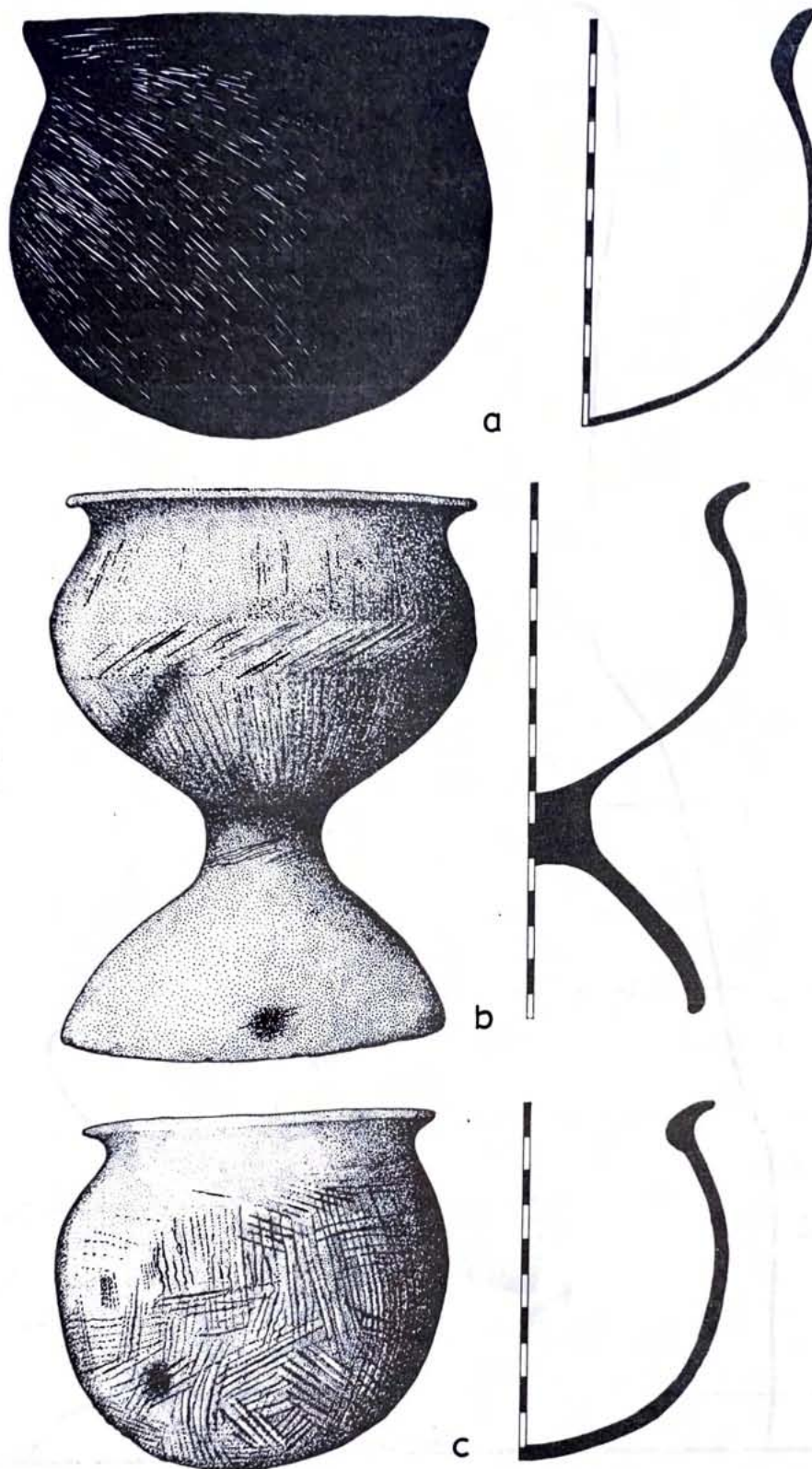


FIGURE 8-66

Ban Na Di: The grave assemblage from burial 50
 A. pot no. 64 B. pot no. 128 C. pot no. 22

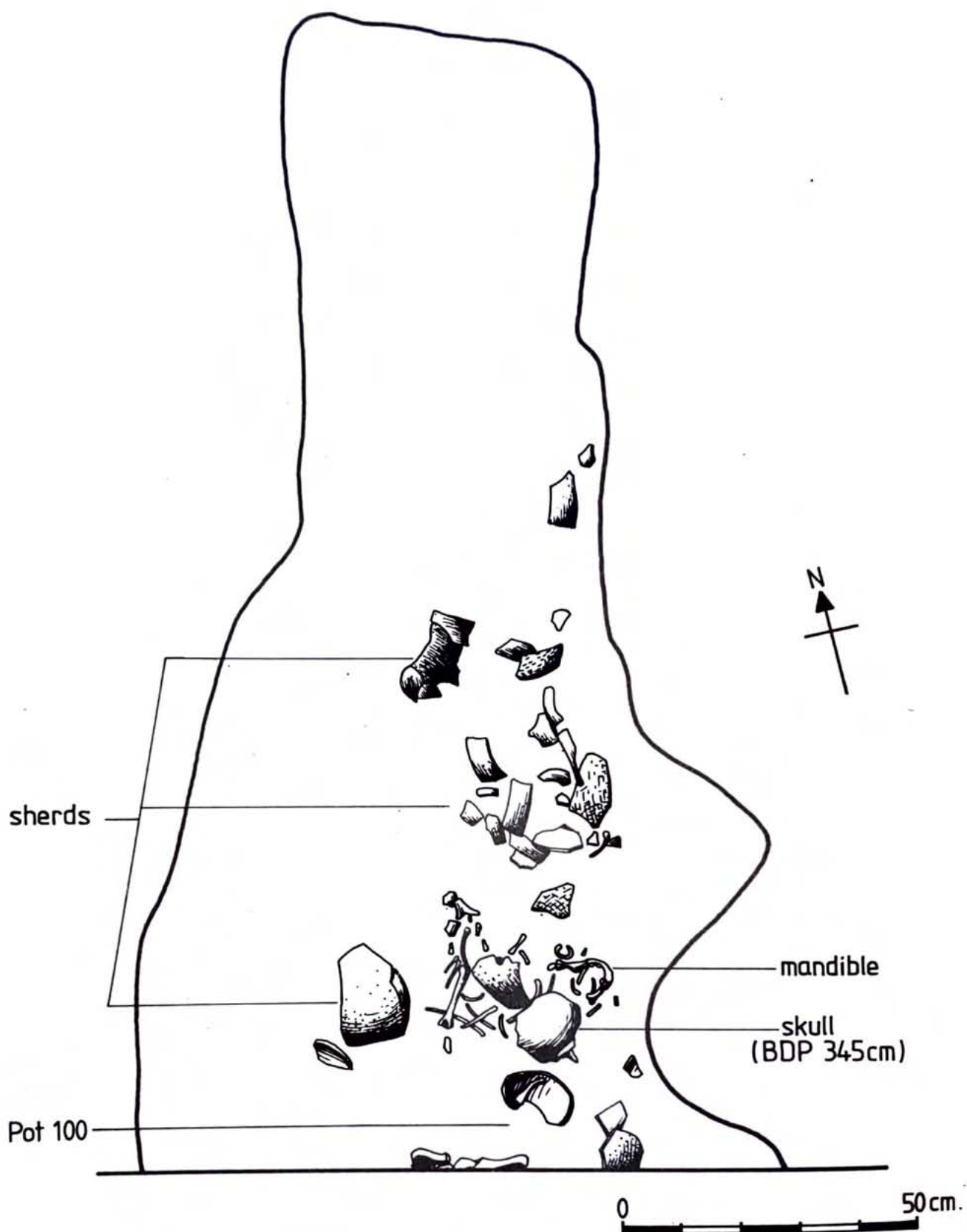


FIGURE 8-87

Ban Na Di: burial 20 square A4 MP 1c

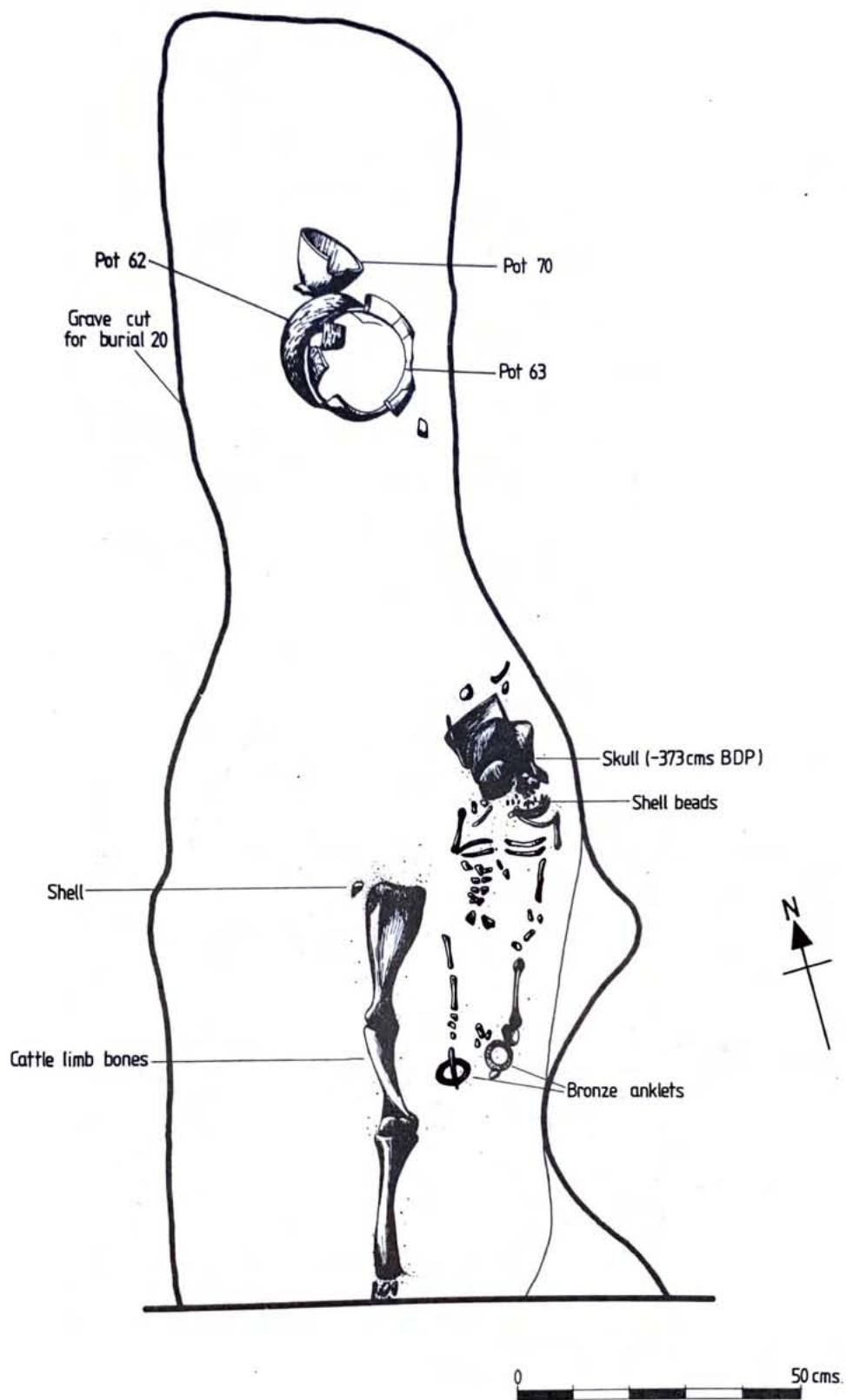


FIGURE 8-88

Ban Na Di: burial 29 square A4 MP 1c

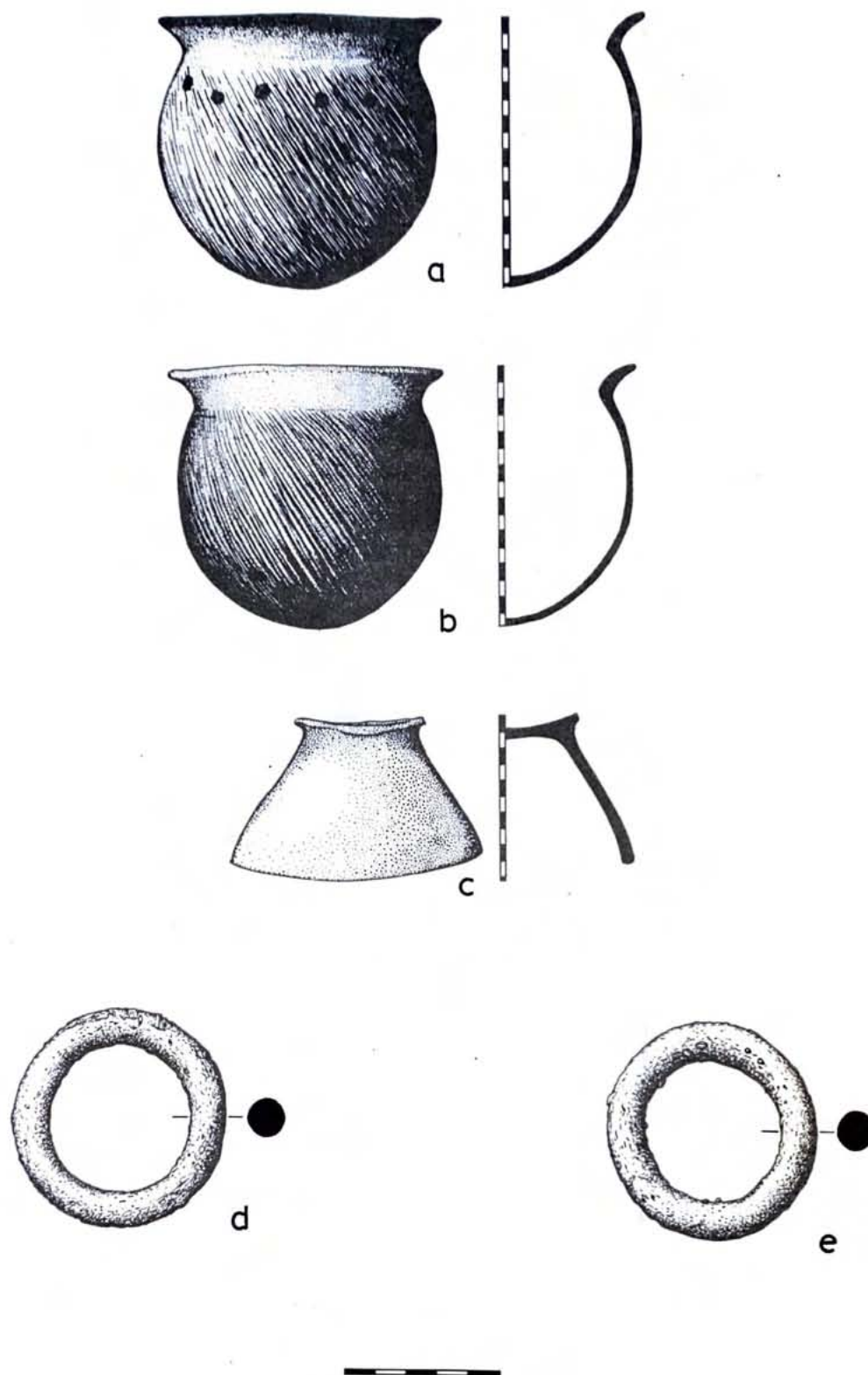


FIGURE 8-69

Ban Na Di: The grave assemblage from burial 29
 A. pot no. 62 B. pot no. 63 C. pot no. 70
 D-E bronze bracelets Cats.1018a-b

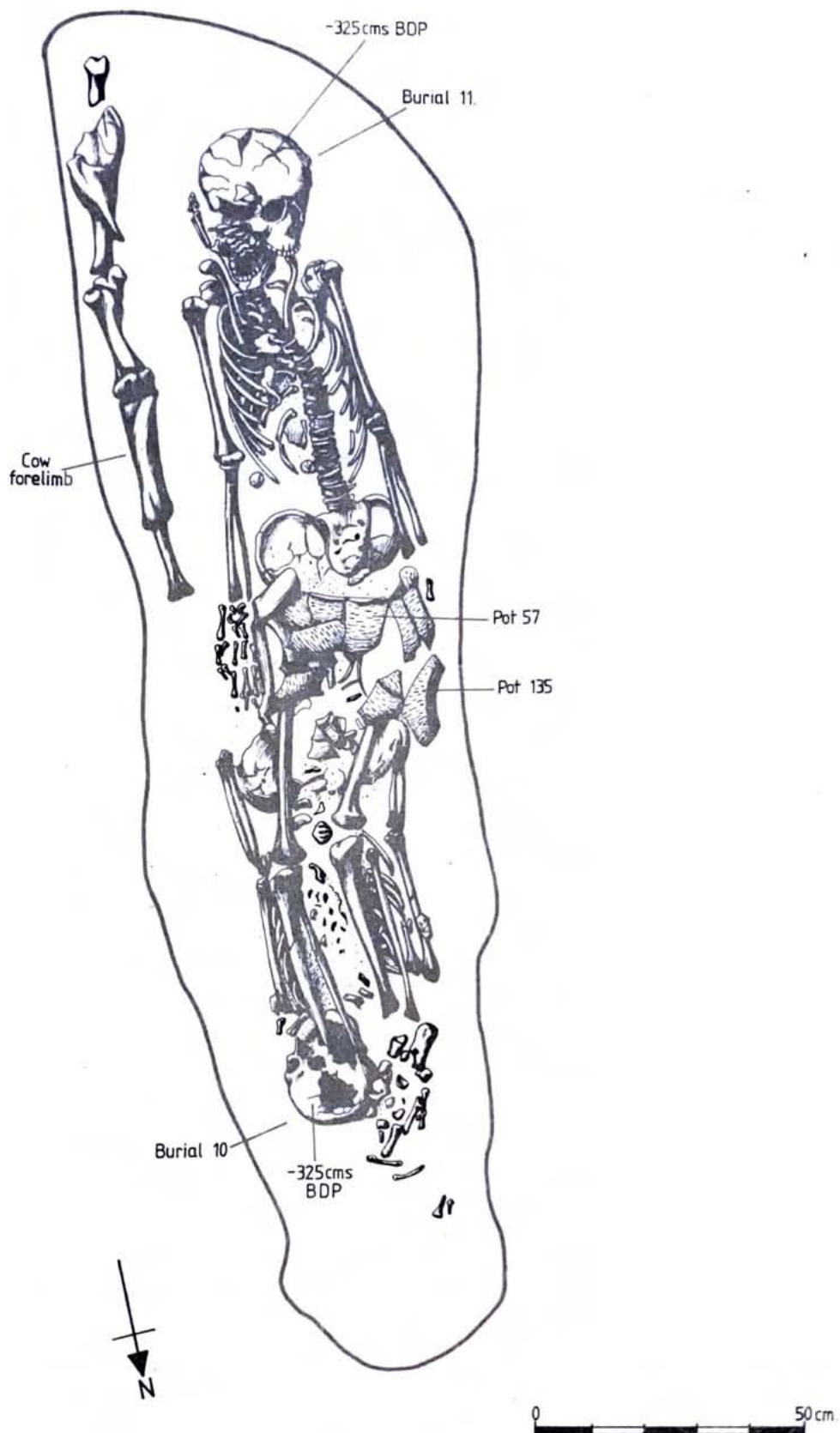


FIGURE 8-70

Ban Na Di: burials 10 and 11 squares A3/A4 MP 1c

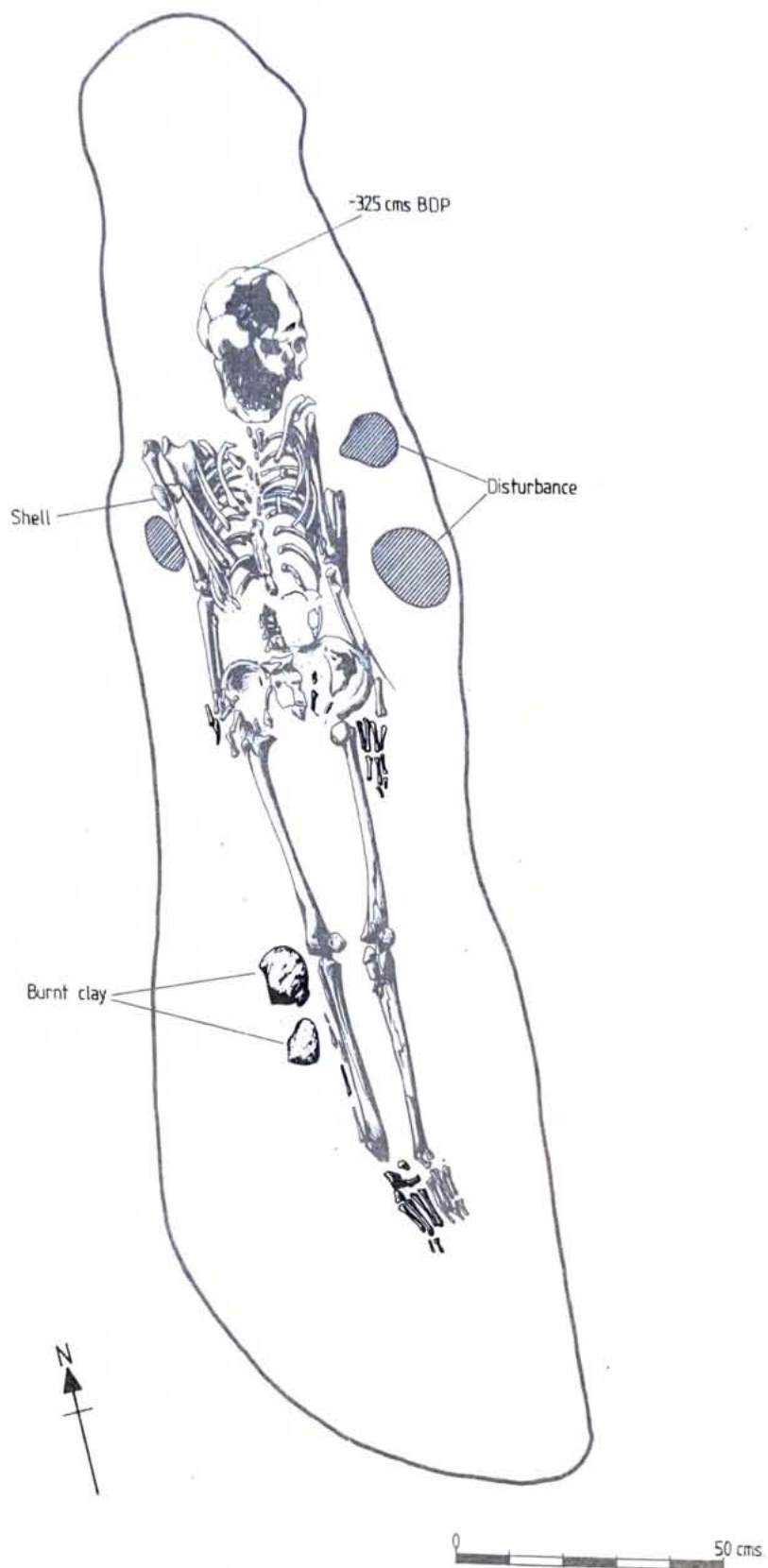


FIGURE 8-71

Ban Na Di: burial 10 squares A3/A4 MP 1c

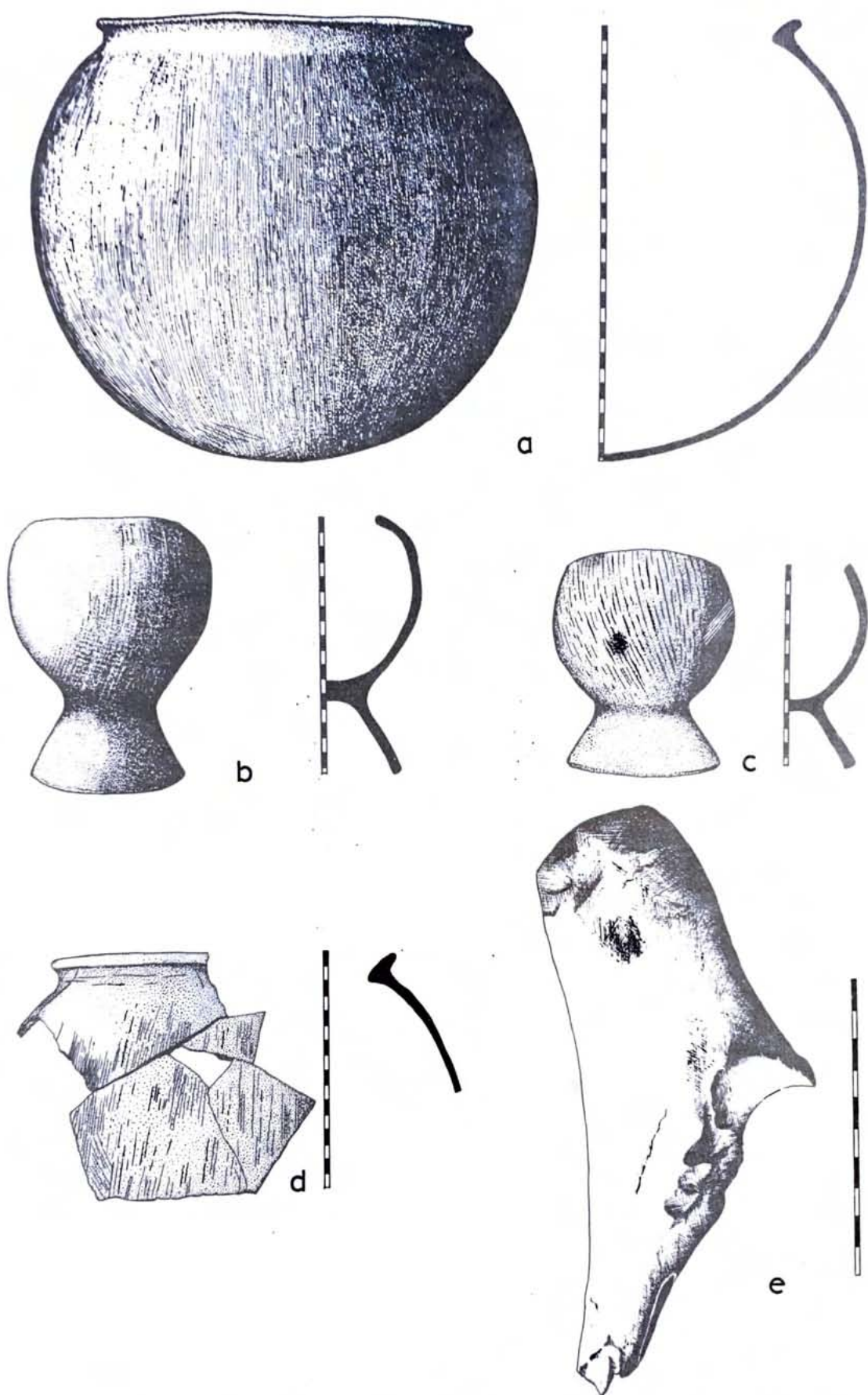


FIGURE 8-72 Ban Na Di: the grave assemblages from burials
 10 and 11. A. pot no. 135 B. pot no. 47 C. pot no. 48
 D. pot no. 57 E. bone implement Cat.1852

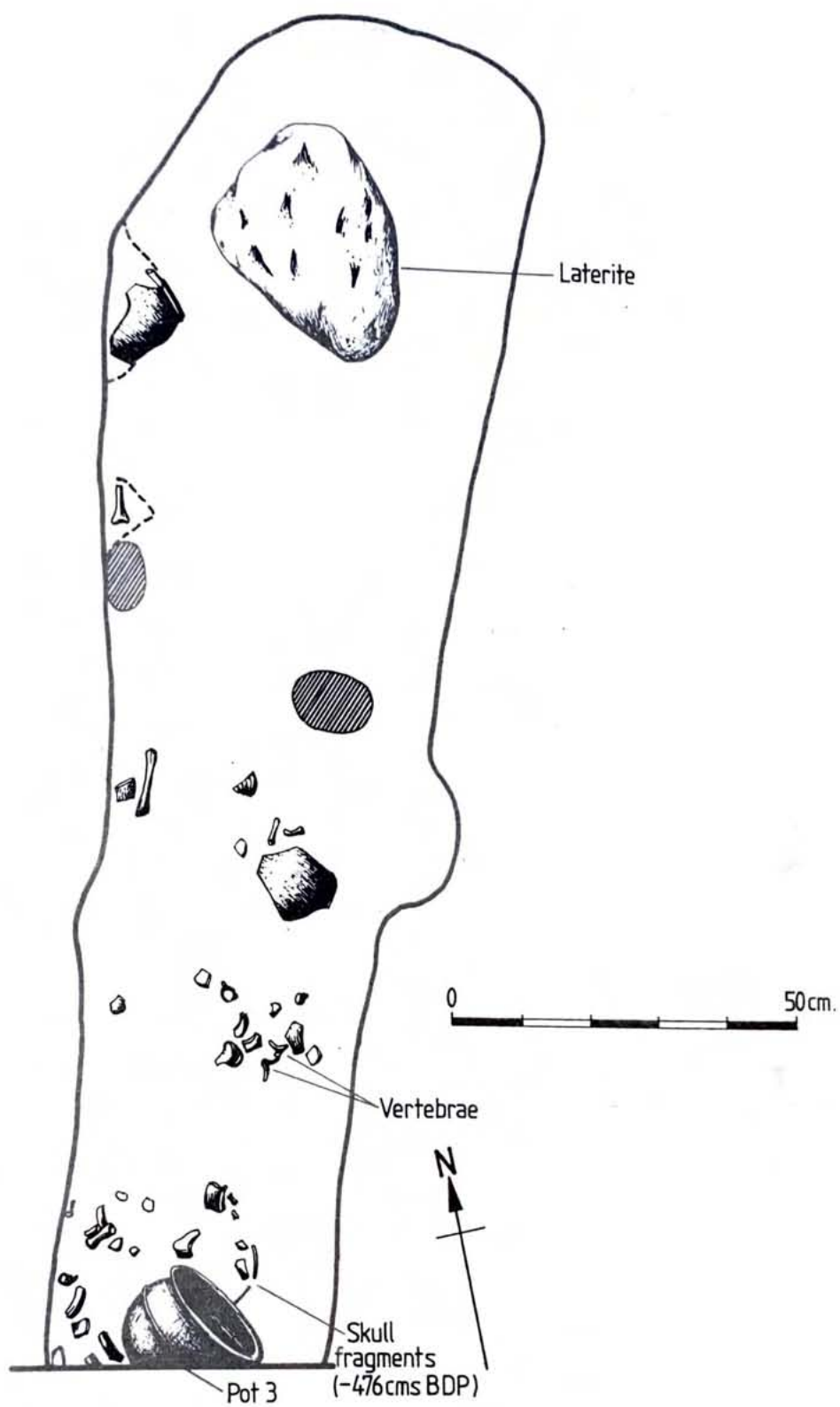


FIGURE 8-73

Ban Na Di: burial 34 square A1 MP 1a

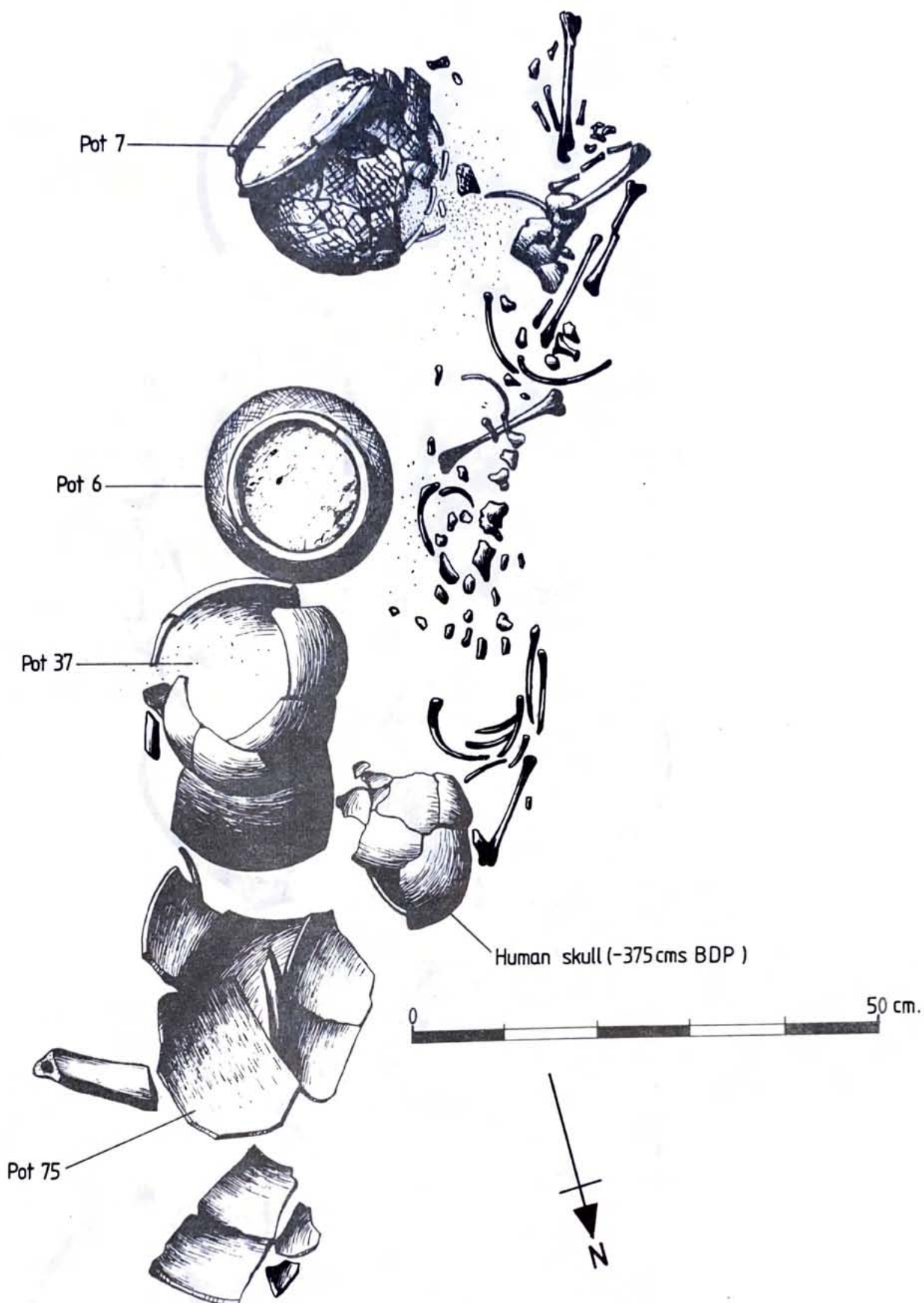


FIGURE 8-74

Ban Na Di: burial 14 square A1 MP 1b

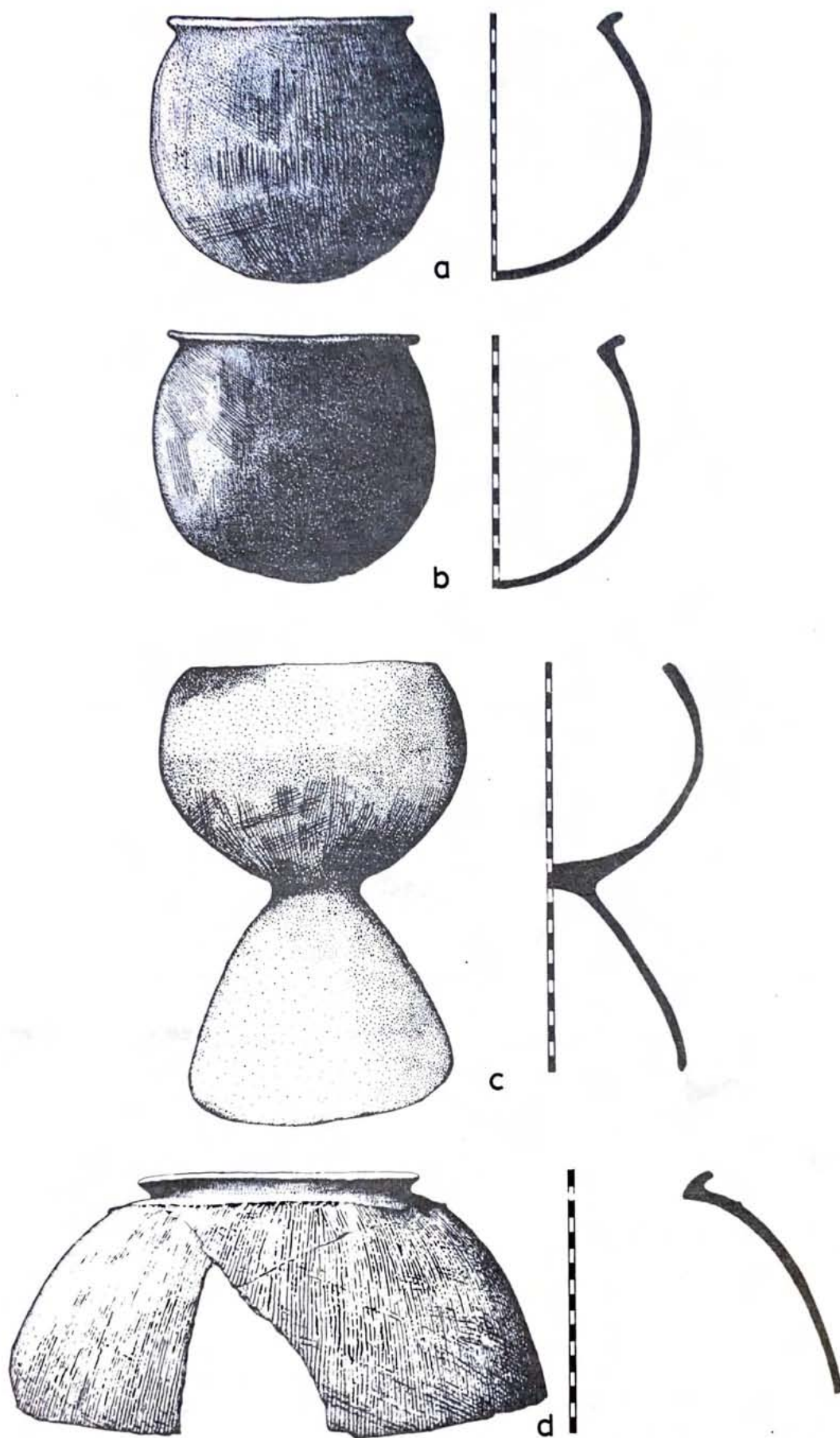


FIGURE 8-75 Ban Na Di: the grave assemblage from burial 14
 A. pot no. 6 B. pot no. 7 C. pot no. 37 D. pot no. 75

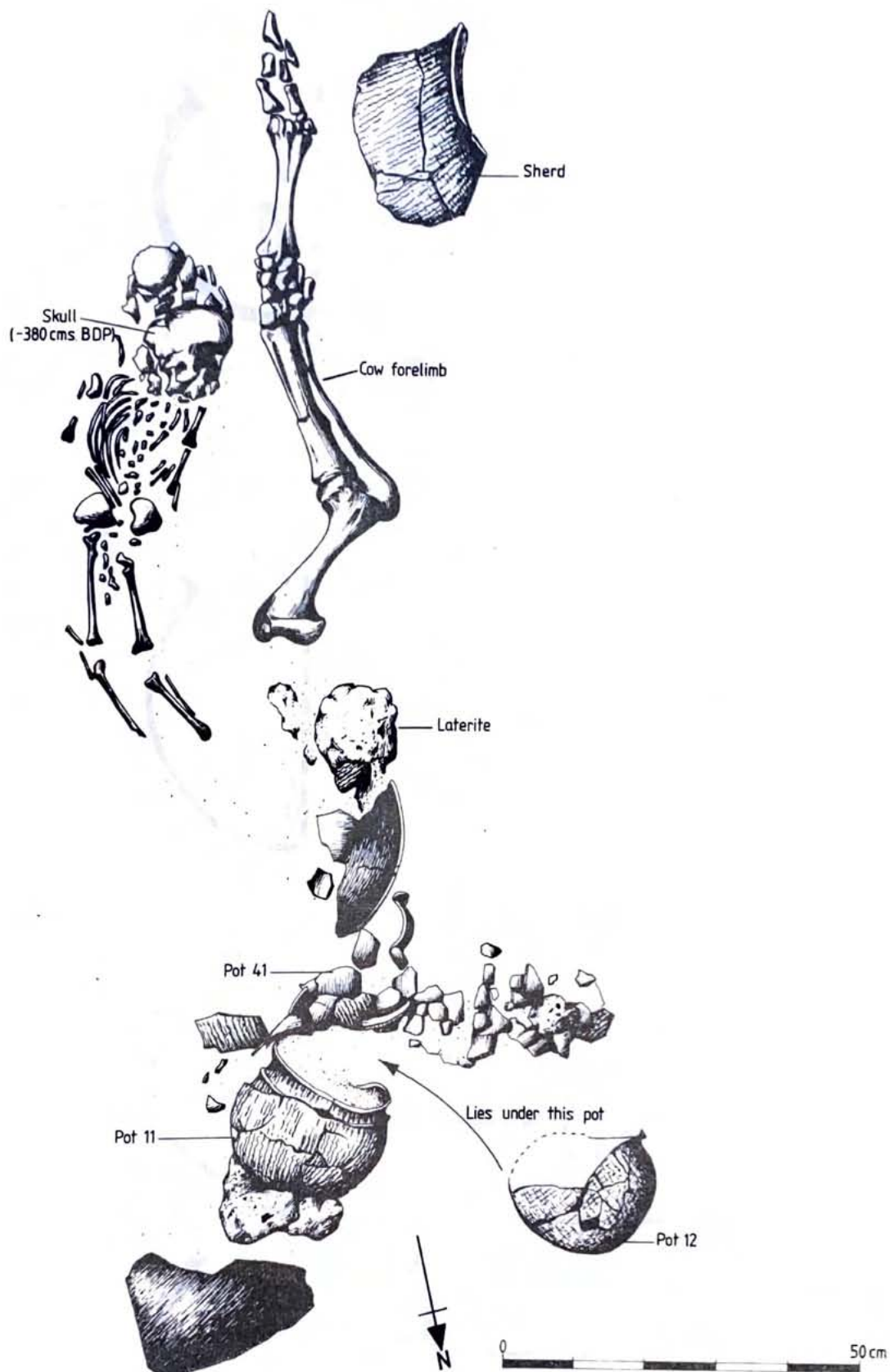


FIGURE 8-76

Ban Na Di: burial 15 square A1 MP 1b

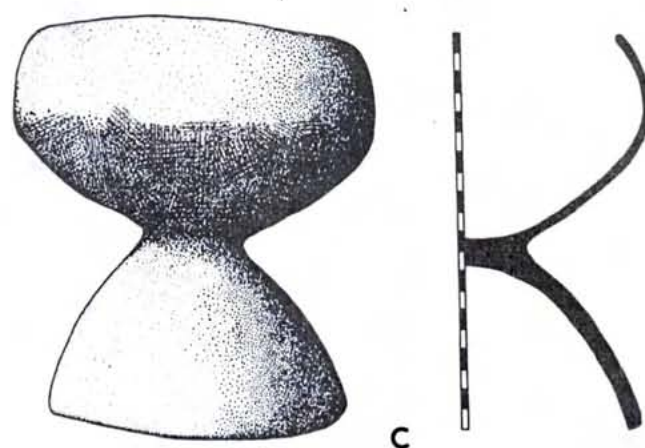
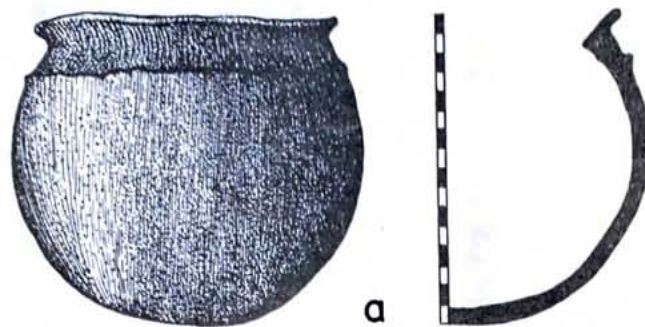


FIGURE 8-77

Ban Na Di: The grave assemblage from burial 15
 A. pot no. 11 B. pot no. 12 C. pot no. 41

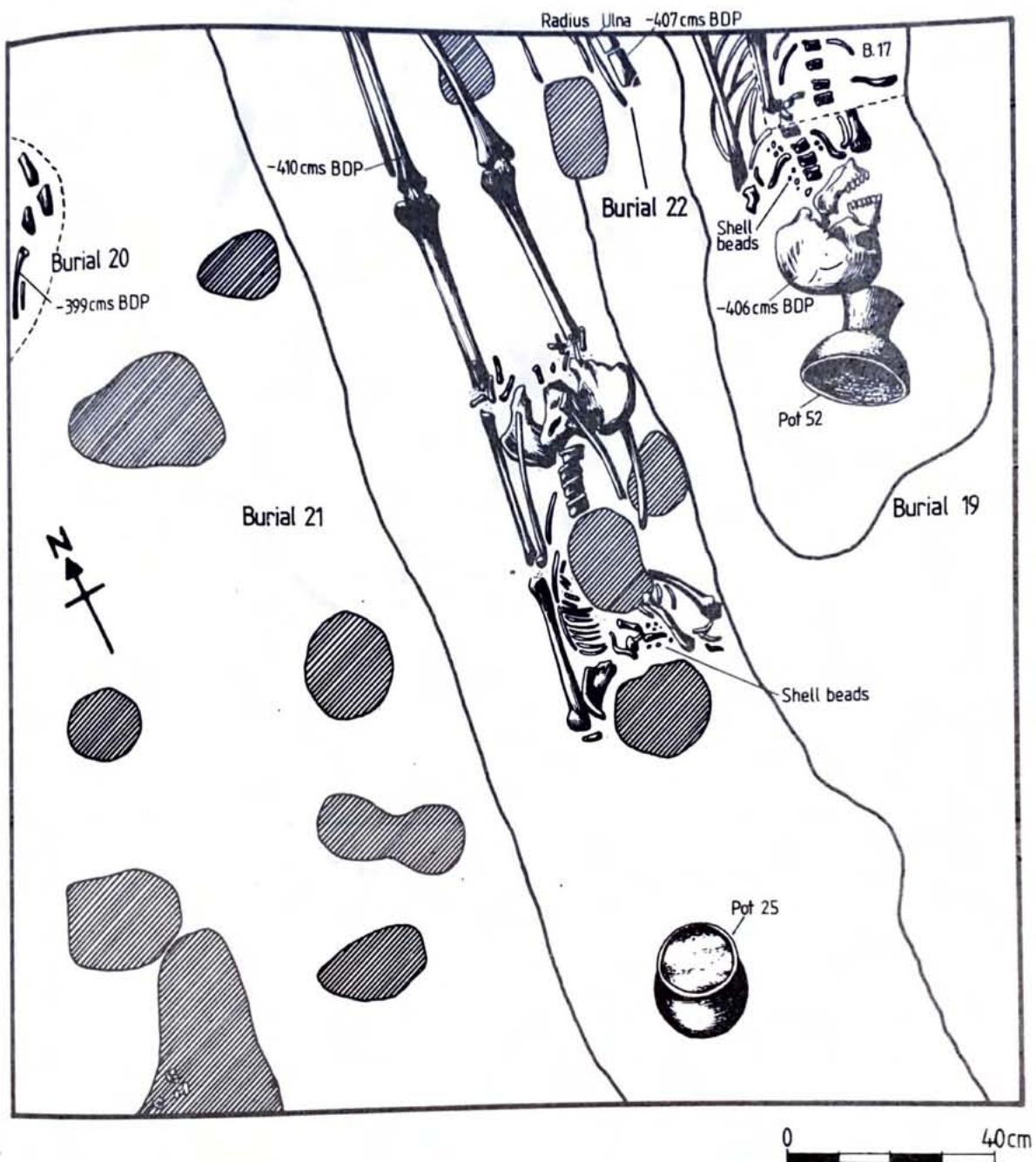


FIGURE 8-78

Ban Na Di: burials TS 19-22 square F5
 Bur.TS19 is MP 1a. Bur.TS20 is MP 1b. Bur.TS21 is MP 1a Bur.TS22 is MP 1a

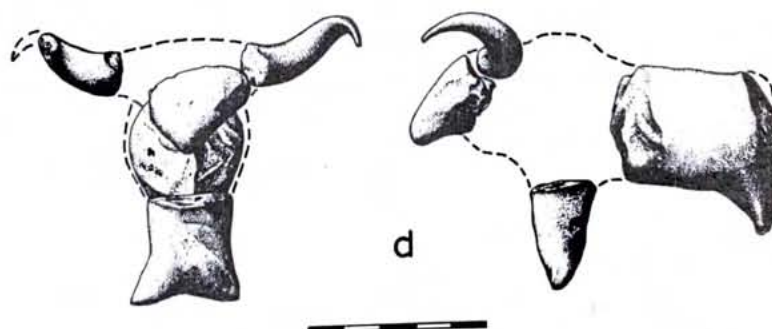
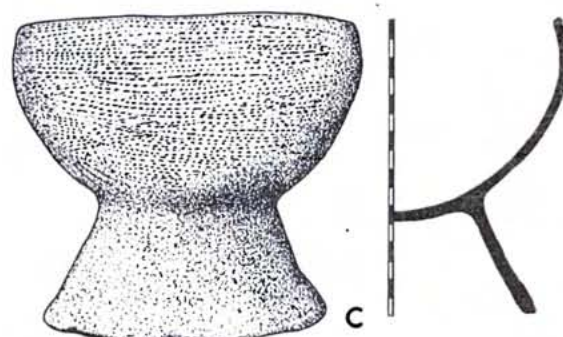
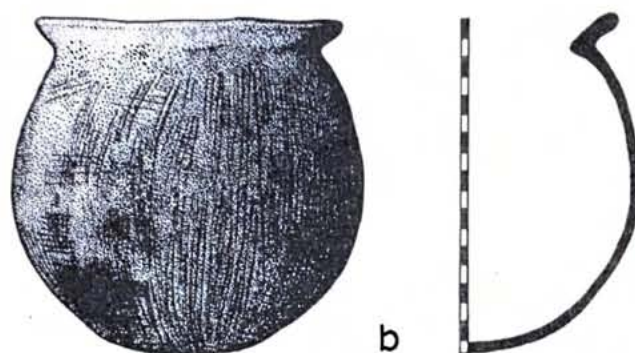
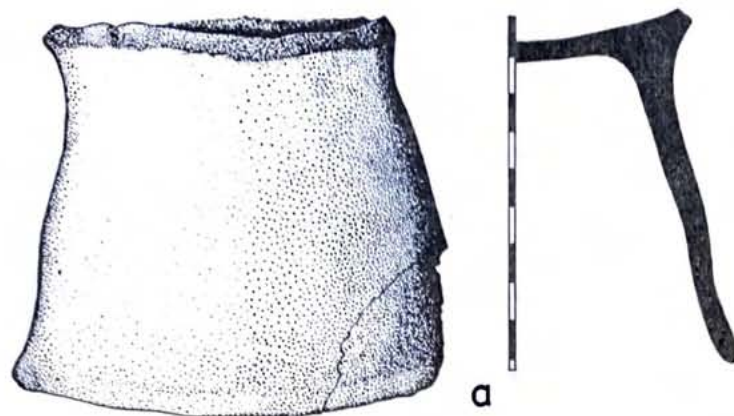


FIGURE 8-79 Ban Na Di: the grave assemblage from burials TS 15 (A-B) and TS19 (C-D). A. pot no. 69 B. Pot no. 27 C. pot no. 52 D. figurine cat. TS 34a-b.

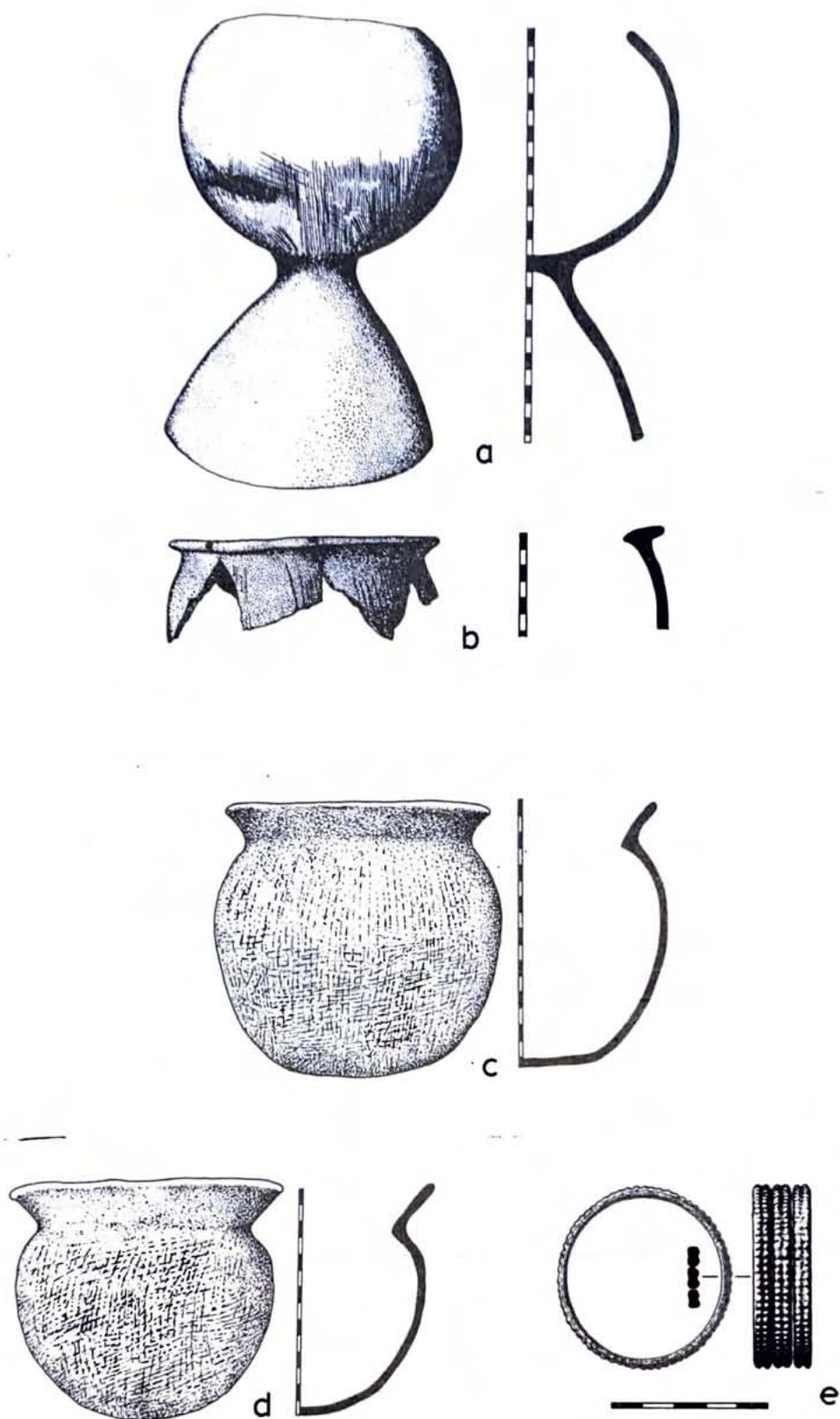


FIGURE 8-80

Ban Na Di: The grave assemblages from burials 13 (A)
 TS3 (B), TS16 (C) and TS21 (D)
 A. pot no. 68 B. pot no. 101 C. pot no. 26 D. pot no. 25

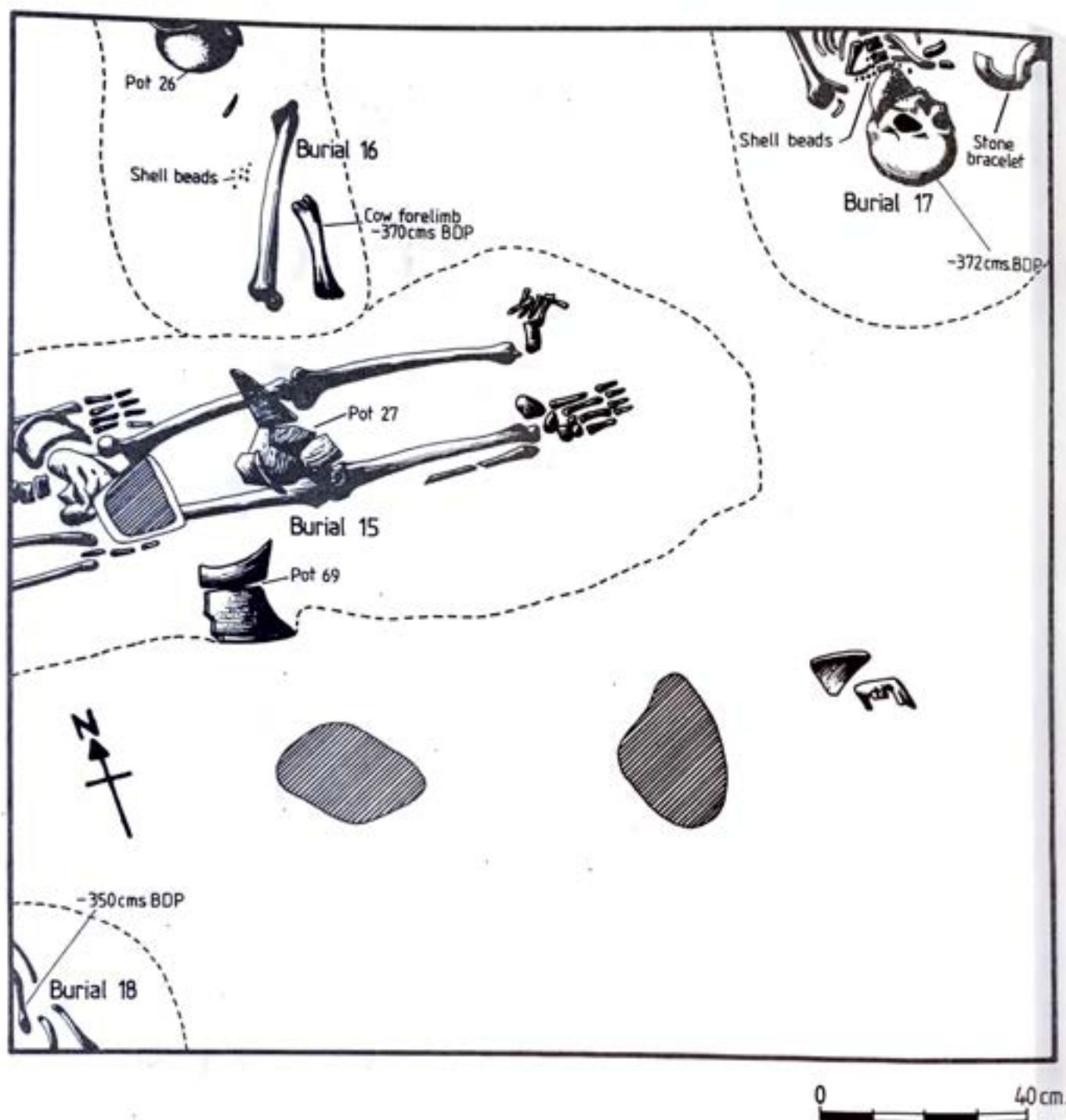


FIGURE 8-81

Ban Na Di: burials TS15-18 square F5. All are MP 1b

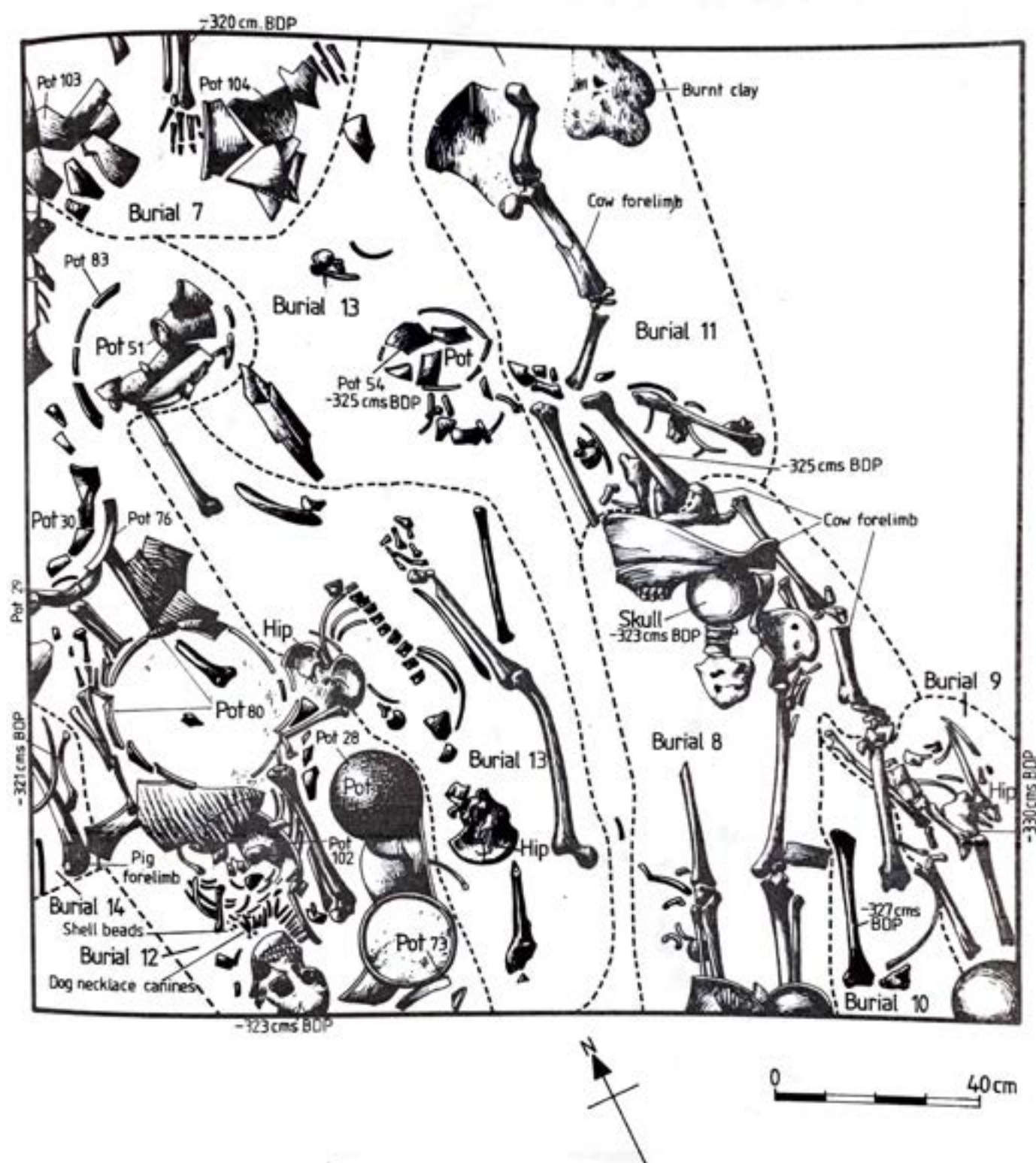


FIGURE 8-82

Ban Na Di: burials TS7-14. All are MP 1c

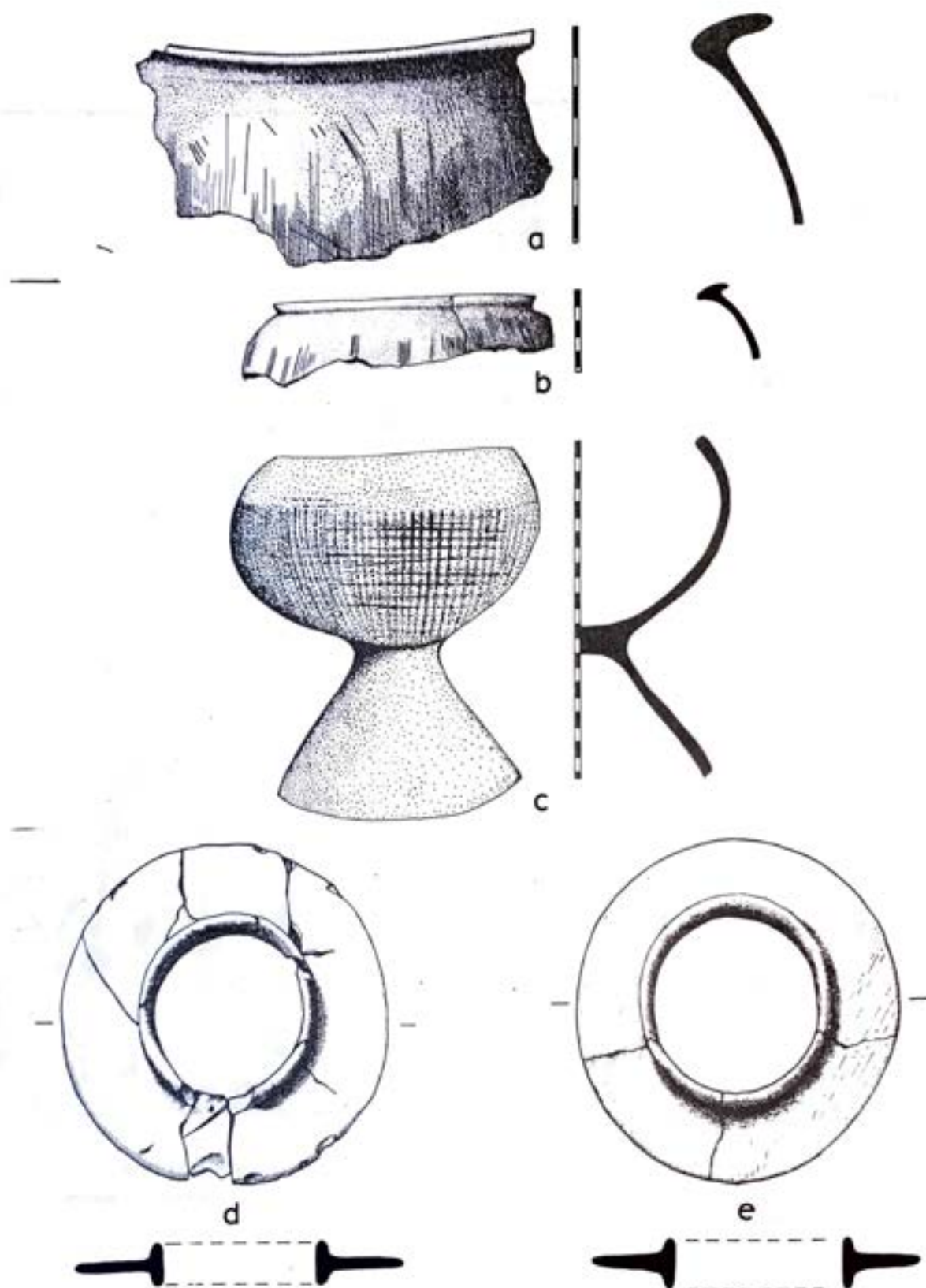
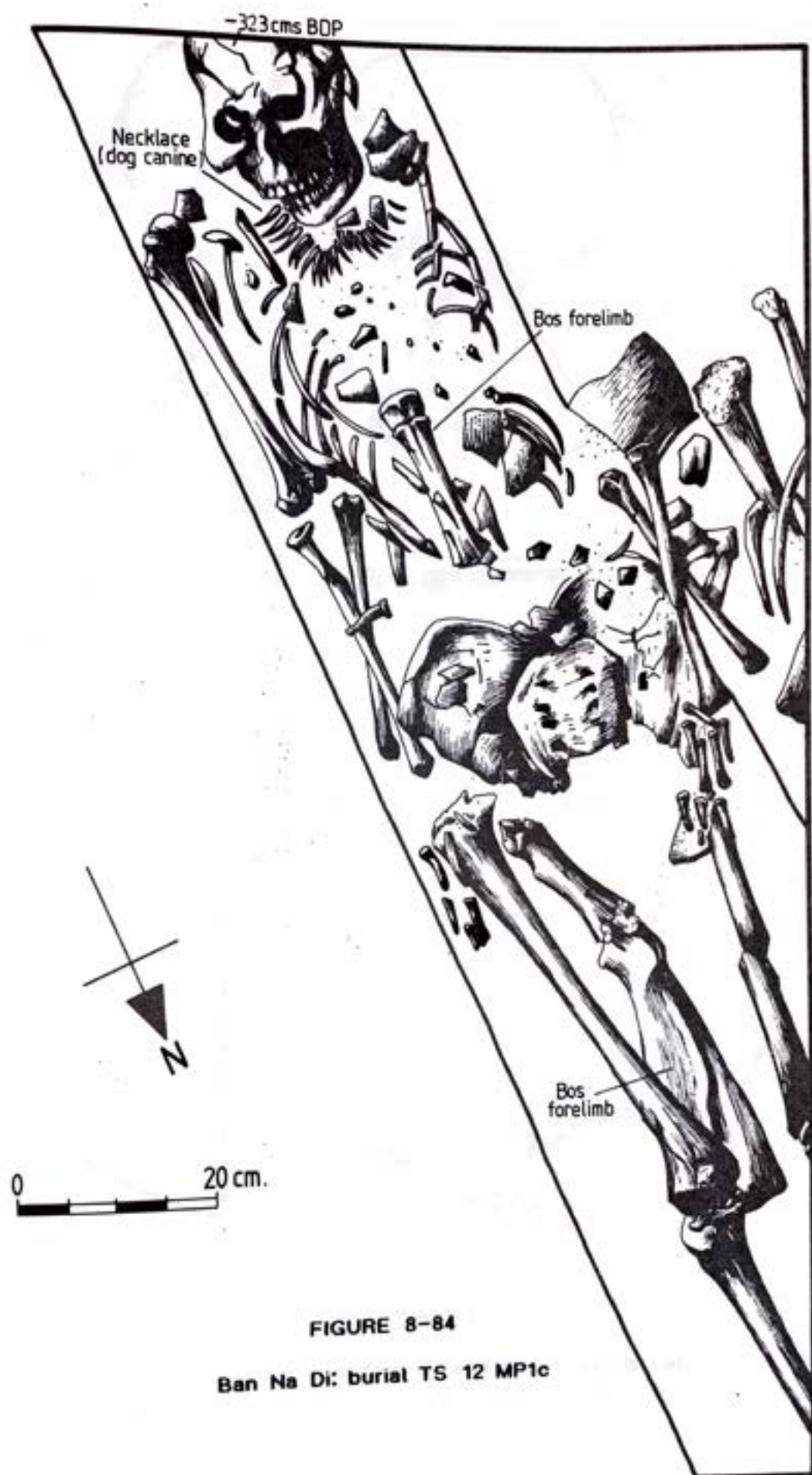


FIGURE 8-83

Ban Na Di: The grave assemblages from burials TS7 (A-B)
 TS13 (C) and TS17 (D-E)
 A. pot no. 104 B. pot no. 103 C. pot no. 54 D-E. stone bracelets
 Cats 33a-b



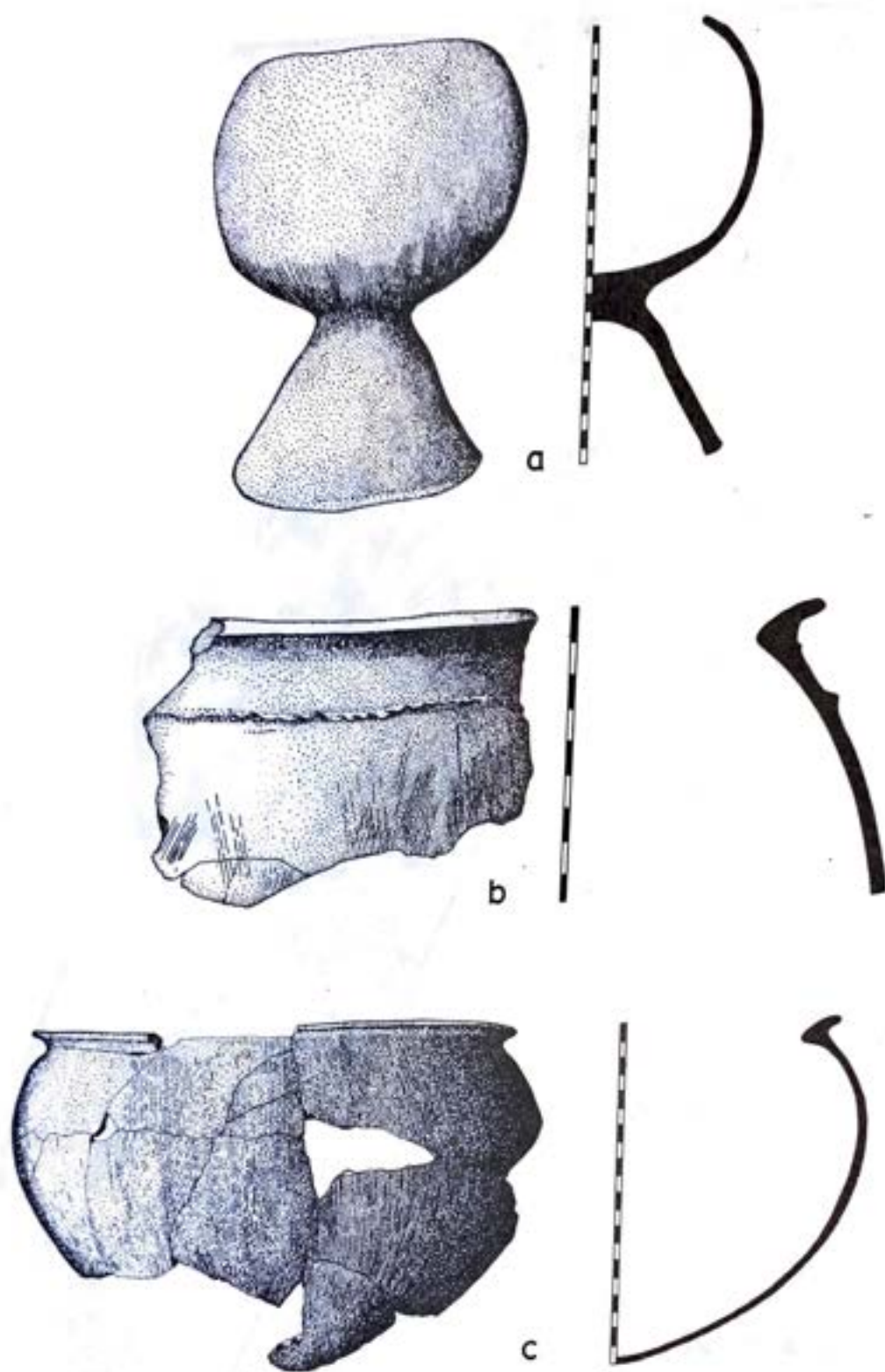


FIGURE 8-85

Ban Na Di: the grave assemblage from burial TS12
 A. pot no. 51 B. pot no. 102 C. pot no. 83

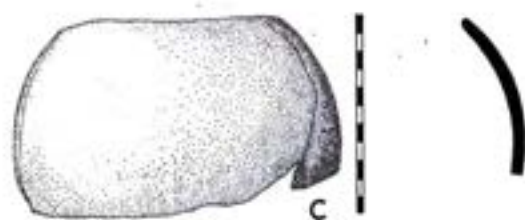
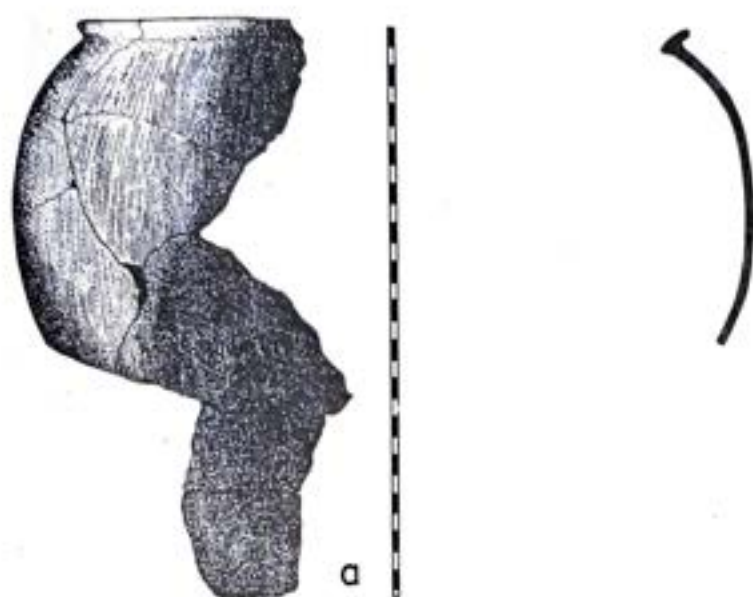


FIGURE 8-86

Ban Na Di: The grave assemblage from burial TS12 (cont.)

A. pot no. 78 B. pot no. 80 C. pot no. 78

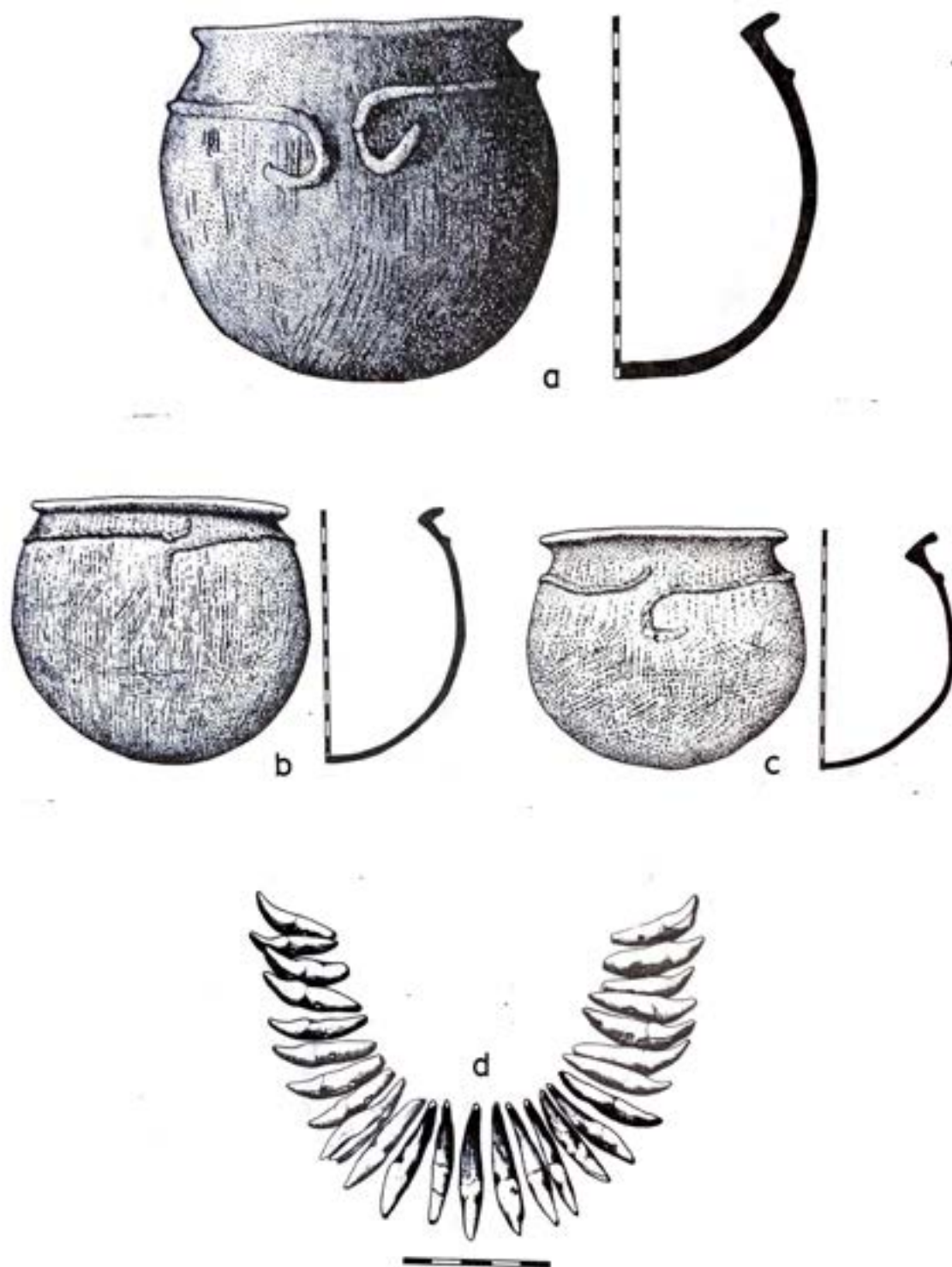


FIGURE 8-87

Ban Na Di: The grave assemblage from burial TS12 (cont.)
 A. pot no. 30 B. pot no. 29 C. pot no. 28 D. dog tooth necklace
 Cat.TS25

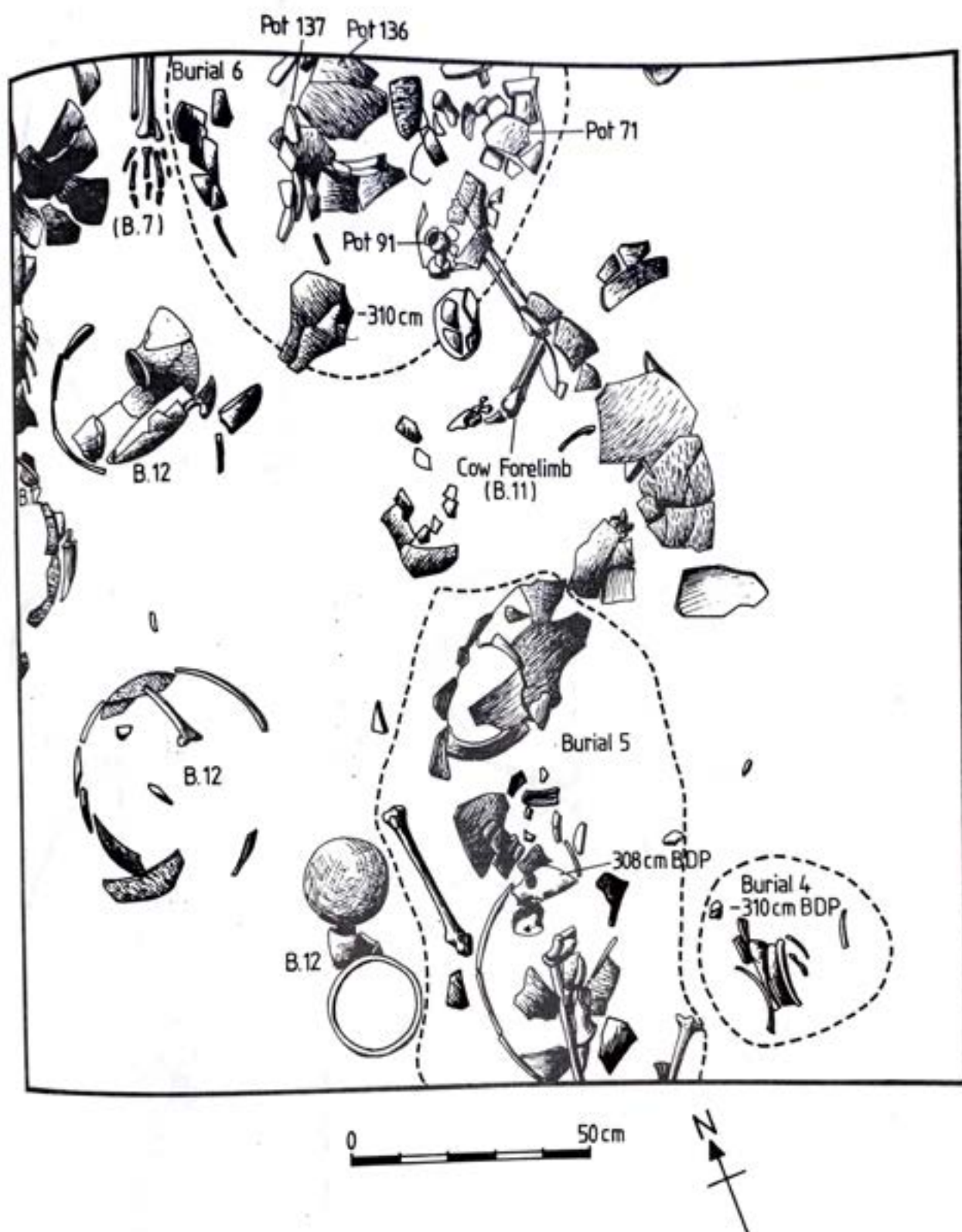


FIGURE 8-88

Ban Na Di: burials TS4-6 square F5 MP 1c

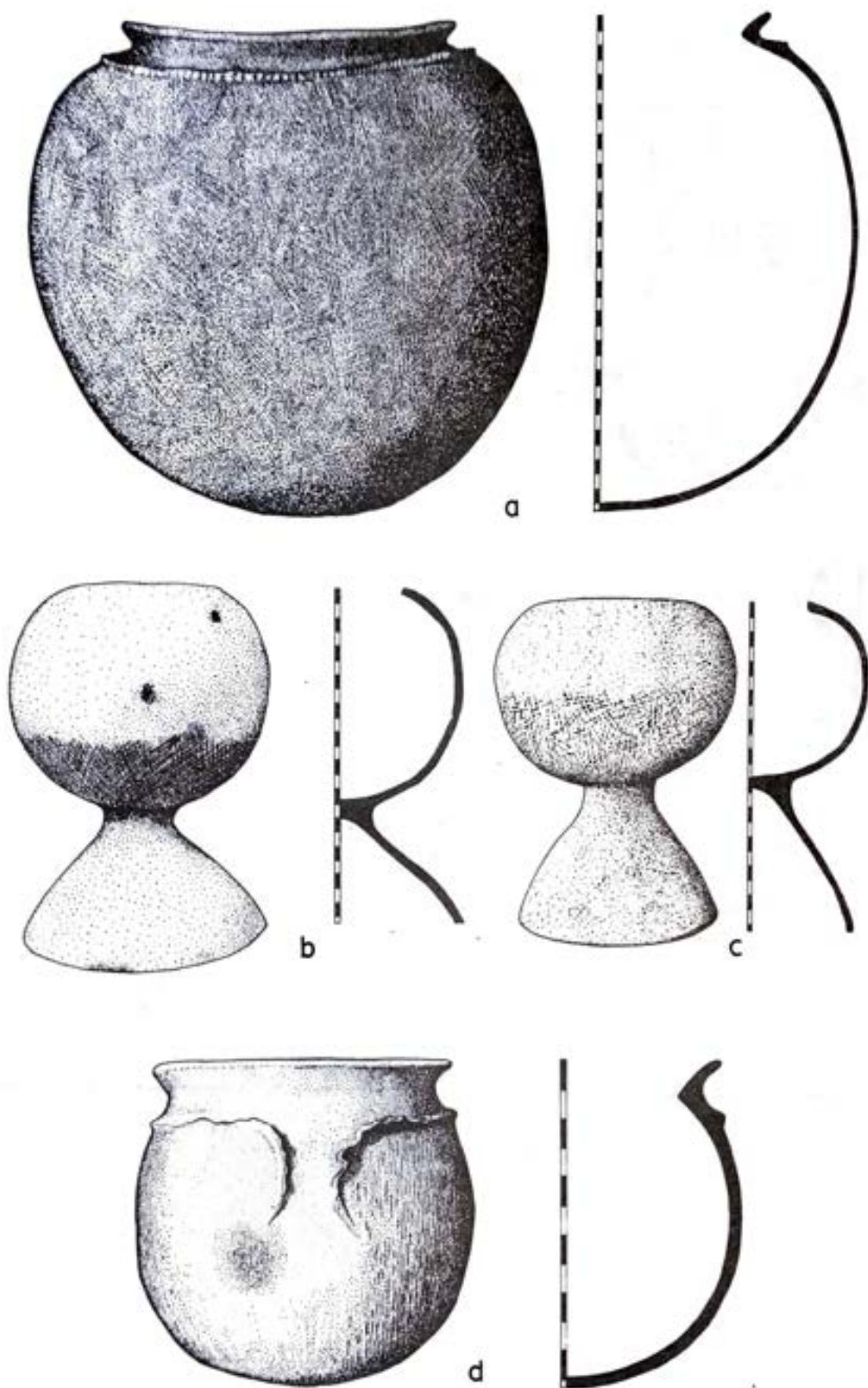


FIGURE 8-89 Ban Na Di: the grave assemblage from burial TS5
 A. pot no. 58 B. pot no. 55 C. pot no. 50 D. pot no. 34

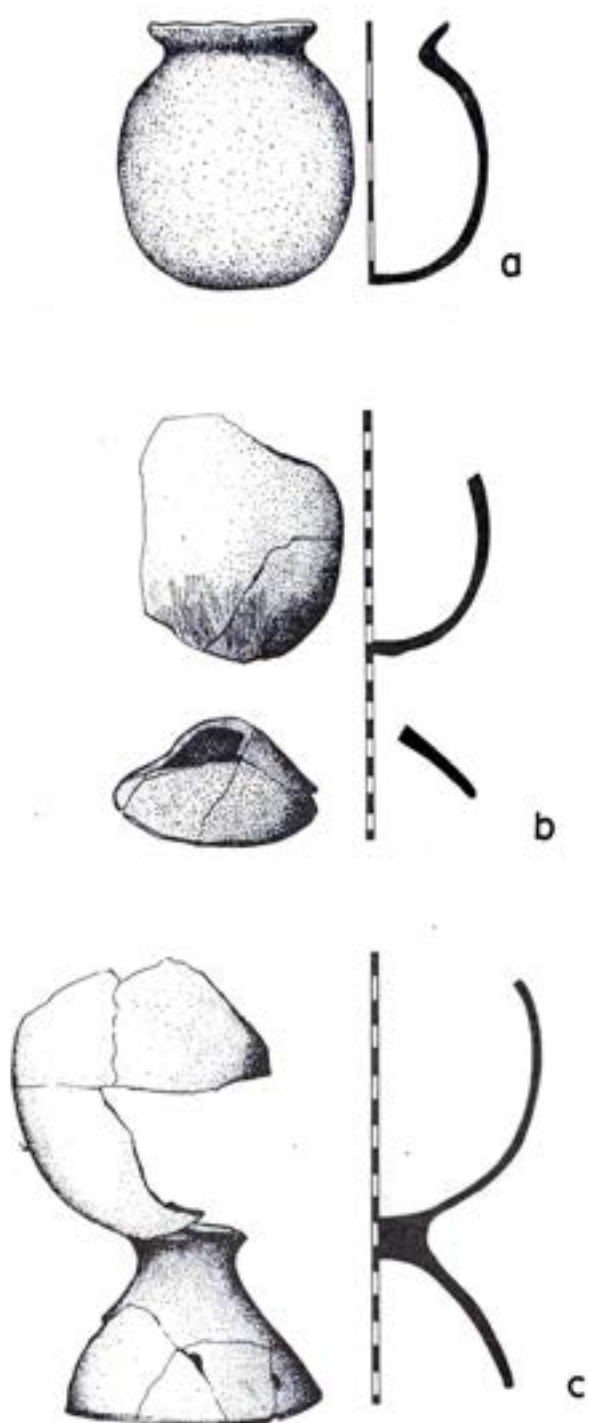


FIGURE 8-90

Ban Na Di: The grave assemblage from burial TS6
 A. pot no. 91 B. pot no. 137 C. pot no. 71

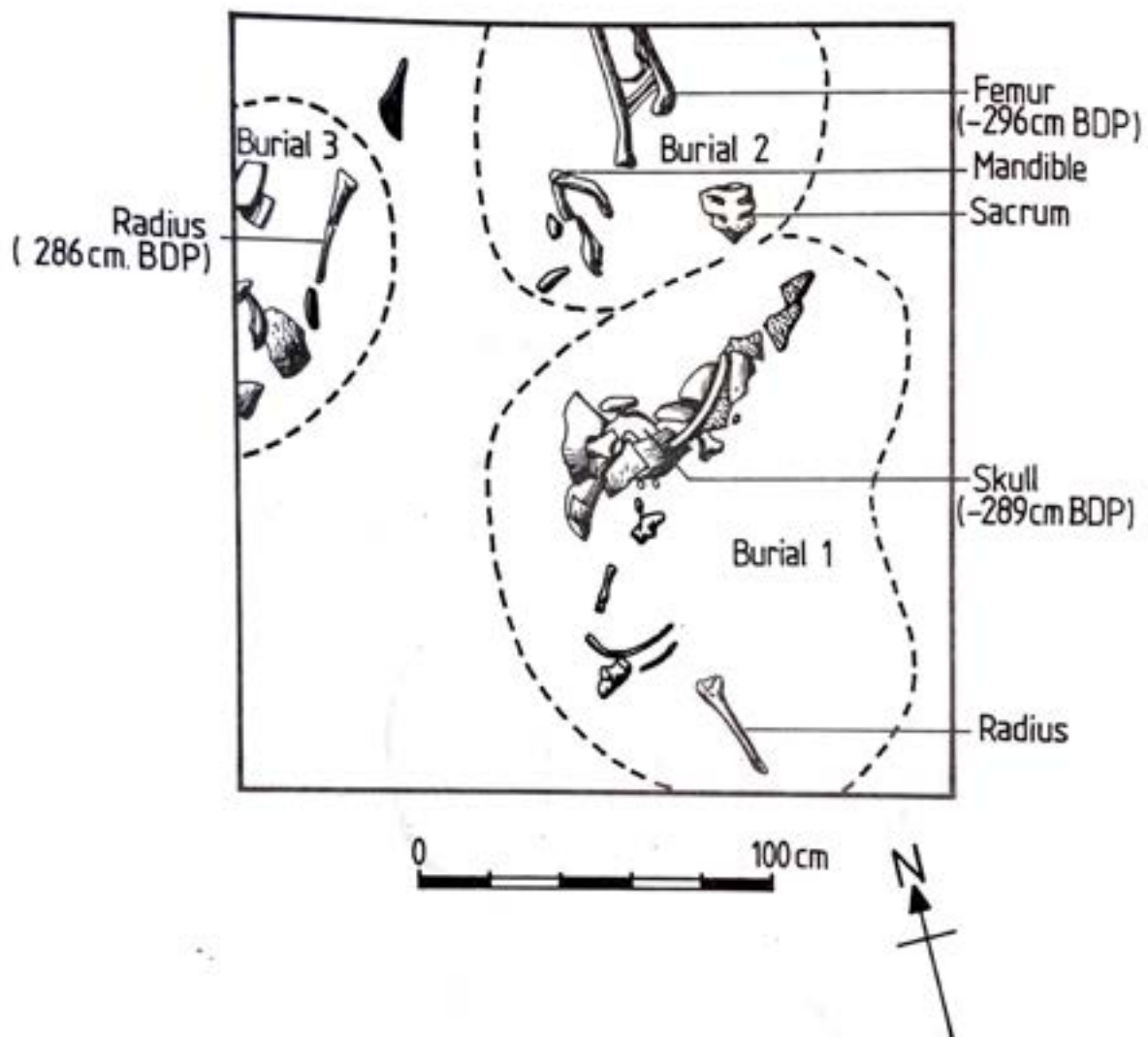


FIGURE 8-91

Ban Na Di: burials TS1-3 square F5 probably MP 1c

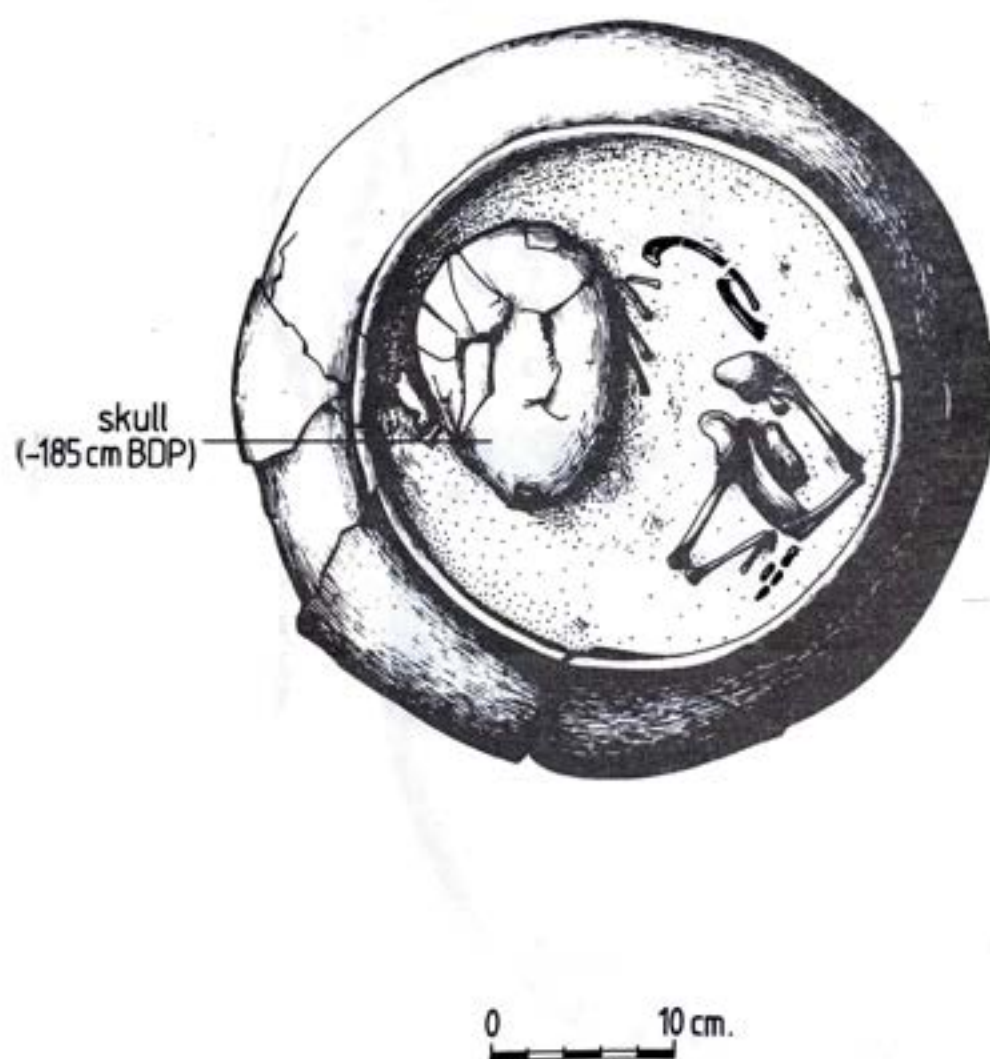


FIGURE 8-92
Ban Na Di: burial 4 square A1 MP 2

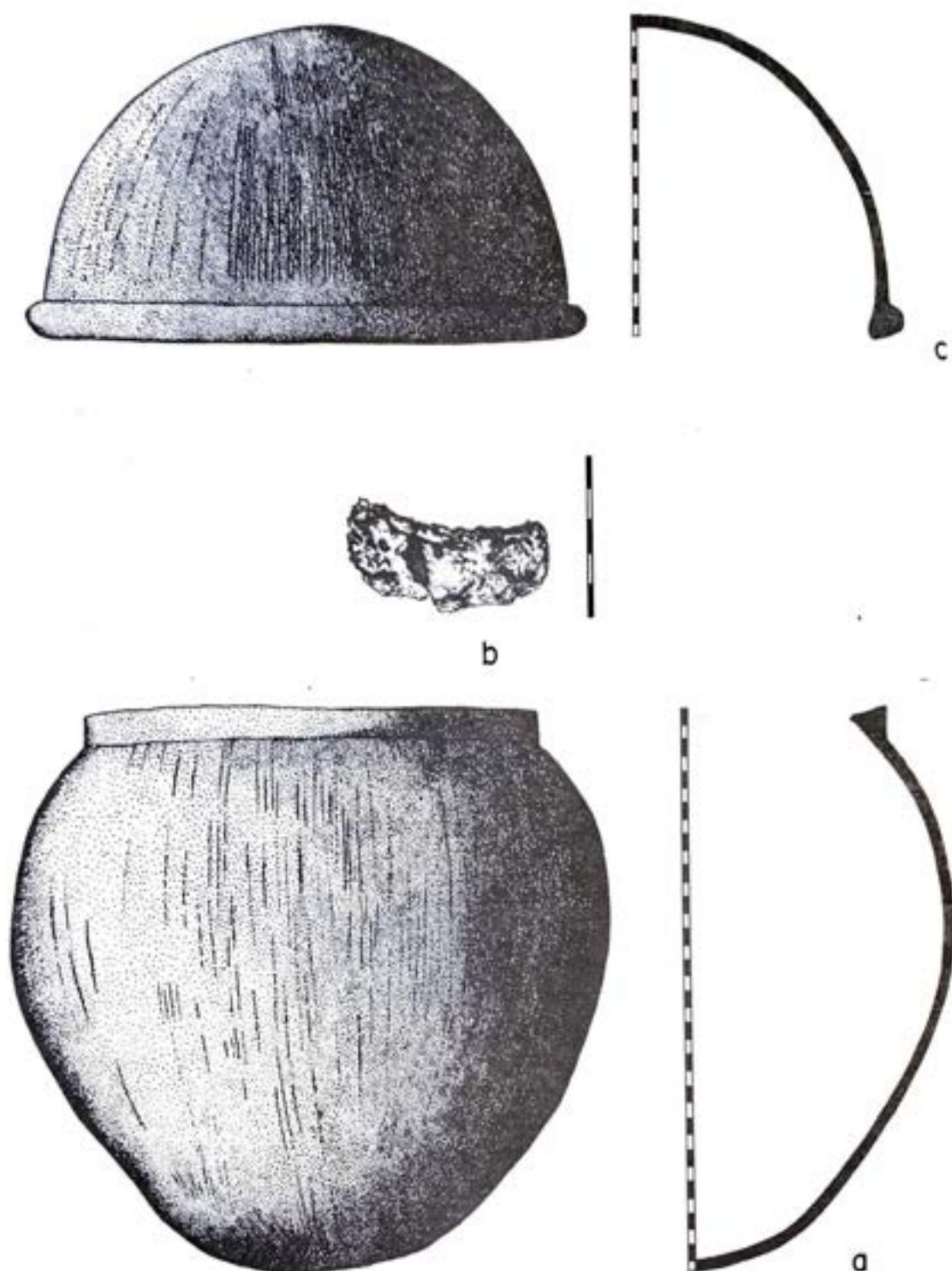
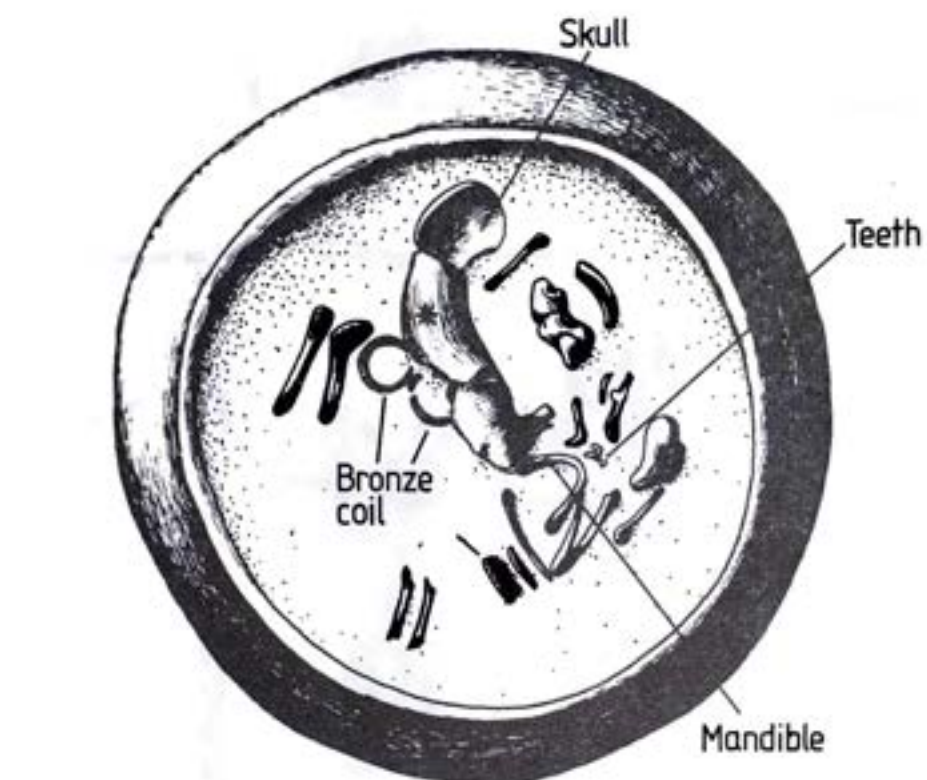


FIGURE 8-93

Ban Na Di: The grave assemblage from burial 4
 A and C, pot and lid no. 113 B. iron knife Cat. 379



* (-188 cm BDP)

FIGURE 8-94

Ban Na Di: burial 5 square A1 MP 2

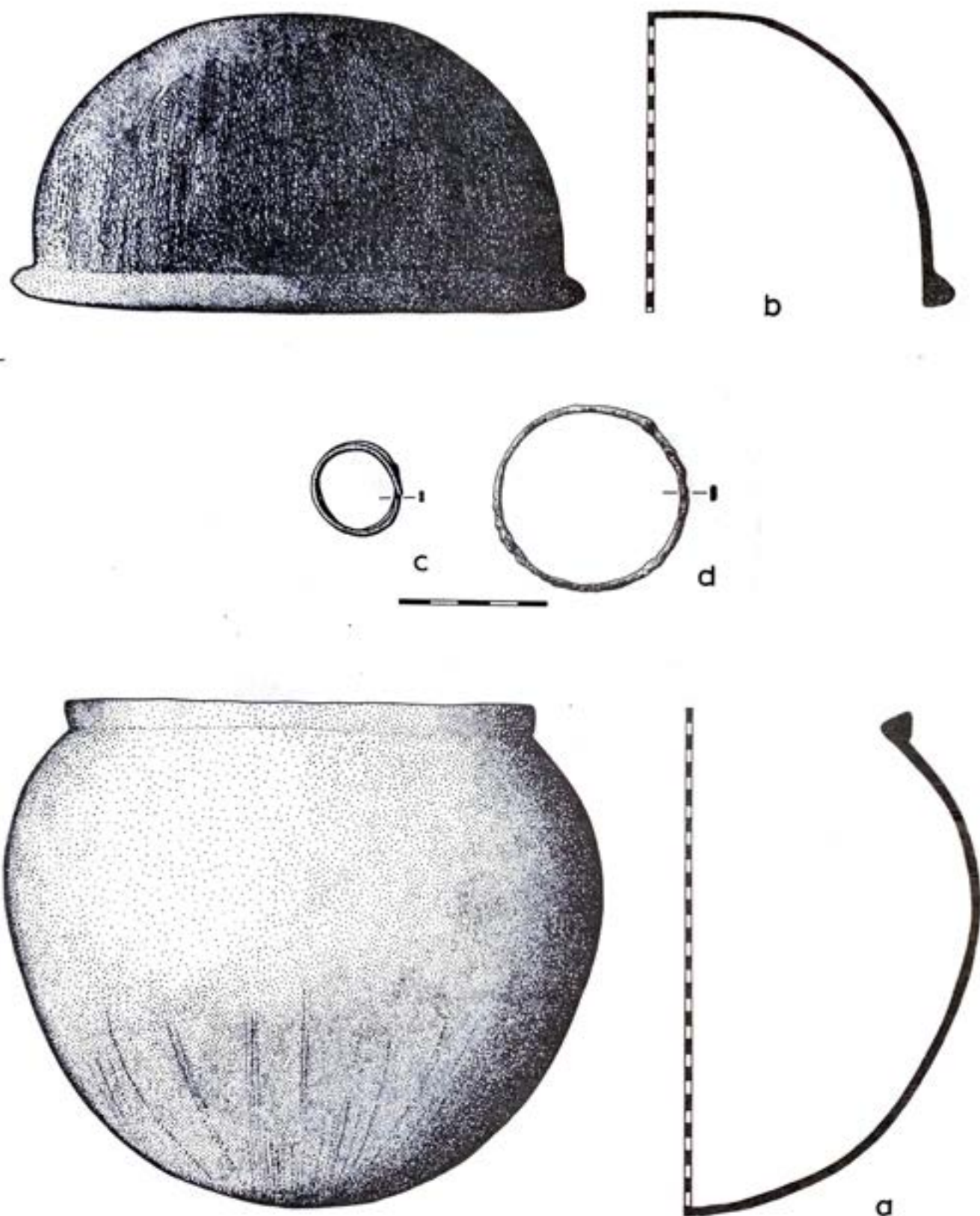


FIGURE 8-95

Ban Na Di: The grave assemblage from burial 5
 A-B. pot and lid no. 114. C-D bronze bracelets Cats. 427a-b

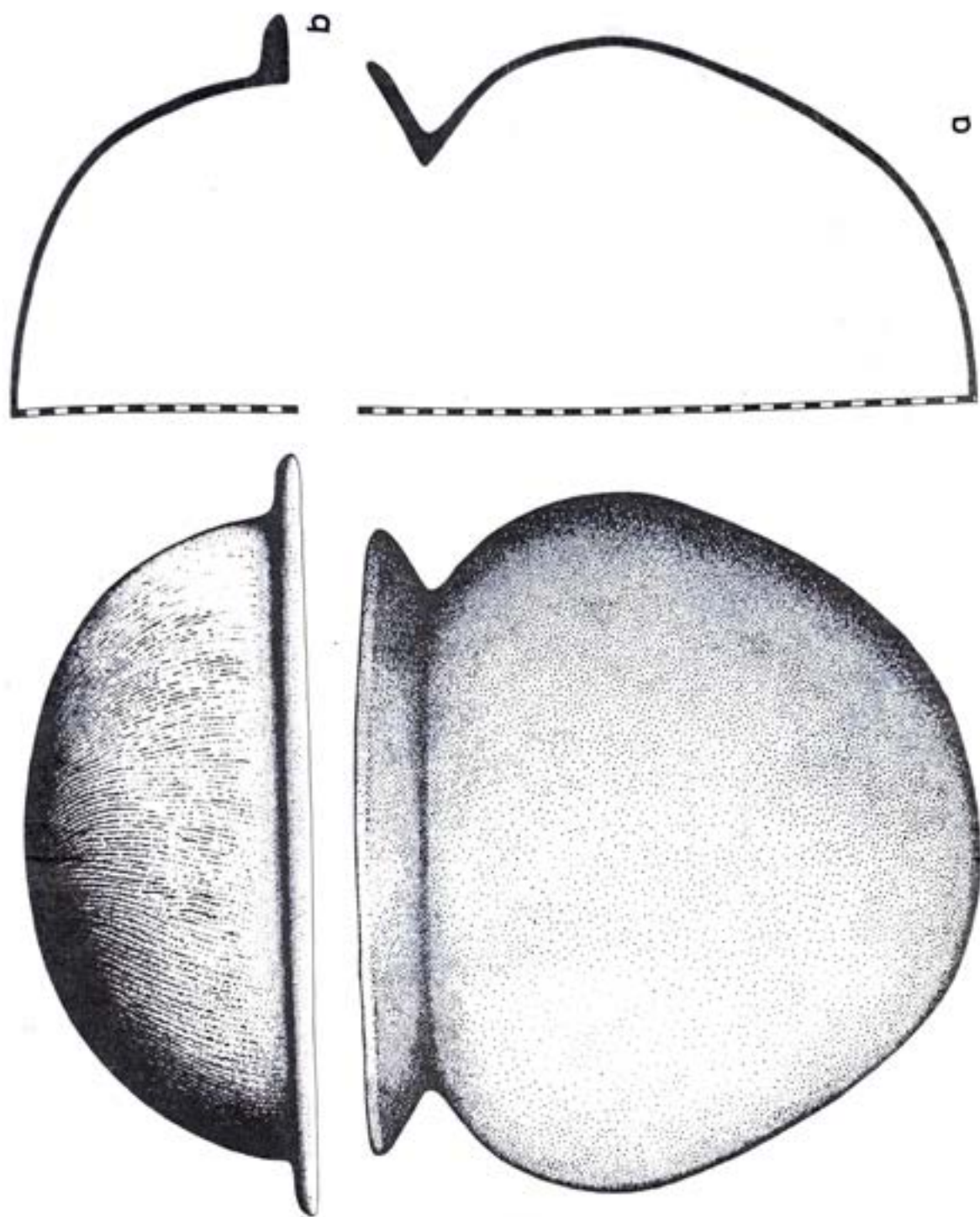


FIGURE 8-96

Ban Na Di: the grave assemblage from burial 6 MP 2
A-B pot and lid no.117



FIGURE 8-97
Ban Na Di: burial 7 square A2 MP 2

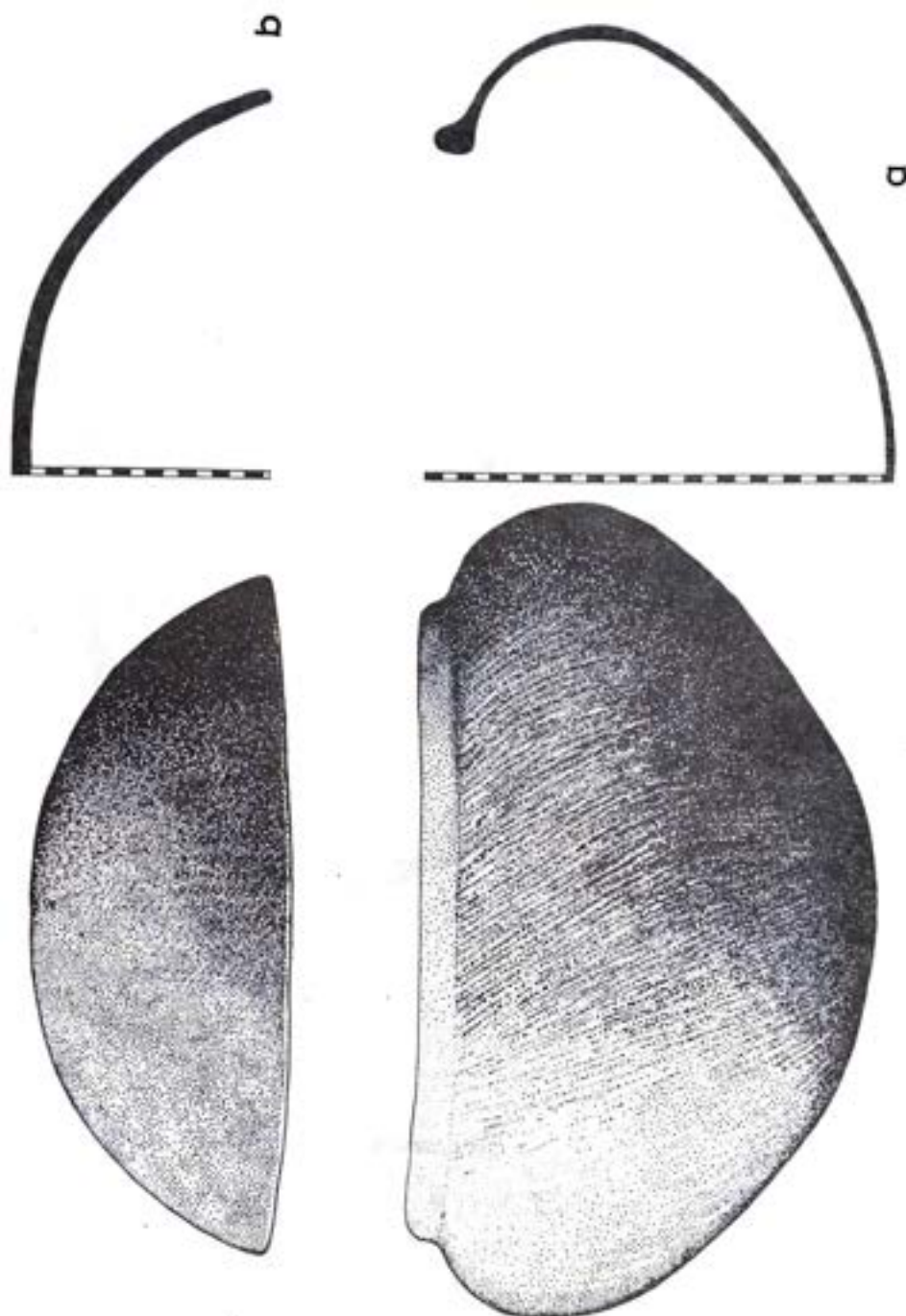


FIGURE 8-98

Ban Na Di: The grave assemblage from burial 7
A-B. pot and lid no. 116

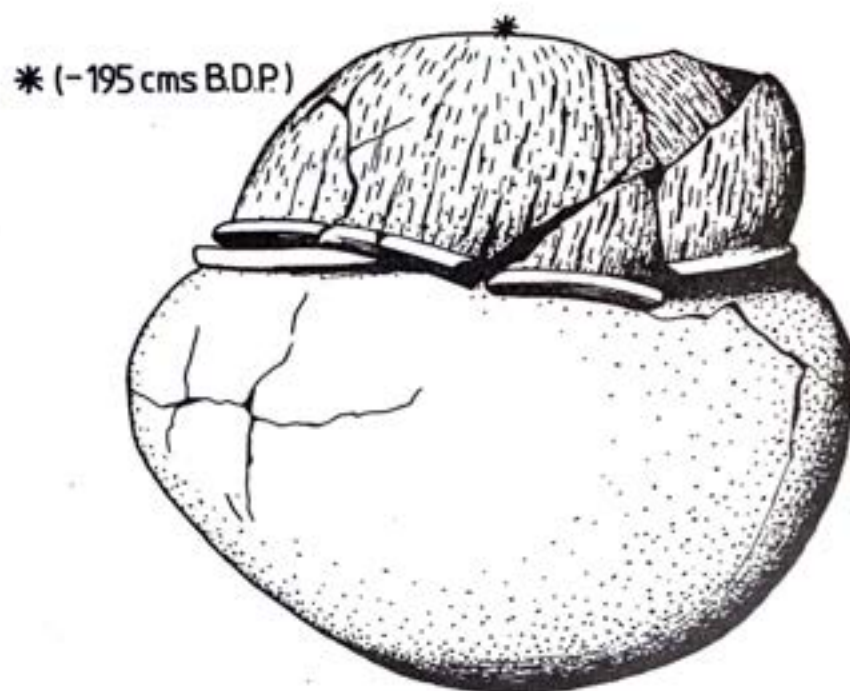


FIGURE 8-99

Ban Na Di: burial 8 square A1 MP 2

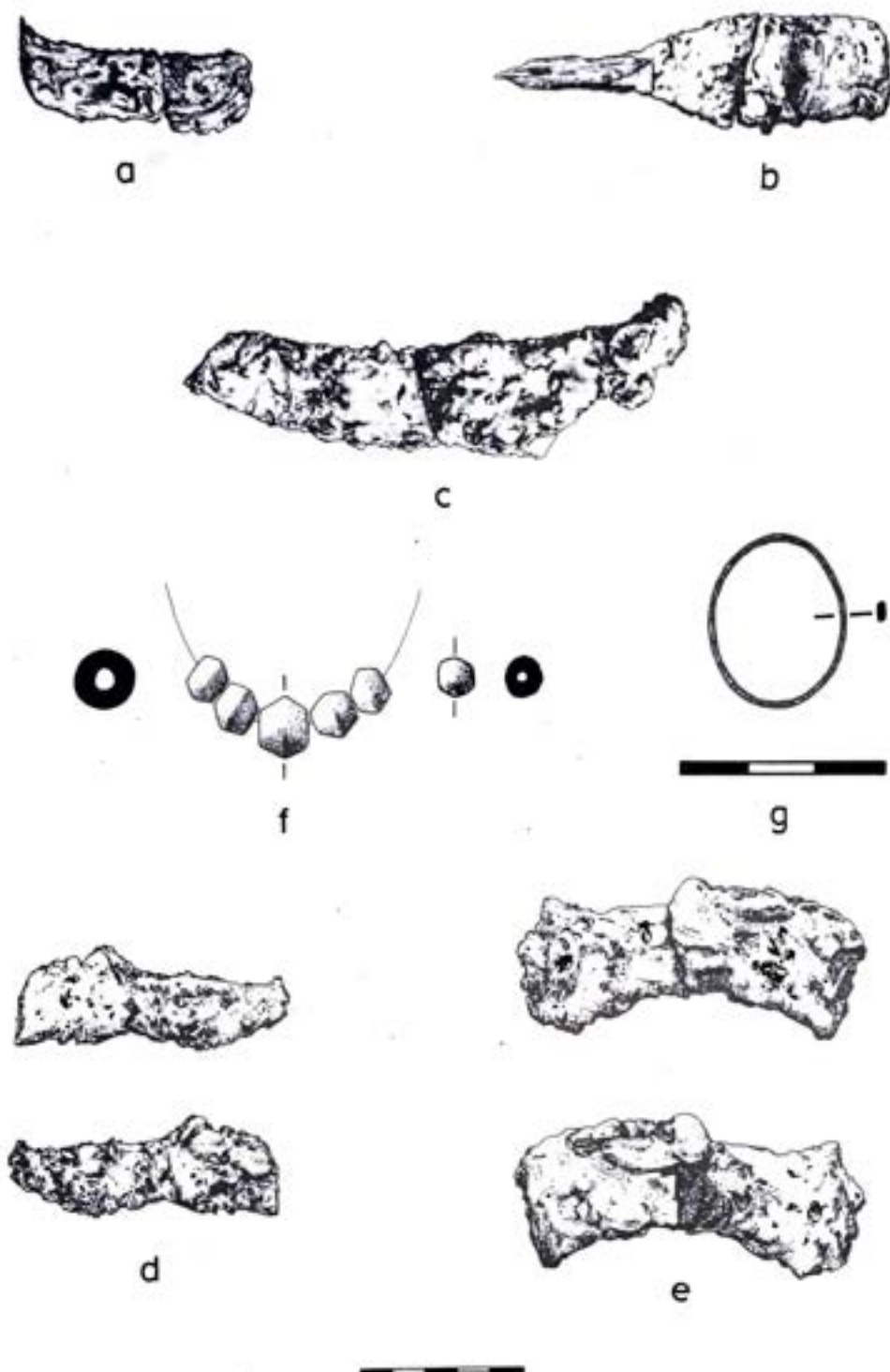


FIGURE 8-100

Ban Na Di: The grave assemblage from burial 8
 A-E. iron implements Cats.1428a-f F. blue glass beads Cats.1430a-e
 G. bronze bracelet Cat.1431

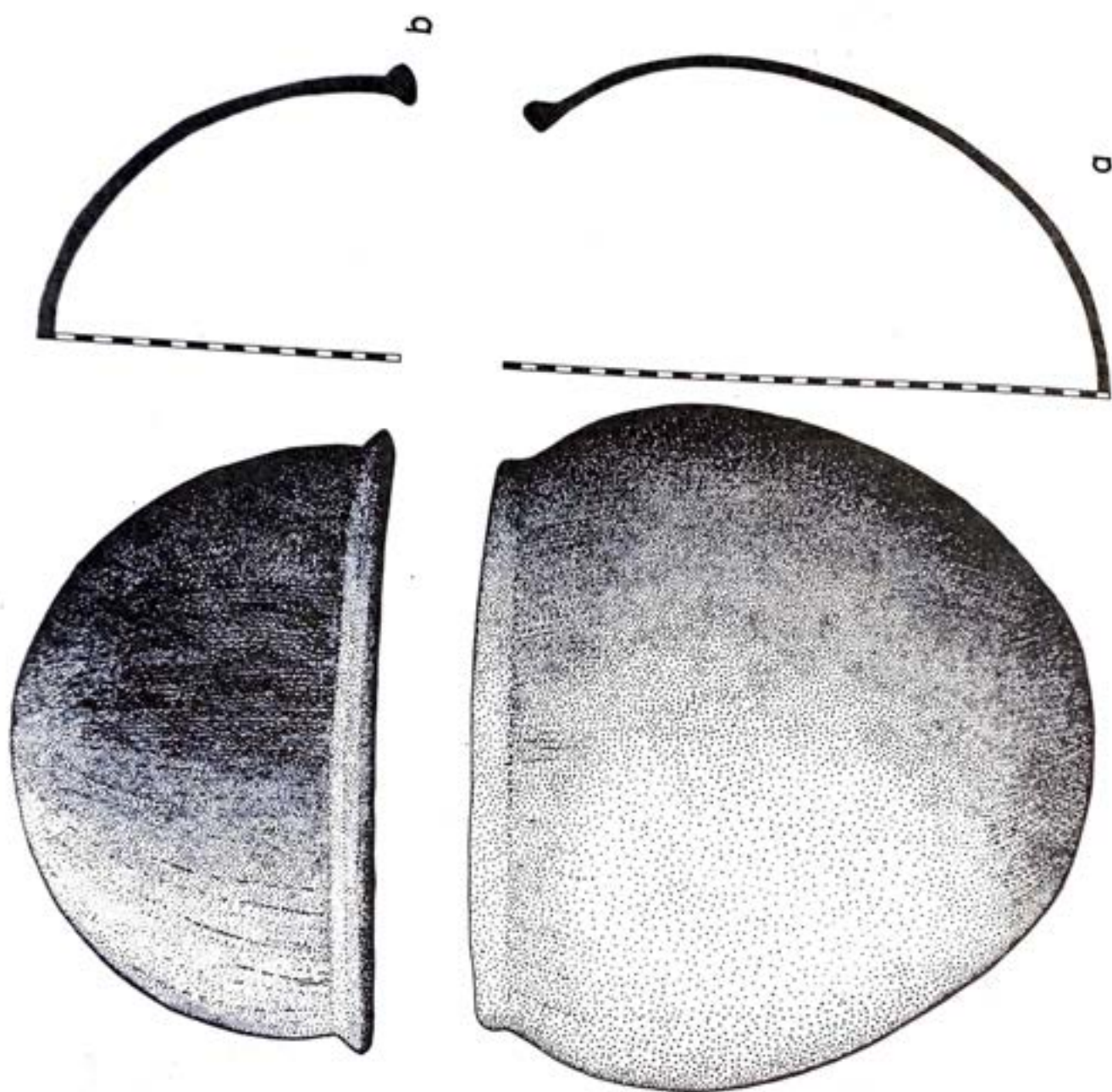


FIGURE 8-101

Ban Na Di: the grave assemblage from burial 8 (cont.)
A-B pot and lid no. 115

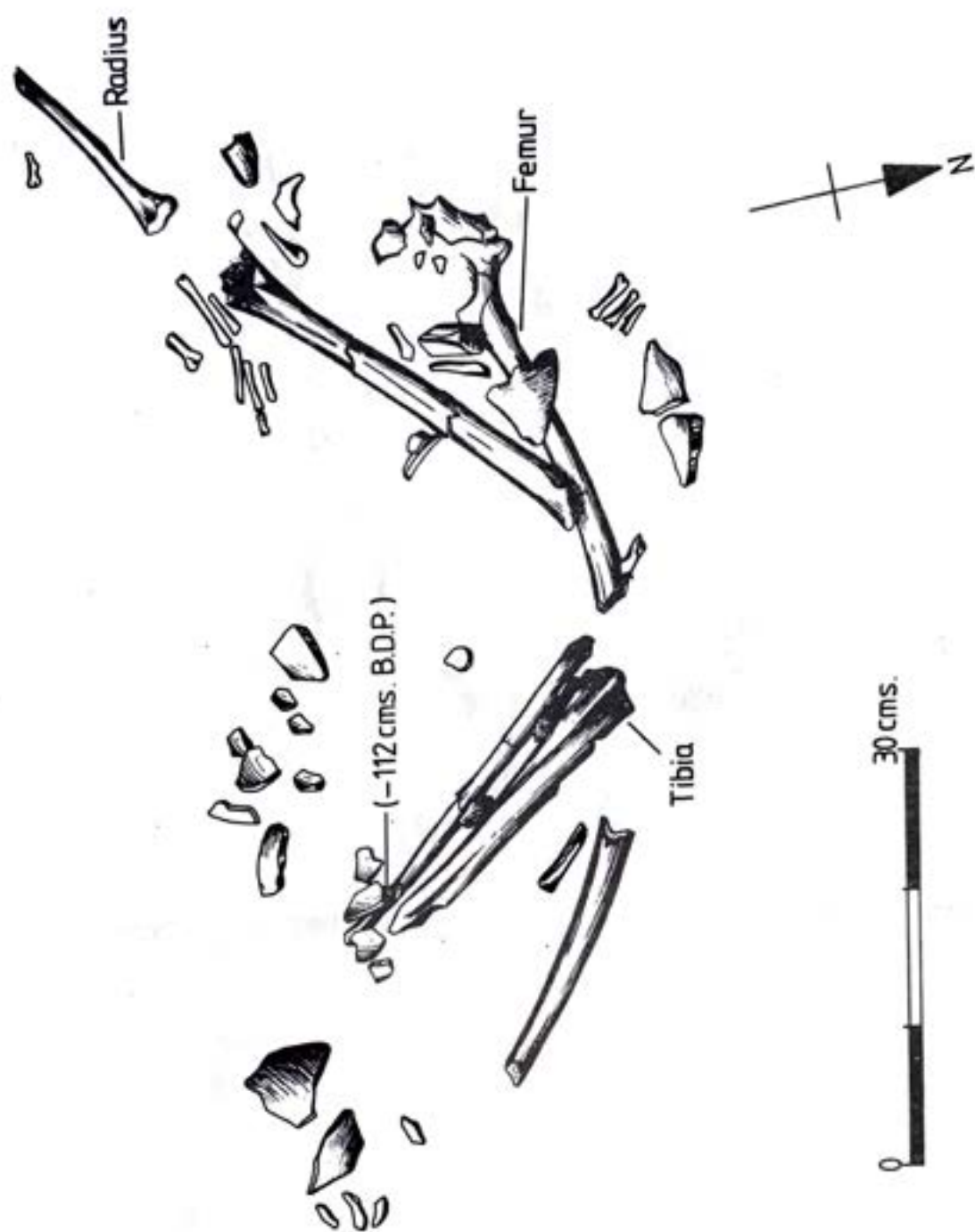


FIGURE 8-102

Ban Na Di: burial 2 square A4 MP 3

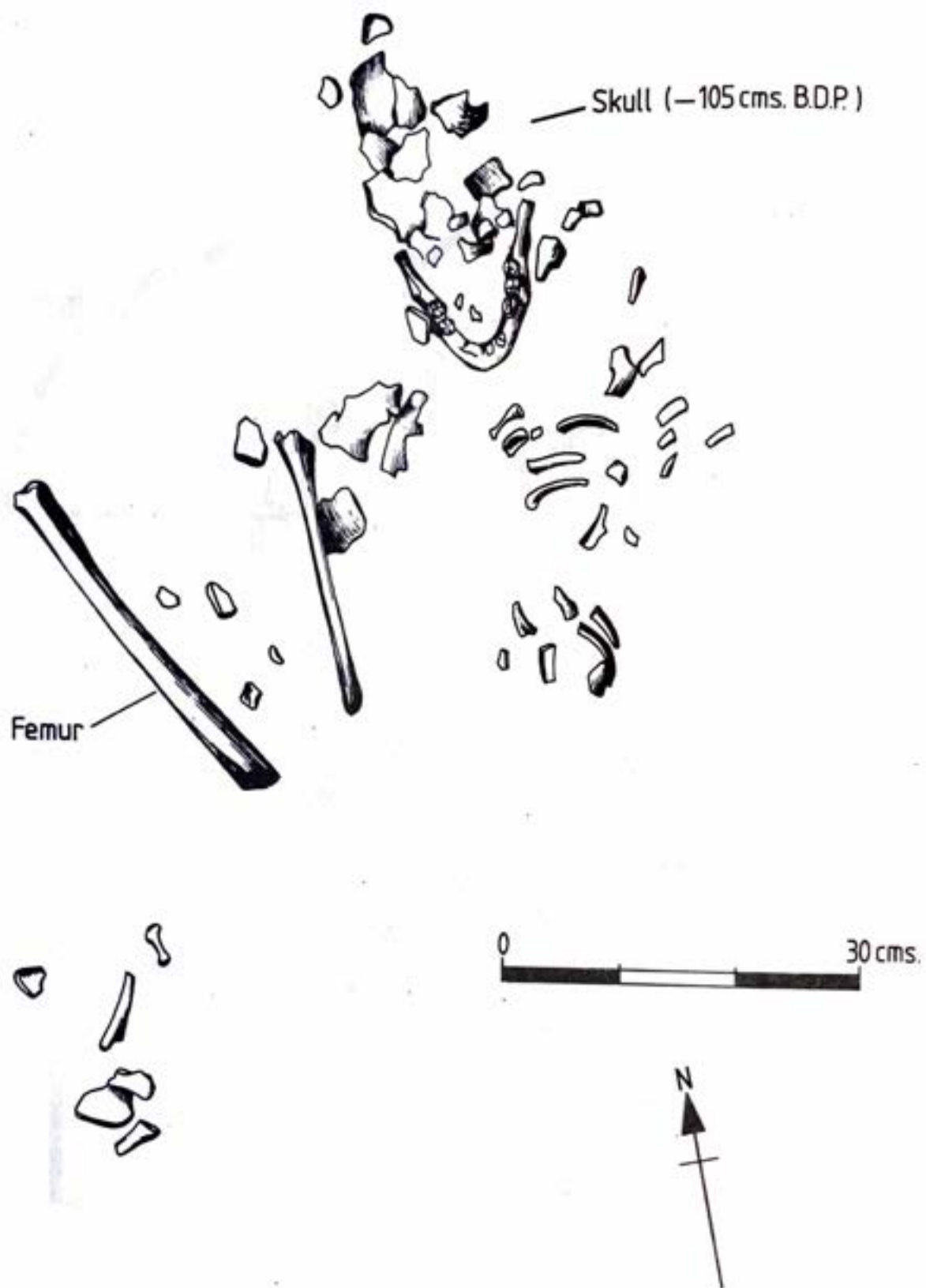


FIGURE 8-103

Ban Na Di: burial 1 square A3 MP 3

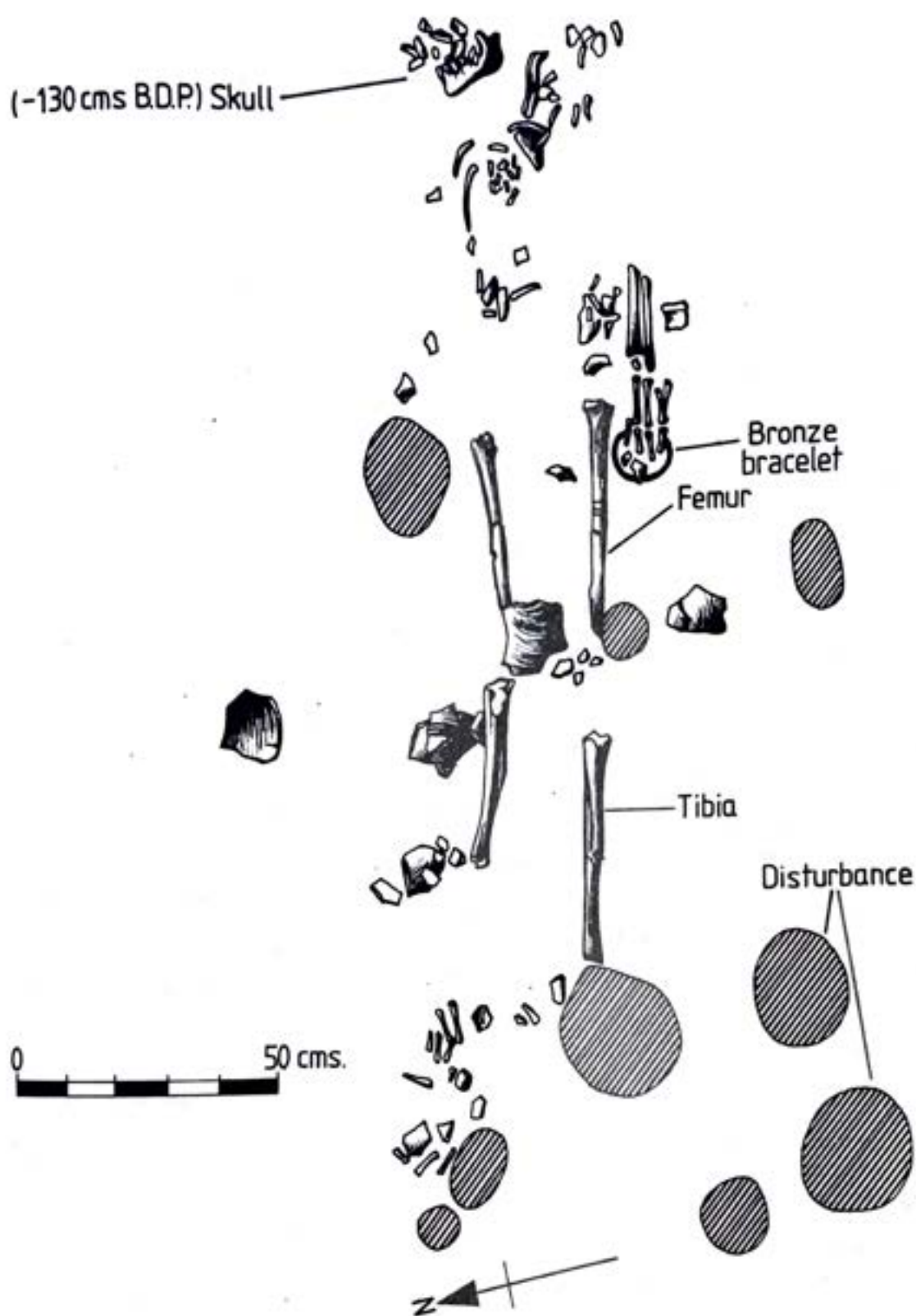


FIGURE 8-104

Ban Na Di: burial 3 square A3 MP 3

CHAPTER NINE

THE ANALYSIS OF UPPER SONGKHRAM SETTLEMENT PATTERNS

Metha Wichakana

A preliminary report on the results of the site survey has already appeared (Kijngam, Higham and Warrachai, 1980). The authors' initial conclusion, was that sites in the Upper Songkhram Valley were not ranked according to size, and exhibited a significant preference for soils of the low terrace situated near streams. The report referred to was of a preliminary nature, because it described only the first stage of a longer research project. Thus, when fieldwork commenced, there was only the slightest amount of information available on the local prehistoric pottery sequence. This made it practically impossible to order sites identified on any chronological basis. There were other problems too, which particularly stand out when the area is compared with the recently described settlement pattern studies in the Valleys of Mexico and Oaxaca (Sanders *et al.* 1979, Blanton 1978). These must be examined in order to set the results obtained in their proper perspective.

The first problem is the differential visibility of sites between the low terrace on the one hand, and the middle and high terraces on the other. In the former area, sites with any relief at all stand out even at a considerable distance, because of the flat terrain. As soon as one enters the middle or high terraces, however, land use immediately changes from rice cultivation to such crops as sugar cane and kenaf. Moreover, much land remains under scrub forest where all the ground is covered by dead leaves. Surveying in the high and middle terraces is therefore extremely difficult and in terms of prehistoric sites, unrewarding.

Even in the low terrace, one must seriously question the representativeness of the site distribution seen in fig 9-1. Chantaratiyakarn has observed for the Middle Chi area, that there is a tendency for sites either to lie below modern villages or in open ones, to be covered by sterile wind or water deposited soil (see chapter 13). This can be illustrated by referring to three sites. The first is Ban Don Kao (fig 9-1 site 50). This site is strategically placed at the outflow of the Pao River from Lake Kumphawapi. It was clear on arriving there, that it had been a focus of ceremonial activity during the first millennium AD. An inscription dating to c. 800 AD was found there, as well as several *sama* stones. The Abbot of the local temple also described the former existence of moats and earth banks, but no sign of these could be found on the ground. Indeed, the ground surface even in areas which had been recently ploughed revealed very little evidence for occupation, ancient or modern.

The same situation was found at site 63 (Non Pa Kluay). From the air, this site reveals a moated perimeter enclosing an area of c. 500 by 200 m. A diligent search on the mound's surface, which was under a crop of sugar cane at the time, revealed hardly any pottery. This is clearly an enigmatic site and excavation alone will illuminate its affiliations. Finally, there is a cluster of small mounds located around Ban Kho Noi. These again, yielded scarcely any pottery on the ground surface yet were clearly

artificial. Wherever there had been disturbance or in the case of Non Taeng Saeng, human interference, much pottery was seen eroding from the mound's edge. Excavation at Non Taeng Saeng suggested that this concentration of small sites results from salt processing.

The second major problem concerns site area. This variable is critical for any successful attempt to approach population trends and rising social complexity (Steponaitis, 1981). It is a straightforward procedure to measure the area of a mound, either approximately in the field or by using a digitiser on aerial photographs. This provides a measure of the site's maximum extent, but doesn't reveal the area during successive phases of occupation. Excavations at Ban Chiang revealed six phases, and it is quite likely that the area occupied fluctuated with time. This problem is compounded where, as is often the case, a prehistoric site is covered by modern settlement. Unless the mound is very clearly demarcated, it is often impossible to estimate the site area at all.

The site survey undertaken in the Upper Songkhram area was designed to enlarge our understanding of demographic trends and associated prehistoric cultural changes. This approach, despite the *caveat* of the investigators, has been extremely instructive when applied to the Basin of Mexico (Sanders *et al.* 1979). Their work however, involved a number of considerable advantages when compared with that in the Upper Songkhram. For example, they had available a detailed and as time passed, increasingly refined sequence of pottery types. Surface collections therefore, offered some insight into the occupation period of each site identified. The establishment of such a dated, typological sequence, is by contrast one of the principal aims of the present work, and its absence has clearly impaired the results initially obtained from the site survey. In fact, each site identified was searched for a range of rim types and body sherds which displayed as much variation as possible. Naturally, other categories of artefact were also sought, but these were, in the event, restricted to clay smoking pipes and the very occasional stone flake.

A second advantage of the Mexican survey was the presence of architectural remains on the surface. These ranged from edifices the size of the main temple pyramid at Cuiculco to the smaller rural house and temple mounds. This situation reflects the materials used for construction. Excavations undertaken at Ban Chiang have shown that wooden posts were used in prehistory to raise houses above flood level. Therefore, no indications of structures on the surface could be expected until stone or brick were used as construction materials during the historic period.

A final problem which is shared with Sanders's study, is the destruction or covering of sites by alluvial deposition. There is no doubt that the extensive forest clearance and levelling associated with wet rice cultivation has led to a major reworking of the landscape. Non Kao Noi is a case in point. This very important early site is barely recognisable as a mound, and it would not be difficult to walk over it without realising its significance. The knowledge of the local inhabitants led the survey party to it, and the presence there of burials interred at a depth of about 1.5 m below the present surface was described. The only surface indications were scraps of pottery in the heaps of soil left by the looters, but subsequent excavation revealed undisturbed burials. There are, quite probably, similar undiscovered early sites covered by alluvium or soils of aeolian origin.

Upper Songhkram Valley settlement patterns

This however, is a perennial problem not confined to the Upper Songhkram area. It is considered proper to recognise it both in the planning, execution and interpretation of a site survey. In terms of the first issue, it is conceded that the survey was not conducted with the same systematic overall coverage as was undertaken by Sanders and his associates. The procedure was as follows: the area was initially examined by viewing aerial photographs through a stereoscope. Any apparent mounds or unusual features were noted for examination in the field. The area coverage began by visiting every village and seeking the permission of the headman to survey the village and its environs. The area today comprises a dense network of modern settlements. On the low terrace, these are surrounded by rice fields which, during the dry season, are covered by stubble about 30 to 40 cm high. In the middle terrace area, the villages are more dispersed and surrounded by fields or scrub forest. In each case, the headman was asked if he knew of any indications of prehistoric activity in his area. Specific mention was made of burials with complete pottery vessels and ornaments. A sample of prehistoric pottery was also shown to the local inhabitants. It cannot be too strongly emphasised that the survey area was contiguous with the site of Ban Chiang, centre of looting for the whole Sakon Nakhon Basin. Once that site was ransacked, groups of professional looters fanned out to locate new sources of prehistoric artefacts. This search has been intense since the early 1970's and it was always the case that looters had preceded the survey party to the sites identified. In the event, it was found that the present inhabitants were able to take the survey team to sites and describe generally what had been found there. In addition, parts of the area were surveyed by teams on foot. It is intended to return over the years and undertake further such intensive foot surveys, but it is felt appropriate at this juncture, to consider the settlement distribution seen in fig 9-1 in the expectation that further work will not radically alter the site distribution as currently known.

This site distribution is approached from two points of view. The first supposes that sites are not located in relation to any particular environmental variables (the nul hypothesis). The second begins with the hypothesis that the sites are randomly distributed relative to each other. It is noted, that the question of site size has already been considered, and it has been shown that the distribution for prehistoric settlements is not tiered or multimodal (Kijngam, Higham and Wiriyaromp 1980). The same authors also considered the location of sites relative to soils, water sources and altitude, and concluded that there was a significant adhesion between location and soils of the low terrace adjacent to streams and in particular, stream confluences. The present study differs from the earlier one in the manner whereby the soil data were computed. In the earlier study, a rectangular area 3 by 3 km in extent and centred on the site was taken, and the frequency of occurrence for different major soil types, estimated. The same procedure was undertaken for points selected at random, and the soil frequencies were then compared. The present analysis began by drawing circles with radii of one and three km centred on each site, and repeating the procedure for the same number of randomly selected locations. Two sites just outside the survey area were also included in the subsequent analysis: Ban Chiang and Ban Phak Top. The radii were selected in the light of Chisholm's (1988) finding that the most intense utilization of a village territory occurs within one km of the

Upper Songkhram Valley settlement patterns

settlement. The area beyond normally receives less intense exploitation with increasing distance. The precise area of each soil type was then calculated by using a digitiser on the 1:100,000 scale soil maps of the region. The soils in question are as follows: type 2 belongs to the Phimai, Chiang Mai, Si Songkhram and Chai Nat/ Ratchaburi groups. These are found on the flood plain and valley flat, and while suited to rice cultivation, are prone to flooding. Type 3 belongs to the Roi Et and Phen types. These are low terrace soils moderately suited to rice cultivation, but with attendant problems of shallowness, stoniness, salinity, low fertility or unfavourable texture. Type 4 are the Ubon and Roi Et sandy variant soils which are poorly suited to rice due to combinations of the problems which afflict type 3 soils. Type 5 comprises Khorat, Phon Pisai, Sakon and Nam Pong soils of the middle terrace, which are unsuited to rice because of poor topography. The resultant areas for each site are seen in table 9-1. Table 9-2 provides the mean and coefficient of variation for each soil area.

TABLE 8-1

The areas in hectares, of different types of soil within radii of one and three kilometres

from prehistoric sites and randomly selected points within the Upper Songkhram survey area

1. within a three km radius of the site 2. Within a one km radius of the site

site no.	soil type	1. within a three km radius of the site												2. Within a one km radius of the site											
		2	3	4	5	H.T.	LAKE	2	3	4	5	H.T.	LAKE	2	3	4	5	H.T.	LAKE						
53		855.66	1396.50	0.0	67.61	0.0	507.67	108.68	205.47	0.0	0.0	0.0	0.0					0.0	0.0						
54		722.96	1668.75	0.0	23.62	0.0	412.11	47.08	267.07	0.0	0.0	0.0	0.0				0.0	0.0	0.0						
58		721.27	1013.95	0.0	634.21	0.0	458.01	100.32	96.02	0.0	108.76	0.0	0.0				0.0	9.05							
59		597.68	1917.11	0.0	192.53	0.0	120.12	82.38	231.77	0.0	0.0	0.0	0.0				0.0	0.0	0.0						
62		429.77	1973.37	0.0	405.18	19.12	0.0	5.26	290.53	0.0	18.36	0.0	0.0				0.0	0.0	0.0						
65		355.82	2278.21	0.0	193.41	0.0	0.0	0.0	314.15	0.0	0.0	0.0	0.0				0.0	0.0	0.0						
68		345.99	1578.67	0.0	281.96	183.29	437.53	8.51	227.04	0.0	78.80	0.0	0.0				0.0	0.0	0.0						
69		123.80	2110.46	0.0	376.63	216.91	0.0	0.0	314.15	0.0	0.0	0.0	0.0				0.0	0.0	0.0						
77		424.14	2335.10	0.0	68.2	0.0	0.0	18.81	285.34	0.0	0.0	0.0	0.0				0.0	0.0	0.0						
78		22.06	2429.85	0.0	375.53	0.0	0.0	0.0	310.85	0.0	3.30	0.0	0.0				0.0	0.0	0.0						
79		0.0	1972.60	0.0	854.84	0.0	0.0	0.0	207.39	0.0	106.76	0.0	0.0				0.0	0.0	0.0						
86		0.0	1496.90	21.48	1309.08	0.0	0.0	0.0	157.65	0.0	156.5	0.0	0.0				0.0	0.0	0.0						
88		0.0	1522.73	0.0	619.42	685.29	0.0	0.0	173.68	29.53	110.94	0.0	0.0				0.0	0.0	0.0						
89		0.0	1370.10	43.24	598.05	816.05	0.0	0.0	235.67	14.15	36.90	27.43	0.0				0.0	0.0	0.0						
90		0.0	1628.08	0.0	430.35	769.01	0.0	0.0	294.19	0.0	0.0	19.96	0.0				0.0	0.0	0.0						
92		0.0	2107.36	0.0	503.23	216.85	0.0	0.0	287.41	0.0	26.74	0.0	0.0				0.0	0.0	0.0						
93		0.0	1321.71	0.0	1505.73	0.0	0.0	0.0	245.75	0.0	68.40	0.0	0.0				0.0	0.0	0.0						
94		0.0	1531.76	0.0	1295.68	0.0	0.0	0.0	238.78	0.0	75.37	0.0	0.0				0.0	0.0	0.0						
96		0.0	2038.69	7.21	741.99	0.0	39.55	0.0	277.56	0.0	36.59	0.0	0.0				0.0	0.0	0.0						
97		0.0	2084.28	34.19	644.81	28.60	35.56	0.0	283.16	0.0	30.99	0.0	0.0				0.0	0.0	0.0						
121		441.56	1764.52	0.0	0.0	0.0	621.36	68.35	245.8	0.0	0.0	0.0	0.0				0.0	0.0	0.0						

1. within a three km radius of the site

2. Within a one km radius of the site

site no.	soil type	2	3	4	5	H.T.	LAKE	2	3	4	5	H.T.	LAKE
129		0.0	2244.31	0.0	522.83	60.30	0.0	0.0	314.15	0.0	0.0	0.0	0.0
130		0.0	2032.27	0.0	170.43	624.74	0.0	0.0	281.31	0.0	32.84	0.0	0.0
131		0.0	2084.37	0.0	53.1	889.97	0.0	0.0	277.53	0.0	36.62	0.0	0.0
132		0.0	2468.12	0.0	132.17	227.15	0.0	0.0	278.94	0.0	35.21	0.0	0.0
133		0.0	2404.35	0.0	37.38	385.71	0.0	0.0	283.71	0.0	30.44	0.0	0.0
135		20.19	1008.41	0.0	1143.29	540.89	114.66	0.0	88.67	0.0	156.20	89.28	0.0
138		25.79	1968.20	0.0	833.45	0.0	0.0	0.0	209.76	0.0	104.39	0.0	0.0
139		0.0	2070.76	0.0	756.88	0.0	0.0	0.0	294.36	0.0	19.79	0.0	0.0
140		601.2	1247.61	0.0	255.61	0.0	723.02	54.03	260.12	0.0	0.0	0.0	0.0
BAN CHIANG		0.0	1359.57	0.0	1467.83	0.0	0.0	0.0	234.37	0.0	79.79	0.0	0.0
B.OM KAE0		0.0	1830.61	0.0	986.79	0.0	0.0	0.0	185.12	0.0	129.04	0.0	0.0
N. KHI KLING		0.0	1990.99	0.0	836.41	0.0	0.0	0.0	245.88	0.0	68.28	0.0	0.0
B. PAK TOP		0.0	1105.22	181.41	1540.77	0.0	0.0	0.0	295.41	35.28	19.46	0.0	0.0
B. TONG		0.0	2150.99	0.0	676.45	0.0	0.0	0.0	151.32	0.0	162.83	0.0	0.0

1. within a three km radius of random points

2. within a one km radius of the random point

point no.	soil type	2	3	4	5	H.T.	LAKE	2	3	4	5	H.T.	LAKE
10		0.0	986.34	36.21	1804.89	0.0	0.0	0.0	71.78	0.0	242.37	0.0	0.0
13		0.0	2613.72	213.68	816.11	0.0	0.0	0.0	314.15	0.0	0.0	0.0	0.0
21		0.0	2026.79	0.0	800.65	0.0	0.0	0.0	255.14	0.0	59.02	0.0	0.0
25		0.0	513.51	34.13	2279.80	0.0	0.0	0.0	69.88	7.91	236.36	0.0	0.0
30		0.0	32.56	0.0	2794.84	0.0	0.0	0.0	314.15	0.0	0.0	0.0	0.0

1. within a three km radius of random points 2. within a one km radius of the random point

point no. soil type

	2	3	4	5	H.T.	LAKE	2	3	4	5	H.T.	LAKE
44	0.0	2151.50	0.0	675.90	0.0	0.0	0.0	230.5	0.0	83.66	0.0	0.0
48	0.0	908.52	429.52	1489.36	0.0	0.0	0.0	0.0	43.3	270.86	0.0	0.0
103	0.0	1680.30	0.0	1147.14	0.0	0.0	0.0	285.53	0.0	28.63	0.0	0.0
172	0.0	1901.90	0.0	925.54	0.0	0.0	0.0	190.47	0.0	123.68	0.0	0.0
197	0.0	1474.32	0.0	1328.33	24.79	0.0	0.0	158.25	0.0	155.9	0.0	0.0
296	0.0	1578.92	0.0	1165.62	48.21	34.69	0.0	133.88	0.0	180.27	0.0	0.0
310	0.0	1654.44	47.55	457.73	667.68	0.0	0.0	286.99	0.0	27.17	0.0	0.0
363	0.0	599.50	0.0	2094.74	133.20	0.0	0.0	63.82	0.0	250.23	0.0	0.0
371	0.0	548.31	0.0	2017.28	261.85	0.0	0.0	.86	0.0	313.29	0.0	0.0
383	0.0	2116.97	0.0	472.27	238.2	0.0	0.0	293.85	0.0	20.3	0.0	0.0
386	0.0	495.24	0.0	1527.79	804.41	0.0	0.0	19.31	0.0	48.36	246.48	0.0
422	0.0	1908.54	0.0	816.01	102.89	0.0	0.0	272.05	0.0	42.10	0.0	0.0
427	0.0	1529.88	0.0	644.69	652.87	0.0	0.0	185.58	0.0	86.89	41.68	0.0
442	0.0	2308.54	0.0	416.01	102.89	0.0	0.0	272.05	0.0	42.1	0.0	0.0
480	0.0	1108.7	0.0	1377.33	341.41	0.0	0.0	0.0	0.0	201.26	112.89	0.0
495	6.02	874.91	0.0	1578.09	368.42	0.0	0.0	45.19	0.0	146.64	122.32	0.0
519	344.85	1230.42	0.0	310.17	183.22	758.68	0.0	250.82	0.0	63.33	0.0	0.0
532	0.0	692.85	19.95	2008.16	106.48	0.0	0.0	74.22	0.0	215.14	24.79	0.0
540	0.0	666.74	43.17	2017.89	99.64	0.0	0.0	95.7	0.0	218.45	0.0	0.0
573	0.0	744.05	81.37	1967.00	35.02	0.0	0.0	99.6	38.77	175.78	0.0	0.0
600	113.68	712.47	0.0	32.78	137.43	1831.08	0.0	0.0	0.0	0.0	0.0	314.15
620	38.07	940.71	0.0	473.71	543.85	831.10	22.88	111.19	0.0	39.89	53.27	86.92
657	158.65	689.43	0.0	386.55	360.71	1232.1	9.16	130.65	0.0	20.39	37.80	116.15
681	0.0	658.24	0.0	365.44	162.92	1840.84	0.0	59.06	0.0	40.64	0.0	241.45
735	831.30	208.61	0.0	280.99	0.0	1506.5	37.64	0.0	0.0	76.01	0.0	200.51
807	171.57	1243.62	0.0	781.09	142.33	148.63	3.05	191.04	0.0	102.81	17.25	0.0
868	0.0	1333.52	0.0	1469.0	24.92	0.0	0.0	83.29	0.0	230.86	0.0	0.0
845	608.61	1976.04	0.0	11.86	0.0	230.93	40.77	273.38	0.0	0.0	0.0	0.0

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TABLE 9-2

The Upper Songhkram area: The areas of different soil types within a different series of radii from prehistoric sites and randomly chosen points.

	Core Area				Peripheral Area			
	site		random		site		random	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Soil 2	14.0	2.17	3.4	2.9	148.4	1.6	85.4	2.7
3	245.7	0.24	146.4	0.7	1568.7	0.2	1069.0	0.5
4	2.2	3.5	2.7	3.7	5.9	4.4	24.7	3.0
5	49.5	1.10	113.4	0.83	537.5	0.8	999.7	0.6
H.T.	3.3	3.83	19.9	2.5	152.8	1.7	148.1	1.3
Lake	0.2	5.9	29.0	2.6	98.9	2.1	219.9	2.1

Weighted Area

	Site		Random	
	mean	CV	mean	CV
Soil 2	63.5	1.7	25.2	2.7
3	1152.9	0.2	754.2	0.5
4	6.4	3.5	16.4	2.9
5	343.0	0.8	669.9	0.6
H.T.	81.4	1.7	103.9	1.4
Lake	49.8	2.1	153.5	2.2

The abbreviations in the above table are as follows: CV = Coefficient of Variation. H.T. = High Terrace soils

The question of site location was approached in two ways. The first applied a stepwise discriminant function analysis and the second employed a non-parametric Mann Whitney test. These tests were applied to the data using three different sets of soil figures. Initially, only the soil figures for the circles with a radius of one km were used. This is described as "the core area". Secondly, the area between one and three km was employed ("the peripheral area") and finally, both were used with the value of soils in the core area weighted by a factor of three ("the weighted area").

The results of the stepwise discriminant function analyses reveal that one variable alone, the area of low terrace soil, is sufficient to discriminate the prehistoric sites from randomly selected points. In the

case of the one km radii, the area under low terrace soils alone successfully identifies 80% of the prehistoric sites. The statistical analysis identified 74% of the sites correctly on the basis of the amount of low terrace soil available in the peripheral area, and 77% on the basis of this soil type in the weighted area. The same results were obtained from the Mann Whitney test. In all three cases, the differences on the basis of soil type three is highly significant (fig 9-2).

There are also significant differences on the basis of the amount of middle terrace soil (type 5) for all three areas measured. The null hypothesis is therefore rejected, and it is concluded that prehistoric sites were located so as to take advantage of low terrace soils. Examination of the map suggests that this is so even for the six sites assigned by the discriminant function analysis to the "random" group. These are sites 79, 86, 135, 138, Ban Om Kaeo and Ban Tong (fig 9-2). It is a characteristic of many sites that they were located on knolls or tongues of slightly elevated middle terrace soil, probably to avoid the inconvenience of flooding. These tracts are surrounded by low terraces. Thus over half the core catchment at Ban Tong comprises middle terrace soil. Yet it commands an extensive area of low terrace. A similar situation is found in the remaining apparently anomalous sites.

Chantaratiyakarn has considered the relationship between site size and site catchment for the Middle Chi survey area, and applied Steponaitis's (1981) model which relates catchment productivity and site area to the results. The basic assumptions in her work are concerned with the productivity of rice cultivation, and the annual average individual requirements *per annum*. Her figures for both are derived from Hanks's (1972) consideration of different methods of cultivation, and are set out in Table 3-7.

TABLE 9-3

The Yields of Rice under different methods of Cultivation

Mode of Cultivation	Yield (kg/ha)		
	n cases	average	range
Shifting cultivation	6	1449.4	741.0-2227.4
Broadcasting	4	1333.8	790.4-4843.8
Transplanting	7	2188.3	494.0-4843.8

Hanks (*op.cit*) has also concluded that the average annual *per capita* rice consumption is 178 kg/year (.49 kg/day)

Some confirmation for these figures, as well as a note of caution, has been provided by Geddes (1978). In his consideration of rice cultivation among the Blue Meo, he found considerable individual household variation in the rice yield per unit area. The Blue Meo also rely on

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poppies for their cash income and use their profit to supplement rice requirements by purchase. Nevertheless, the relationships between the number of people in a community, the area cultivated and the yields are interesting. In the table below, the equivalent size of a prehistoric settlement is based on a figure of 50 inhabitants to the ha, and the actual area of riceland to support the Meo population is extrapolated from Geddes consumption figures.

TABLE 9-4

Production Figures, Population Levels and Areas under Rice Cultivation for the Blue Meo (Meto Area).

n people	Cultivated area (ha)	kg yield	kg/ha	kg ¹ Area needed	Equivalent needed area	preh. site ²
33	4.3	3766	876	5940	6.8	2/3rds ha
94	11.3	7482	662	16920	25.5	2 ha
98	8.9	4866	676	17640	28.1	2 ha
48	1.23	5086	4135	8640	2.0	1 ha
207	12.5	21327	1706	27260	21.8	4 ha

¹ at a consumption rate of 180 kg/year

² at a density of 50 people/ha

Now White (1982a) has suggested that Ban Chiang and related sites were located in the mid-courses of tributary streams so as to take advantage of limited seasonal flooding. Enclaves of flooded low terrace soil were favourable to rice cultivation, and the distribution of sites described above supports their close relationship with small, tributary streams. There are exceptions however, in those sites which are found on the flood plain of Lake Kumphawapi itself.

When we turn to site size and population, it is notable that the size of sites as well as the favoured location described by Chantaratiyakarn in the Middle Chi area very closely matches that identified above. In her analysis, she found that the modern densities of population at Ban Chiang and Ban Na Di (Khon Kaen Province) were c. 40 and c. 80 people/ha. She chose a figure of 50 people, which is very similar to that advanced by Sanders *et al.* (1979) for a moderate density in their Mexican survey. If this figure is adopted here, then the prehistoric sites found in the survey area would have been occupied by between 40 and 500 people.

The question is, was there sufficient land within a reasonable radius of the site to sustain them? If we take the minimum figure provided by Hanks for broadcast rice cultivation, then for 40 people, it would be necessary to provide 7160 kg of rice per annum, which would be obtained from 9.6 ha. For sites covering four ha the figures rise to 35,800 kg and 48.3 ha. In the case of the largest site, for which it must be emphasised, there are no data on its prehistoric extent, the figures are 89,500 kg and 120.8 ha respectively.

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Now these estimates must be compared with those recently provided by MacDonald (1980). He claimed that the average annual *per-capita* consumption is one ton (1018 kg) of rice. His other input figures include an estimated site area for Ban Chiang of twenty ha, density from the initial occupation of 100 people per ha and production of 1.5 tons of rice/ha. These undocumented figures, at face value, indicate a population of 2000 people requiring 2000 tons of rice a year from 1333.3 cultivated ha. This would have been inconceivable at Ban Chiang without a form of food tribute from tributary villages, a finding which led MacDonald to propose the existence of chiefdoms from a very early period in prehistory.

MacDonald's figures, however, are wrong. Ban Chiang probably covered no more than five ha at any phase in the prehistoric sequence. Again, one ton of rice a year is a figure almost 8 times greater than that provided by Hanks (1972). If MacDonald's conclusions are rejected, what inferences can be made on the basis of the present study? Two points are made. The first is that, when broad spectrum hunting and gathering as well as stock raising are taken into account, there was sufficient land in the site catchments to provide for the level of population which has been estimated. Secondly, there is at present, no evidence for a hierarchic prehistoric settlement distribution based on size. Excavation may well disclose the existence of a bimodal site distribution period in the Middle Chi (Chantaratiyakarn below). Were a central place as identified in the Chi Valley to be sought, then Ban Don Kaeo (fig 9-1) would be a logical place to begin.

The establishment of at least a partial rim sequence for the Upper Songkhram also has implications for the interpretation of the site distribution identified during the initial site survey. During that campaign, each prehistoric site was searched for a sample of rim and body sherds. Since so little was then known of the changes in pottery styles with time, it proved impossible in the initial report, to distinguish changes in settlement patterns with time. Such changes were the essence of Sanders *et al.*'s reconstruction of cultural processes underlying the Formative and Classic phases in the Valley of Mexico. The question may now be considered again in the light of the successive rim styles identified on the basis of excavated material. The results of a re-examination of the surface collections are interesting. Apart from Non Kao Noi, no other site yielded the characteristic EP (Ban Chiang Early Period) rims found there, although some sites were ascribed to the earlier phases of the EP on the basis of body sherds (fig 9-4). Clearly, the deeper the actual deposits under the present ground surface, the lesser are the chances of early material reaching the attention of the site survey. As might be expected, nearly all parallels between the surface collections and the dated rims from excavated sites refer to LP (Ban Chiang Late Period) material. Figure 9-5 shows the distribution of all sites which have yielded rims or through excavation, evidence for LP occupation. It is stressed that this does not rule out the future recovery of LP material from other unexcavated survey sites. The interesting point is the number of sites which document LP occupation, and their presence close to the present dry season shore of Lake Kumphawapi. The implications of this point are considered in more detail below.

At Ban Chiang, Ban Tong and Ban Na Di, there was a lengthy period of occupation spanning Early, Middle and Late periods. Clearly, factors encouraging early settlement were also attractive during the LP. White

(1982a) has suggested that Ban Chiang and related early settlements were sited in the middle courses of small streams, where flooding was relatively gentle. That flooding occurred is evidenced by the numerous flood lenses in the basal two m at Ban Na Di. Older informants at the village Kumphawapi. Ban Na Di is now situated about 15 km from the lake shore, but several LP sites are located very much closer to it. It is also noted that differentially large, moated sites in the Middle Chi, such as Ban Chiang Hian and Kantarawichae, were located on the margins of the Chi Flood Plain. It is tempting to seek in this settlement of areas prone to extensive flooding, a novel adaptive agricultural strategy. This will be set out in the form of a hypothesis, to act as a focus for testing by future field research.

Wheatley (1983) has recently reviewed the evidence for settlement of another flood prone area: the Transbassac. In doing so, he has offered new insight into the well known reference of the 3rd century AD Chinese mission to the area, which noted that the indigenous inhabitants "*Sow (or plant) in one year (and) reap for three*". This reference is sufficiently close chronologically to the later prehistoric period in Northeast Thailand as to be judged relevant. Wheatley has suggested that the crop being described was rice, and that the technique being described was ratooning. This involves planting out rice of the rapidly growing "floating" variety, and taking advantage over successive seasons, of the plants' annual regeneration from the stem nodes.

It has been suggested that agricultural intensification in Northeast Thailand at the time of the rise of chiefdoms and central places involved the adoption of ploughing (Higham and Kijngam 1979). If this was indeed the case, then it is curious that the area has not yielded one example of the socketed bronze ploughshares so common at the same time in the Red River Valley. This absence must be considered in the light of the increasing body of evidence documenting MP and LP contact with the Dong-Son culture. An alternative hypothesis, is that the growth of chiefdoms in the Chi Flood Plain and the expansion of settlement even to the margins of Lake Kumphawapi were underwritten by the availability of the floating variety of rice. This did not require ploughing, but did nevertheless open up extensive and hitherto unexploited floodlands to agriculture.

Such a hypothesis is open to testing. It would be sustained if further excavation were to demonstrate that the other shoreline sites in addition to Ban Muang Phruk, were initially occupied with the beginning of the LP. Again, the recovery of large samples of rice itself could throw light on the agricultural techniques in use.

A second change in settlement pattern may also be represented by the commencement of intensive salt extraction. Fig 9-3 shows the concentration of small mounds found to the east of Ban Muang Phruk. Excavation at one of them, Non Taeng Saeng, has revealed initial use during the LP. The radiocarbon date for the basal horizon there is 1880 $\pm$ 85 BP (corrected). The ceramics, while dominated throughout by coarse, plain industrial wares presumably used in salt extraction, also include rice chaff tempered red slipped pots characteristic of Ban Muang Phruk and later Ban Na Di wares. Excavation at more of these mounds may well reveal the general commencement of large scale salt working which, as in the Roi Et sites examined by Higham (1977), could have supplied an

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important exchange commodity.

As yet, no evidence has been advanced for the development of a central place and by inference, a chiefdom in the Upper Songhkram area during prehistory to match those now known in the valley of the Chi. This may very well be illusory and again we must turn to future research for enlightenment. The most obvious site to examine is Ban Don Kaeo, located strategically at the outlet of Lake Kumphawapi into the Pao River. It is well located to control water borne exchange products, and was obviously a centre of importance during the later first millennium AD to judge from the *sama* stones and inscription found there (Kijngam, Higham and Wiriyaromp, 1980). The local abbot has also described his recollection of defensive banks there, though these were not observed during the site survey.

NEAREST NEIGHBOUR ANALYSIS

The distribution of sites may be considered not only relative to environmental variables, but also relative to each other. Such an enquiry is concerned with the question of space between settlements: are they mutually attracted, randomly dispersed, or significantly distant from each other. Welch (1984) has applied Clark and Evans's R statistic to the distribution of prehistoric settlement on the Mun Flood Plain in his Phimai survey area, and found evidence for a slight degree of clustering which is significant at the 0.001 level of probability ($R=0.88$). The equivalent value for the Kumphawapi survey area is 0.718, which indicates a greater degree of affinity between the location of prehistoric sites than in the Mun Valley.

Welch however, did not consider the boundary effect. As Ripley (1981) has noted:

The effect of ignoring these edge corrections is to bias the test, so that regularity will be detected spuriously. (Ripley 1981:154).

The Kumphawapi data were therefore analysed using Donnelly's modification of Clark and Evans's R statistic which takes into account the area and perimeter of the area being studied. Testing for significance uses the formula

$$t = (\bar{d} - M)/SE$$

— where $\bar{d}$ is the mean observed nearest neighbour distance, which has expected value M and standard error SE on the assumption of randomness. The value of t is tested against the standard normal distribution. Formulae for M and SE are given by Ripley (1981, p. 153).

The result for the Kumphawapi area is a value for t of -9.91, which is highly significant ($P < 0.001$) and allows the conclusion that sites are closer to each other than would be expected under a random distribution across the landscape.

There are several possible reasons for this situation. One is that they are located on a broad alluvial tract surrounded by mid and high terrace land unsuited to agriculture yet incorporated in the survey area.

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The affinities within the broad alluvial area are with the soils of the low terrace, although many sites are, as in the Mun Valley, situated on slightly elevated terrain probably to reduce the risk of flood damage. The sites are also found by preference, along the courses of small streams.

Probing further into the reasons for the significant nearest neighbour statistic at this stage of enquiry is considered injudicious, because an important prior assumption is site contemporaneity. As will be shown, we cannot assume this. Indeed, it is held that sites close to the present edge of the lake were occupied late in the prehistoric sequence. We must therefore, defer to future research on this point.

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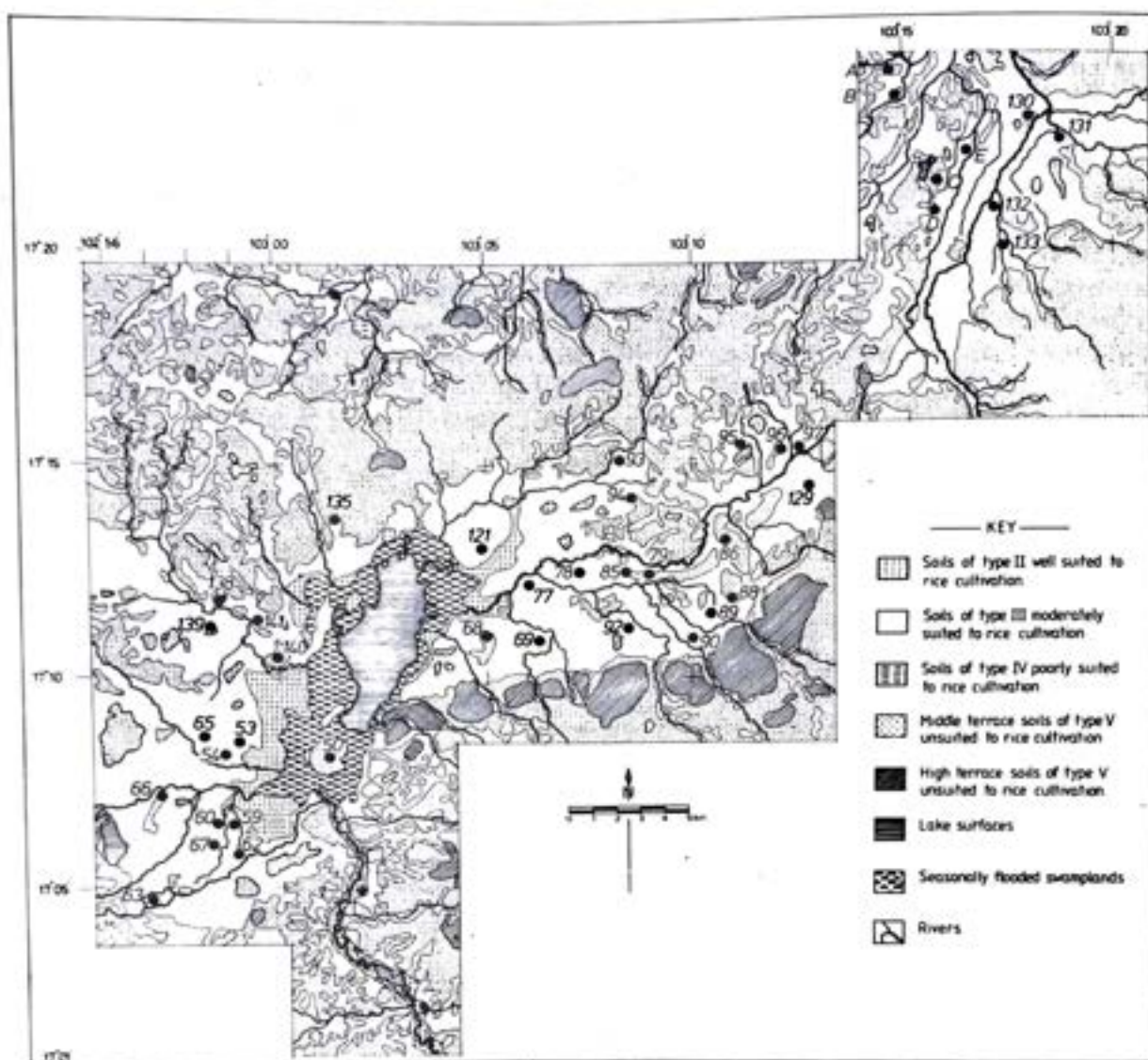
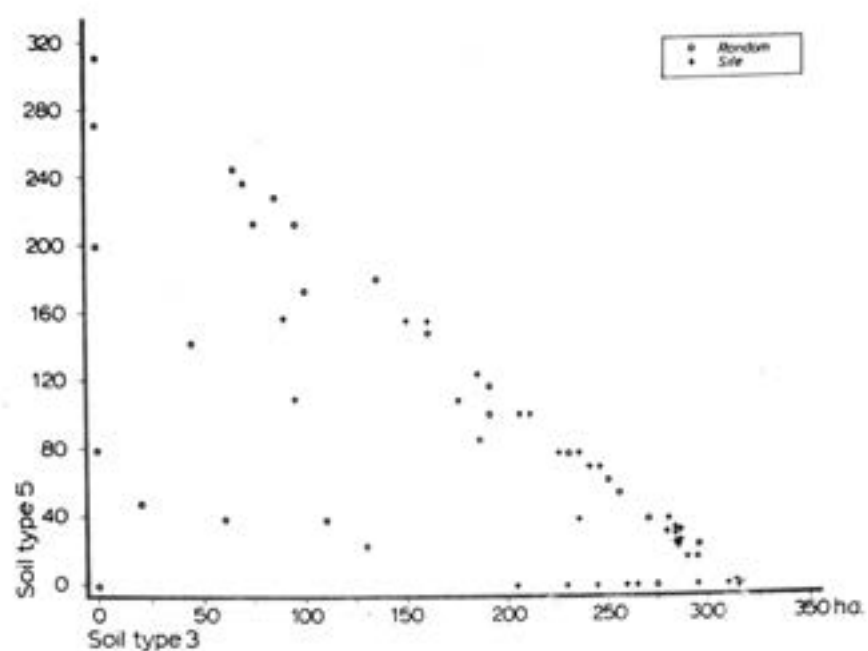


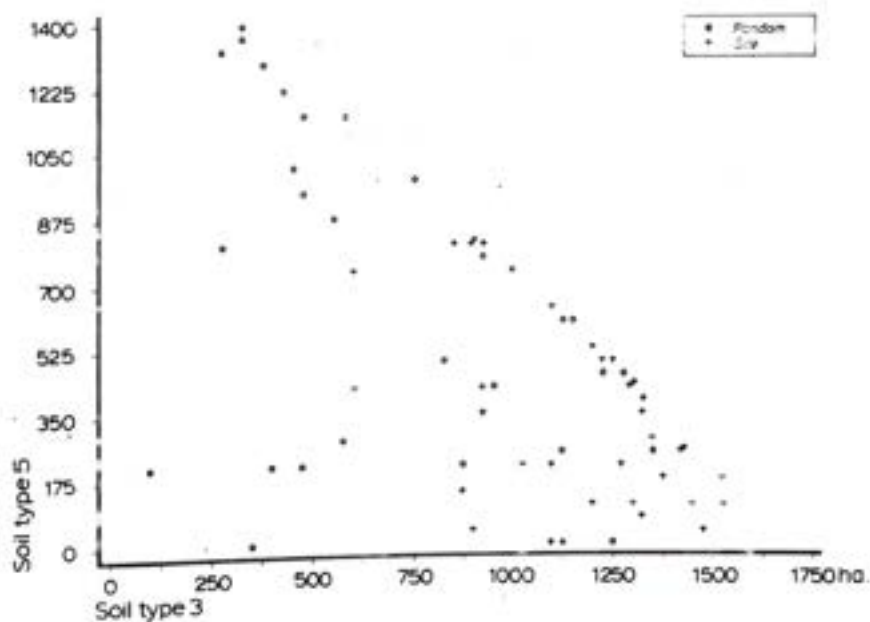
FIGURE 9-1 The distribution of all identified prehistoric sites in the Upper Songkram survey area. The site names are as follows (with site sizes in brackets):

A. Ban Chiang (ca. 4-5ha) B. Ban Om Kaeo C. Ban Tong D. Non Khi Khling E. Ban That F. Ban Phak Top 50. Ban Don Kaeo 53. Non Than (150x100m) 54. Non Siao Yai (140x70m) 59. Ban Phai 60. Non Ban Kao 62. Ban Tum Tai 63. Non Pa Khluay (400x300m) 65. Ban Phan Don 66. Ban Don Kaen 67. Ban Non Tam Tiang 68. Ban Muang Phruk 69. Ban Kho Noi 78. Ban Phai Chan 79. Ban Don Kaen 85. Wat Non Sawang 86. Ban Non Khok Kok (800x500m) 88. Ban Lao Suan Khluay 89. Ban Yang (100x100m) 90. Ban Chit 92. Ban Don Kok (90x90m) 93. Ban Na Di (150x120m) 94. Ban Tan Dieo (100x100m) 95. Ban Hua Nong Yang 96. Ban Sanguai 97. Non Kao Noi (50x50m) 121. Ban Muang Pang 129. Wat Non Sawang Samakkhi (1000x200m) 130. Ban Ya (150x150m) 131. Ban Kho Tai (100x100m) 132. Non Ban Nad (200x200m) 133. Non Ban Bua (100x100m) 135. Ban Suan Mon 138. Ban Mak Ba (150x300m) 139. Ban Lao (200x200m) 140. Ban Chiang Wae 141. Non Sung. Sites prefixed with a letter are those known prior to the survey. Numbers were allocated in the field and missing numbers refer to historic rather than to prehistoric sites.

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A



B

FIGURE 9-2

The distribution of prehistoric sites and random points relative to the area under soil types 3 and 5. A: on the basis of soils within a one km radius. B: on the basis of the "weighted" area.

Upper Songkhram Valley settlement patterns

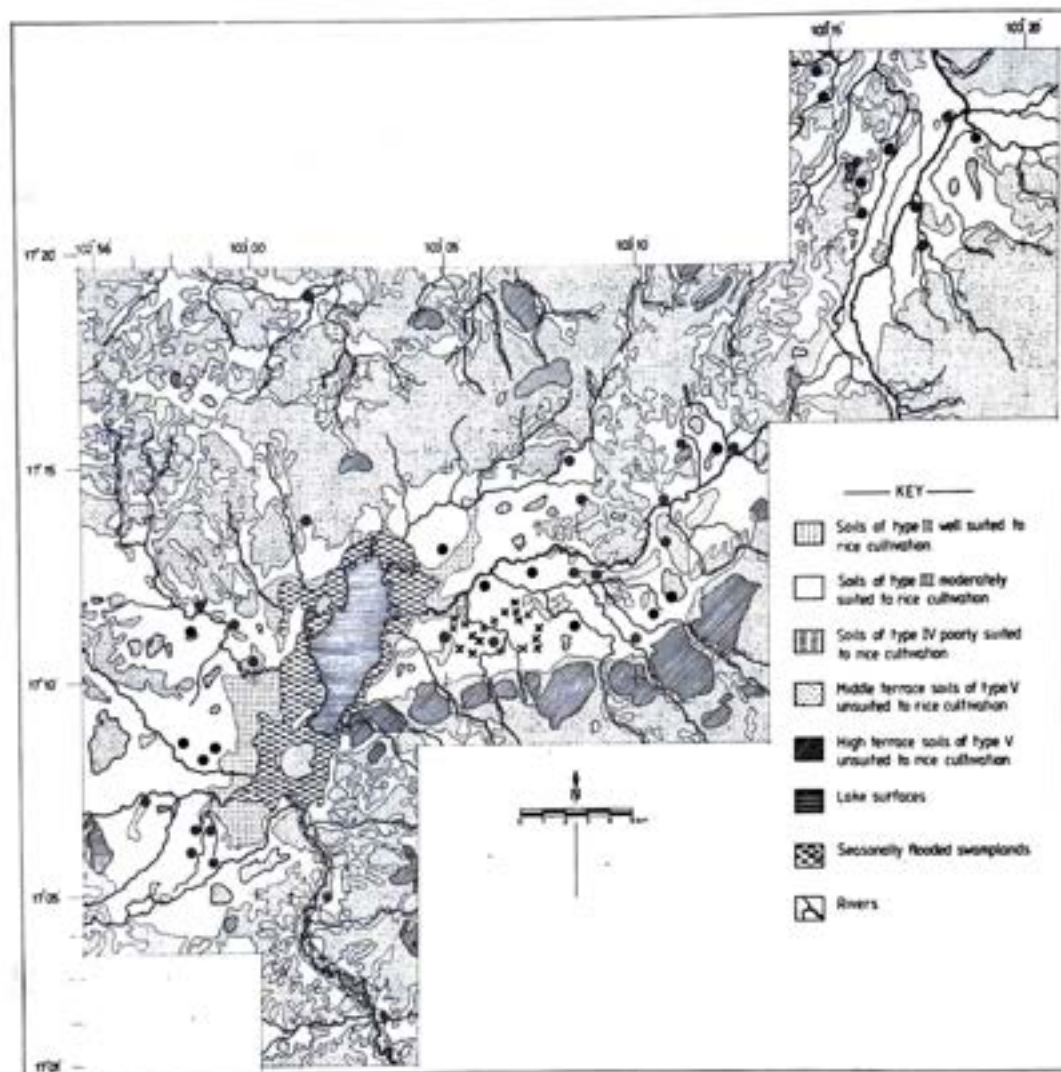


FIGURE 9-3

Map of the Upper Songkhram survey area showing the distribution of presumed salt working sites (marked x).

Upper Songkhram Valley settlement patterns

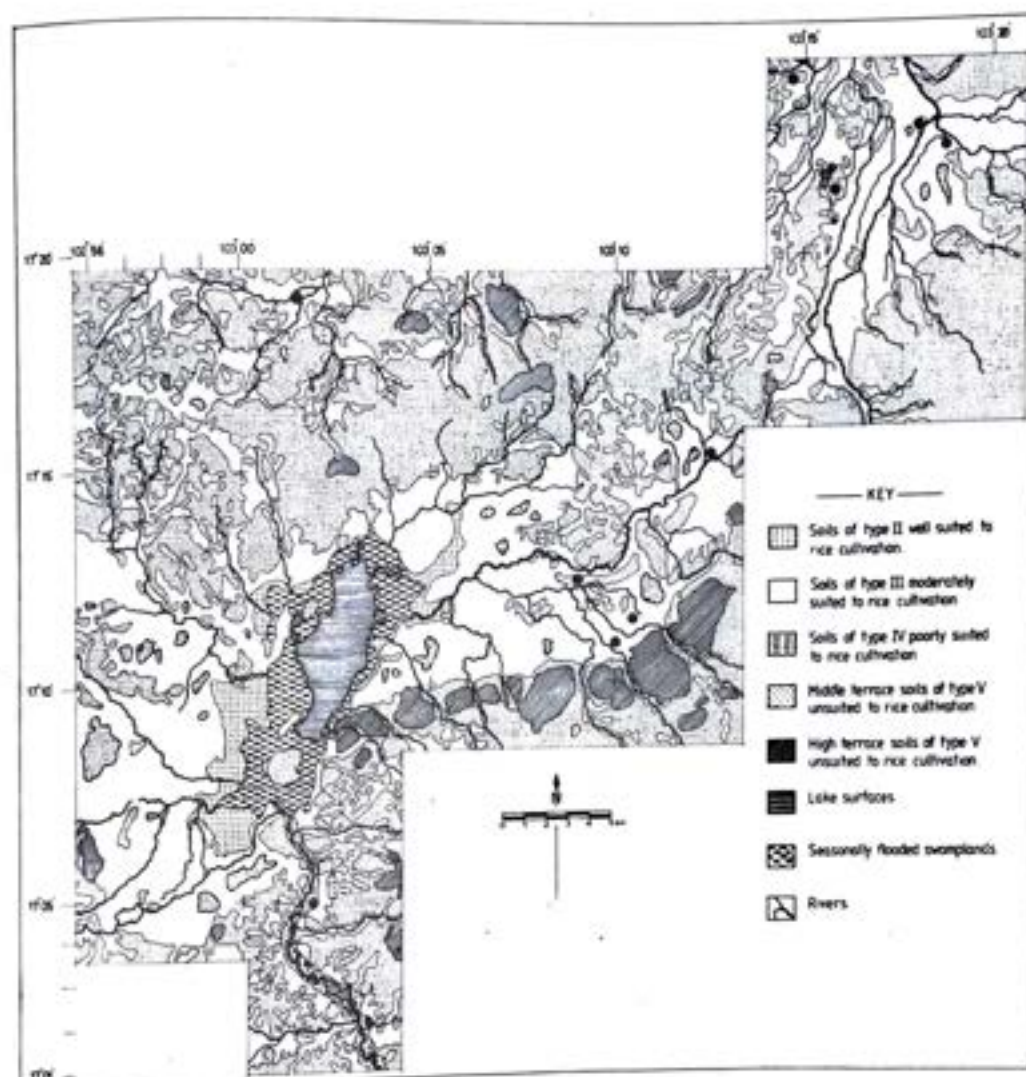


FIGURE 9-4

Map of the Upper Songkhram area showing the distribution of sites dating to the equivalent of Ban Chiang Early Period.

Upper Songkhram Valley settlement patterns

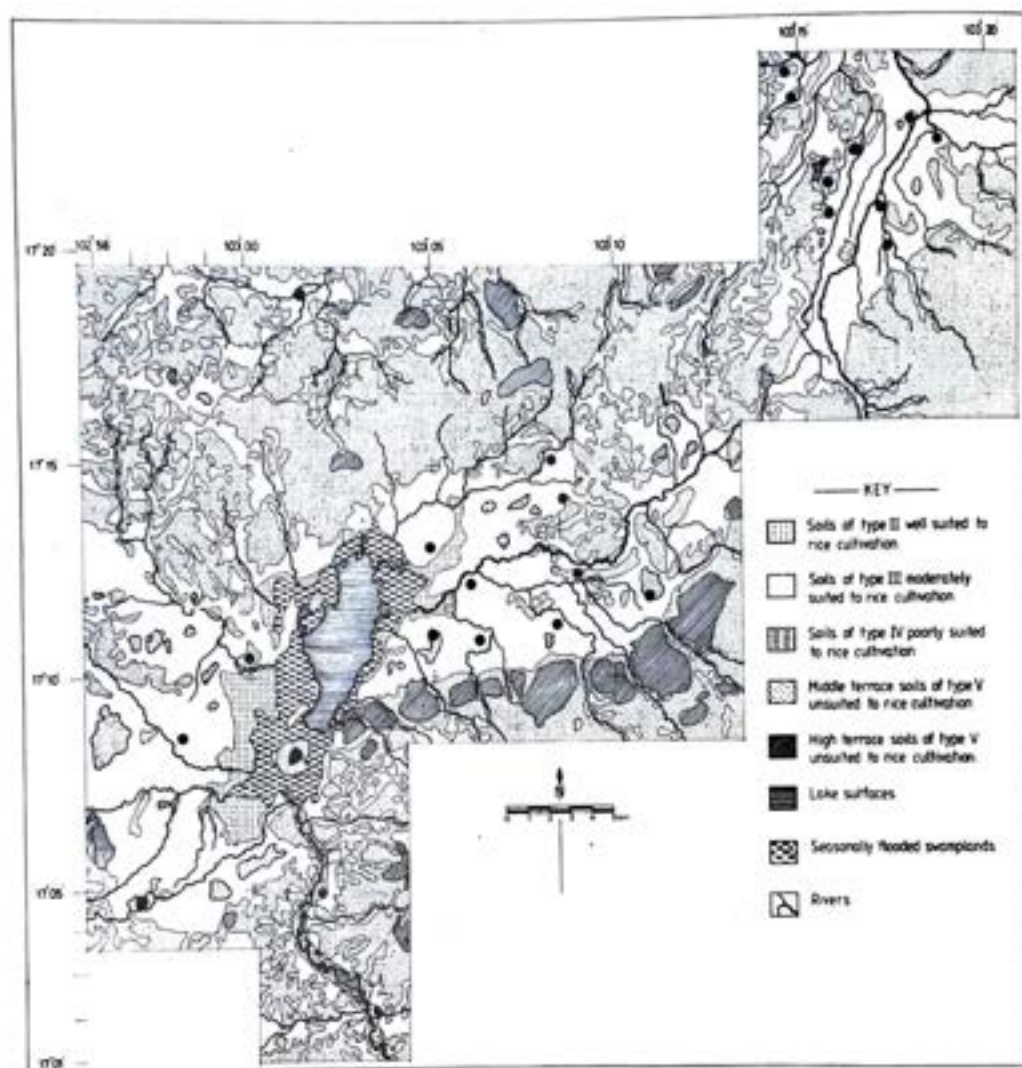


FIGURE 9-5

Map of the Upper Songkhram area showing the distribution of sites dating to the equivalent of Ban Chiang Late Period

SECTION TWO

CHAPTER TEN

THE RESEARCH PROGRAMME IN THE MIDDLE CHI VALLEY

AIMS AND METHODS

Payom Chantaratiyakarn

The Middle Chi fieldwork was designed to test a model set out by Higham (1972, 1977), which attempted to articulate the prehistoric sequences in the Ban Chiang area and the Lower Chi and Lam Siao Yai valleys (fig 10-1). When his model was first proposed, excavations had been undertaken at Non Nok Tha and in the three sites of Bo Phan Khan, Non Dua (also known as Ban Tha Nen) and Don Taphan (Higham 1977). The first site is located near a tributary of the Upper Chi River. The other three lie near the Lower Chi, 140 km to the southeast. Ten years ago, Bayard (1971) and Solheim (1968) were arguing in favour of a very early and indigenous development of bronze technology in Northeast Thailand, an argument based on the radiocarbon dates from Non Nok Tha. Bo Phan Khan, Non Dua and Don Taphan are located on the margins of an extensive deposit of salt. Limited excavations there in 1970 revealed that occupation was probably underway as late as 500-0 BC.

Noticing that the Khorat Basin, of which the Chi Valley forms part, receives significantly less rainfall than the adjacent Sakon Nakhon Basin (fig 10-2), Higham suggested that occupation of the extensive plains of the Mun and Chi came later than in the wetter valleys to the north. Moreover, the development of iron technology and in particular, the use of the buffalo-drawn plough, facilitated expansion into more arid areas by opening them to wet rice cultivation in fixed fields.

Two subsequent excavations apparently supported this simple settlement/expansion model. The first was undertaken at Ban Chiang, a cemetery and settlement site located in the Sakon Nakhon Basin, near the Songkhram River. Following two long excavation programmes there in 1974 and 1975, Gorman and Charoenwongsa (1978) and Gorman (1978) claimed that the radiocarbon dates sustained Bayard's long chronology for prehistoric settlement and bronze working in Northeast Thailand. The initial settlement was placed in the fourth millennium BC. An analysis of the animal bones and shellfish remains revealed that the first domestic water buffalo, as well as iron, appeared in phase four. The excavators dated this particular phase to between 1600 and 800 BC. Moreover, graves belonging to phases five and six contained red on buff painted ware and red-slipped pottery. Red-painted pottery was found in the earliest occupation phase at Non Dua in the Lam Siao Yai Valley (fig 10-1). This situation seemed to support the priority of settlement at Ban Chiang and related sites and relatively late expansion to the Chi Valley area.

The Middle Chi research programme: introduction

The second excavation took place at Non Chai (Rutnin 1979, Charoenwongsa and Bayard, 1983). This site is located in the upper reaches of the Chi, and covers approximately 28 ha. Charoenwongsa's excavations there revealed cultural stratigraphy about 5.5 m deep, which was divided into six cultural levels. The pottery from one of the four 4x4 m excavation squares has been analysed by Rutnin (1979), and nine radiocarbon determinations have been obtained, two from the Thai National Energy Authority and the rest from the radiocarbon dating laboratory of D.S.I.R., Wellington, New Zealand. The faunal remains have been studied and published by Kijngam (1979).

Several results are of relevance to the present study. With the exception of a date of 1870±160 BC for material from level 6, the dates reveal occupation between c. 350 BC and 100 AD. Level 6 was virtually sterile, except for some scraps of animal bone. The basal cultural contexts yielded the remains of iron slag and red-painted pottery, and the bones of the water buffalo. In 1978, the evidence from Non Chai supported the model that settlement of the Chi alluvium came late in the prehistoric sequence of Northeast Thailand. The presence of red-painted pottery again posed the possibility of derivation from expansive societies in the Sakon Nakhon Basin.

It is necessary to pause at this juncture, and consider how advances in the study of biological remains and environmental data also sustained the model under review. The excavations at Ban Chiang yielded abundant remains of shellfish. These indicated that, prior to the presence of water buffalo and iron, the site had access to clear-flowing streams and probably a permanent lake. The site is located near the confluence of three small streams, where flooding during the wet season (May–November) would have created marshy conditions suitable for rice cultivation (White 1982). The microfauna included species adapted to cleared terrain (the hare, *Lepus peguensis*, small Indian civet, *Viverricula indica* and mongoose, *Herpestes javanicus*). Shellfish, fish and small mammals became rare with the arrival of the water buffalo, and Higham and Kijngam (1979) have seen this change as being consistent with the development of ploughing in fixed field. Moreover, analyses undertaken on water buffalo third phalanges from Ban Chiang have revealed exostoses which may have developed due to traction-stress, such as pulling a plough (Higham *et al.* 1981).

Ban Chiang, like other sites in the Sakon Nakhon Basin such as Ban Phak Top, Non Nong Chik, Non Nok Tha and Don Klang, are located in the middle courses of small tributary streams where there were enclaves of low terrace soils surrounded by higher soils of the middle terrace. To this day, rice is cultivated only in the former. Before the present research programme began, the proposed development of ploughing was dated to phase 4 at Ban Chiang (1800–800 BC). Part of the model envisaged expansion of settlement as a result of population pressure within the circumscribed areas of low terrace rice land situated along the middle courses of tributary streams and rivers.

The Chi Valley on the other hand, is a substantial river flanked by a broad flood-plain. Flooding would have presented difficulties to the early rice farmer, but not to the same degree if bunding and ploughing were undertaken. Finally the latter technique is potentially much more productive than wet swiddening and would have favoured permanent settlement and rising social complexity (see Goody 1976 and Higham 1984

for a fuller analysis of this point).

Apart from the presence of two excavated and dated sites at each end of the Chi Valley, this region provides several other attractions for the prehistorian. As has been mentioned, the Chi River is large, and flows through a low-lying alluvium flood-plain. For part of its course, the river has a narrow flood plain bounded by the elevated soils of the middle terrace. Where the middle terrace is some distance from the river however, there is a broader area prone to flooding. Behind this flood plain, the soils of the middle terrace are dissected by small tributaries which are fringed by soils of the low terrace. Thus, there are areas very similar in soil type and water regime, to those of the Sakon Nakhon Basin near the broad flood plains. The second interesting fact is that the Sakon Nakhon Basin and the Chi Valley are directly linked by the valley of the Pao River. This river has its headwaters in and around Lake Kumphawapi, and cuts through the belt of uplands which otherwise forms a barrier between the two drainage basins of the Khorat Plateau.

It is also necessary to observe that both the Mun and the Chi valleys have revealed to aerial photographs, numerous round, moated sites (Williams-Hunt 1950). Those in the Chi Valley include Muang Fa Daed, Kantarawichae, Ban Chiang Hian and Non Dua itself (fig 10-1). Although Muang Fa Daed has never been excavated, its surface features include an outer moat which encloses an area of 158 ha, and a considerable number of ornately carved *sema* stones (Quaritch-Wales 1969, Subhadradis 1979). Excavations at Kantarawichae have revealed a Buddhist ordination hall, including a votive deposit comprising several silver plaques. These were decorated with scenes which include representations of high-status individuals (Subhadradis 1979).

After reviewing the valley as a whole, it was decided to concentrate on an area centred on the moated site of Ban Chiang Hian. This area was chosen because it provides a diversity of environments, and was known to include at least one moated site. It is sufficiently far from Non Dua and Non Chai to present its own prehistory yet judged close enough to provide links in pottery styles. Finally, it is located close to the junctions of the Pao and Chi river systems.

After the fieldwork and much of the laboratory analysis had been completed, MacDonald's (1980) doctoral dissertation became available. This study involved a reconsideration of the results of excavations at Non Nok Tha, and much of it is concerned with the Mun and Chi valleys in prehistory. It is necessary to review briefly his principal conclusions, and consider them in the light of the Middle Chi fieldwork.

He began by outlining the characteristics of chiefdoms and states. Following Wright (1977), he began with the assumption that a chiefdom is a sociocultural system with two levels of hierarchic decision making while a state contains at least three. He then follows Peebles and Kus (1977) in seeking archaeological evidence for the existence of a prehistoric chiefdom particularly in mortuary data, and considers the implications for a small and peripheral village represented by Non Nok Tha, of the development in the general area of a chiefdom and a state. In the light of his rejection of certain Non Nok Tha dates and application of an analysis of variance to the balance, MacDonald concluded that the site revealed three major phases. The first, or Non Nok Tha phase, he dated to 2000-1500 BC, the Ban Na Di phase to 1500-700 BC and the Don Kok Pho phase to 700-0 BC. The reader is referred to MacDonald's thesis for the detailed arguments

underlying his conclusions. These are that chiefly societies existed in the area of Non Nok Tha and Ban Chiang by 1500 BC, and that from 1000 BC, the Non Nok Tha area came within the influential orbit of an expanding state centred somewhere in the southern half of the Khorat Plateau. These conclusions are radical and innovative. The data obtained in the Middle Chi can to a certain extent, be used to test them.

GENERAL RESEARCH STRATEGY

The objective of this part of the Northeast Thai research programme, is to obtain archaeological data against which Higham's (1977) model may be tested. Should such data not sustain the model, then another will need formulation. The necessary data were obtained in two related ways. The first was to survey the area selected to locate prehistoric sites, and the second was to undertake a small excavation with the limited objectives of obtaining some insight into chronology and establish phases based on pottery typology.

A number of serious problems were encountered, particularly in the planning and interpretation of the site survey. Some were overcome, but others remain. The most pressing problem during the survey and in preparing the preliminary report, was time control. At that time, there had been no excavation in the area, and therefore there were no radiocarbon dates and no pottery typology ordered chronologically. This inability to control the time factor meant that prehistoric sites were distinguished from later ones by their absence of stoneware or other clearly historic wares, and then grouped together. This problem meant that the preliminary report could only take the form of a site list and locations, associated with very limited conclusions (see Kijngam, Higham and Wiriyaromp 1980).

The second problem is concerned with the recognition of sites. The Middle Chi Valley, in common with practically all areas with low terrace soils in Northeast Thailand, has been greatly modified by the construction of embanked rice fields. This involves first the clearance of natural vegetation, and then the process of levelling and building the low embankments themselves. The banks retain rainwater in the fields during the growing season, though water is allowed to flow between fields since still, stagnant water is injurious to rice plants. This levelling procedure could be very destructive of prehistoric settlements, while flowing water in fields has the effect of laying down silt deposits and thus covering sites. Where a mound is sufficiently large to rule out levelling, it stands out like an island surrounded by rice fields. Several such mounds were located during the site survey, but these were often covered with probably wind blown deposits. The question is, whether these mounds are of natural origin or result from human occupation. In practice, such mounds were carefully searched for artefactual remains, with particular attention being paid to any erosion gullies, cuttings or ploughed areas.

Having identified a site, either as an unoccupied mound or through finding pottery in the road cuttings or well sections in a modern village, one was faced with the problem of estimating its area. Small mounds were simply measured. Prehistoric occupation underlying modern villages however, could not be bounded and therefore the estimation of area was

ruled out. In one case (site 186) the site was recognised only through the discovery of pottery in a well section 2 m from the present surface and no site area could be estimated.

Wherever a site was encountered, a collection of potsherds was made. In some instances, for example Ban Kae Dam (site 174) and Ban Chiang Hian (site 182), road cuttings revealed considerable amounts of pottery, whereas the mound surface revealed hardly any (fig 10-3). In the absence of any information on ceramic phases, collection involved preference for rims, bases and decorated body sherds. Other sites, for example site 180, yielded only a few small pieces of pottery after even a lengthy search. This material was collected in the anticipation that in due course, the establishment of a ceramic sequence would make it possible to estimate a dated phase or phases when the site was occupied. Thus when Non Noi (site 150) was located, the mound was severely eroded and much pottery was found. At the time, its relationships with other sites and its age were unknown, and would remain so until phases firmly based on changing pottery forms and types were established.

A particularly difficult problem, and one with no ready solution, remains that of man's recent impact on the visibility of prehistoric sites. Probably the most important is the effect of accelerated alluviation following forest clearance, and the re-working of the landscape involved in the creation of field embankments. The nature of prehistoric settlement, if any, on the type 2 soils of the Chi Flood Plain illustrates this point. No sites have been identified yet, though site No 186, which lies near the edge of the flood plain, is covered by about 2 m of sterile soil.

The survey area also contains five quite substantial reservoirs, with areas of between 87.5 and 1382.8 ha. These were never surveyed before their completion and may well have drowned sites. All dams were built over tributary stream valleys, locations favoured in prehistory for settlement.

The last major problem concerns the development of categories of site. In this part of Southeast Asia, wood sandstone and brick were the principal building materials used in the past. There is no evidence for the use of either brick or sandstone before the Khmer or Dvaravati periods and indeed, the many post holes found while excavating prehistoric settlements demonstrate the widespread use of wood. Unlike the consideration of surface archaeology in Mesoamerica or Mesopotamia, no traces of structures such as temple mounds survive. This situation together with the present rarity of surface evidence for clearly specialised industrial sites, limits the extent to which function can be determined without extensive excavation.

Not all these questions were satisfactorily answered, but some initial progress was made. The approach towards site surveying was hampered by the lack of air photos as well as time and funds. Neither of the two obvious options was in fact chosen. These are firstly a total survey along the lines advocated and practiced by Sanders *et al.* (1979) in the Valley of Mexico. The second was the adoption of a sampling strategy in which transects or areas chosen at random were intensively surveyed. The problem with the former was that the available resources were insufficient. It is true that a very small part of the study area could have been intensively surveyed. That approach was undertaken in 1970 by Higham in the valley of the Lam Siao Yai. The result was the discovery of a large moated site and several salt working sites, but also an immense period of

time was spent in demonstrating the absence of prehistoric sites among low terrace rice paddies, and nothing approaching a settlement pattern was established. The second alternative was discarded for all the reasons set out by Sanders *et al.* (1979). Future fieldwork is planned, which will begin with intensive surveys of the area, undertaken over a number of years.

As a practical alternative, the area was covered on a village by village basis. In practice, this incorporated all the different environmental types recognised, from the large villages of the Chi Flood Plain to the smaller hamlets of the arid and less hospitable middle terrace. The headman of each village, or in his absence a village elder, was asked for permission to survey the village and its environs for evidence of prehistoric and early historic settlement. A sample of prehistoric sherds was carried to show local people. Invariably, a large crowd would gather and by thus increasing the survey team to include people with a lifetime's local knowledge, we were either taken to sites or informed that there were none in the village territory. This technique was integrated with a considerable amount of walking across all recognised soil and environmental types. The latter included the banks of the Chi River the flood plain and both middle and low terraces. It could well be argued that this approach would naturally lead to the recovery only of sites yielding pottery. In fact sites with stone were also sought, but with no success.

This type of surveying lead to many sites being brought to our attention which would not otherwise have been discovered. Thus, one informant took us to a site (no 195) where he had discovered some human burials associated with whole pottery vessels. A diligent search of the rice fields yielded two crumbs of pottery each no more than a cm across. On numerous occasions we were taken to sites set in rice fields stretching to the horizon. One old woman showed us a bronze axehead found decades earlier during the digging of a well. In other cases, such as Ban Kho Noi (142) and Ban Kae Dam (174), the presence of a prehistoric site was indicated immediately on arrival by the density of sherds lying in the road surface. It is freely acknowledged that an intensive site survey like that undertaken in the Valley of Mexico would reveal further sites. So too could processes of erosion and perhaps, the application of such techniques as infra-red air photography or survey by proton magnetometer. For the present purpose, it is assumed that the prehistoric sites found reflect the basic elements of former settlement patterns, and expected that future discoveries are more likely to expand rather than radically modify that identified.

Having identified a site, a form was filled in. This contained entries necessary for its relocation, including the grid reference and relationship with local landmarks. In all cases where it was feasible, the site's axes were measured so as to allow an estimate of area. In the case of Ban Chiang Hian, the area within the moats was computed with a digitiser from a surveyed map (fig 10-4). Any area revealing stratigraphy was described and its depth, measured. At the same time, a sample of sherds was collected. Since no knowledge was available on the approximate dates of pottery, preference was given to collecting rim sherds and those with different types of surface decoration.

The Middle Chi research programme: introduction

Consideration was given in the field, to the question of different types of site. Reference to the literature, and personal experience while surveying in the Kumphawapi area, suggested the possibility of several site types being encountered. Bo Phan Khan in Roi Et Province and Non Taeng Saeng in Udon Province (fig 10-1) have been interpreted as sites where salt was obtained by boiling brine. Non Nok Tha has been described by Bayard (1984) as a cemetery while Ban Chiang was, according to Gorman, both a settlement and a cemetery. Although its area has never been published, it is unlikely that its maximum extent exceeded 5.5 ha. Non Dua and Muang Fa Daed on the other hand, are large enough to be seen as regional centres, a situation which is supported by the construction of extensive moats.

A further possible approach to the establishment of site types is the estimation of population on the basis of site size and density of surface pottery. This technique has been used in Mexico, but is considered inappropriate for Northeast Thailand. As has been mentioned, deposition of soil over abandoned sites distorts surface density counts. Moreover certain mounds were clearly used for salt extraction, a process which involved the deposition of many broken sherds without actual occupation. In consequence size, location and architectural complexity were the three principle factors used in determining site types.

The establishment of a series of dated phases based on pottery typology can only result from excavation. As has been shown by the problems of dating Non Nok Tha by radiocarbon determinations, success depends in the recovery of charcoal from undisturbed situations (Higham, 1984). Clear stratigraphy is also important in the analysis of provenanced sherds, or other artefacts and biological remains. As a means of approaching the question of ceramic typology and dating, a small (3x3 m) test square was excavated at Ban Chiang Hian (fig 10-4). A major programme of excavation would be necessary to answer more fundamental cultural questions and it is hoped that this will be undertaken in due course. No excuses are offered for excavating what Flannery (1976) would describe as a telephone booth. Before the excavation of the small square, no information of any sort was available for the nature of the site's stratigraphy, nor the depth of cultural material. As will be shown in chapter 11, Ban Chiang Hian revealed a clear stratigraphy, some provenanced charcoal and much pottery. This sample provides the basic data for the consideration of the model under review.

During the site survey, several sites were recovered in which pottery was seen eroding from deep road cuttings or erosion gullies. In two cases, the opportunity was taken to cut back the section to a width of 1 m into undisturbed deposits, and thereby acquire a stratified sequence of pottery. This was a useful exercise in that the cultural stratigraphy of the site was quickly revealed. It was difficult at Ban Kho Noi however, because the base of the eroded section was reached at a depth of 1 m and the tiny (1x1 m) square continued down a further 5m. This was most unexpected, and working within such a tiny space was very difficult. The results of both exercises are set out below.

SUMMARY

Middle Chi research programme: introduction

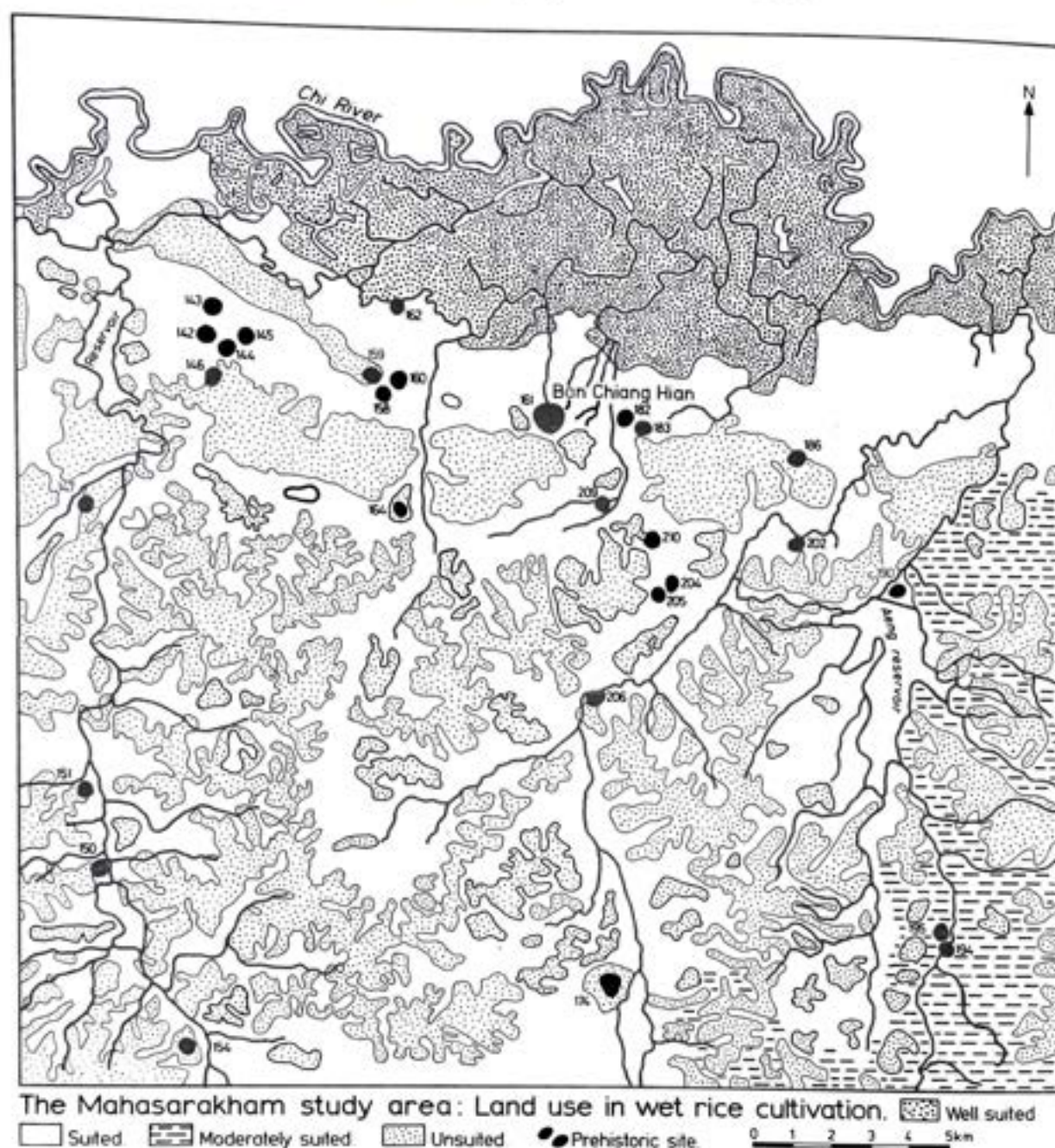


FIGURE 10-3 The Middle Chi Survey area. Sites are as follows, with approximate areas in brackets: 142, Ban Kho Noi (c. 3.6ha.) 143, Non Chao Pho (140x70m) 144, Ban Kho Yai (c. 3.3ha) 145, Non Kok Heng (100x70m) 146, Ban Non Dua 147, no name (100x70m) 150, Non Noi (100x70m) 151, Ban Hua Chang 180, Non Nong Hu Noi (140x120m) 181, Ban Chiang Hian (38ha) 184, Ban Hin Tong 174, Ban Kae Dam (5.5ha +) 182, Non Wat (150x150m) 183, Ban Kwao Yai 186, Ban Lao Noi 190, Ban Nong Saeng 194, Wat Pha Kung Photisan 195, Non Nong Noi (80x110m) 202, Ban Mak Yai 204, Non Ban Lad (300x180m) 205, Non Nong Wae 208, Non Wat 209, Non Khi Thun 210, Non Kho (200x185m) N.B. These are the field numbers. Missing ones refer to historic rather than prehistoric sites.

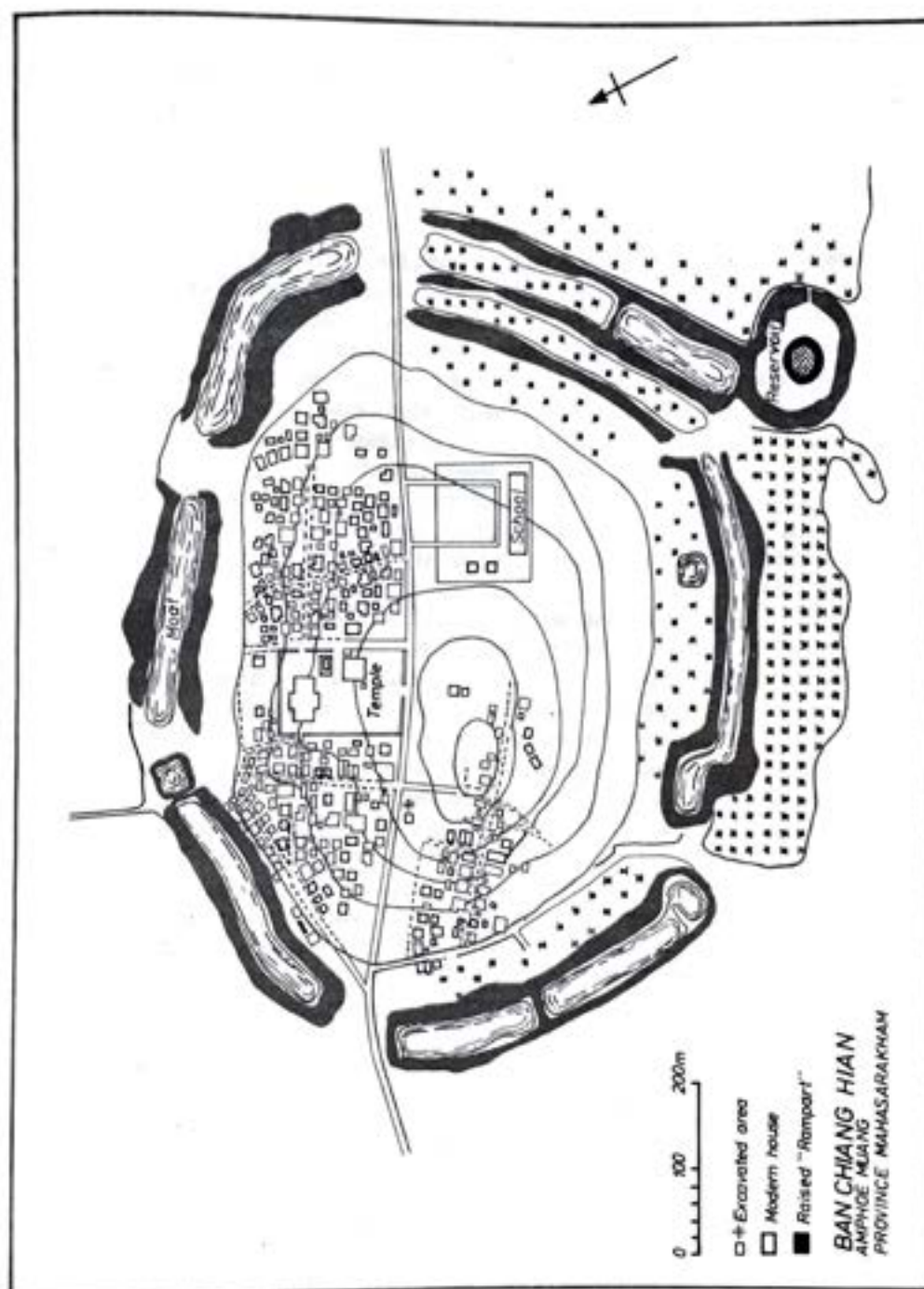


FIGURE 10-4

Ban Chiang Hian: plan showing the area excavated
(the contours are 1 m below datum at the top of the mound)

CHAPTER ELEVEN

THE EXCAVATIONS AT BAN CHIANG HIAN AND BAN KHO NOI

INTRODUCTION

Without information which can only be obtained from excavation, the significance of the site survey and the basic chronological framework of Middle Chi prehistory would remain obscure. During the survey, two very small excavations were undertaken at Ban Kho Noi and Non Noi. After its completion, it was decided to undertake a 3x3 m excavation at Ban Chiang Hian. There are several reasons why this site was selected. It is the largest, and the only one to be surrounded by moats. As Flannery has noted, it is not unusual to expect that the largest site will also be among the oldest (Flannery 1976). A deep, stratified sequence was clearly apparent at the site from an inspection of road cuttings.

Having surveyed the mound, a point near the highest part was chosen and a small test square, laid out. The same excavation technique which had been developed at Ban Chiang and refined at Ban Na Di was employed. Essentially, this divides each square into four quadrants and proceeds by excavating according to the observed cultural stratigraphy. It is often the case that such layers attain a considerable depth and in consequence, excavation within a layer proceeded in artificial "spits". After the removal of each spit, the surface is scraped clean and scrutinised for signs of disturbance such as post holes, pits and grave cuts. These are then assigned a number incorporating the level at which they were first noted, drawn on a site plan, photographed and excavated as a unit. Only after all such features are so treated is a further spit removed. It is stressed, that should a new layer be encountered within a spit, its surface is followed and it begins with a new layer designation. Clear lensing within spits or layers are also followed as discrete units, though in practice, thin lenses are fugitive and difficult to remove with complete integrity.

The soils which are removed are always passed through a screen with a mesh size of 6 mm. A refinement developed at Ban Na Di was applied at Ban Chiang Hian. This involved passing a quarter of all soils through a screen with apertures 1 mm wide. This practice resulted in the recovery of micro-organic remains including the bones of small fish and frogs.

All the material recovered at Ban Chiang Hian and Ban Kho Noi was shipped to the University of Otago for analysis. Artefacts other than potsherds were given an individual number and recorded as to their provenance during excavation. The first objective in the laboratory was to identify artefacts mixed with potsherds, and which had been overlooked during the excavation. This time-consuming procedure was rewarded with the discovery of several fragments of bronze casting moulds and pieces of crucible. All artefacts were then available for detailed laboratory analysis.

THE STRATIGRAPHY OF BAN CHIANG HIAN

The excavation reached the natural substrate at a depth of approximately 6 m. The stratigraphic sequence was very clear (fig 11-1), and eleven major layers were recognised. These in turn included sand lenses, concentrations of ash or charcoal, pits and postholes and towards the bottom of the square, inhumation graves. The layers recognised have the following characteristics.

The superficial layer (no 1) comprised compacted soil rich in humus and the remains of modern pottery. It merged with layer 2, in which the soil was darker and moister. Layer 3 had a lighter colour, and it was noted that much of the pottery found comprised porcelain and stoneware. It was about 30 cm deep. The next layer, no 4, was about the same depth. Stoneware was rare, and glass beads with fragments of iron were found. Layer 5 saw an increase in the amount of iron and bronze remains. There were numerous pits and postholes, which indicate an episode of probably late prehistoric occupation. The same may be said of layers 6 and 7, which were particularly thick and rich in sand and charcoal lenses. Layer 8 was more clayey in texture than those above it. It yielded the first actual pieces of bronze. Again, layers 9 and 10 were clayey and interspersed with sand lenses. They were distinguished from each other largely on the basis of colour differences. The final layer retained the sand lensing, but was also rather more friable and damper than layer 10.

THE BURIALS

Layers 5 to 11 incorporated a series of inhumation burials, their relative stratigraphical positions being seen in fig 11-1. The latest, burial 1, was cut from layer 5 down into layer 6. Burial 2 was cut from layer 6 into 7. It was found about 35 cm below burial 1, and the cut reached a depth of about 80 cm. Only the edge of burial 3 was found in the excavated area and it yielded very little information. Burial 4 was found in a good state of preservation within layer 9. The body had been placed on its back, with the hands parallel to the side. It was accompanied by about 50 poorly preserved shell beads. Burial 5 was only partially found within the excavated area and again, yielded little information. The last burial was also found laid out on its back with the arms parallel to the side. Only the lower torso and legs were located in the excavation square, the rest of the body being left in the west section. A white marble bracelet was found on the left wrist (fig 11-2).

TABLE 11-1

Ban Chiang Hian: details of the burials

BURIAL NO. SEX AGE (Yrs) STATURE (cm)

1	-	adult	-
2	-	adult	-
3	-	-	-

The excavations at Ban Chiang Hian and Ban Kho Noi

4	F	over 40	159.0
5	-	-	-
6	M	over 40	-

THE RADIOCARBON CHRONOLOGY

The radiocarbon samples from Ban Chiang Hian and Ban Kho Noi were selected, with one ill advised exception, from firmly provenanced sources. They were prepared in the laboratories of the University of Otago to remove extraneous organic material and the adhering soil matrix and were then sent to the Institute of Nuclear Sciences in Wellington, where the charcoal was acid washed to remove carbonates and processed. The resulting dates are set out in table 11-2.

TABLE 11-2

Ban Chiang Hian and Ban Kho Noi: the radiocarbon dates

SITE	NUMBER	CONTEXT	DATE	2 SIGMA RANGE MID POINT	
			(5570 half life) BP	(Klein corr.) BC	BC
Ban Chiang Hian	NZ5373	Layer 11; hearth 80 cm above sterile	2910 $\pm$ 180	1570-780	1175
BCH	NZ5547	Layer 11; hearth in same strat. posn. as above	2670 $\pm$ 60	1020-840	830
BCH	NZ5472	Layer 11; scattered in layer	2100 $\pm$ 160	410-215 AD	98
BCH	NZ5470	Layer 8; hearth	2430 $\pm$ 60	780-400	590
BCH	NZ5489	Layer 8; charcoal concent.	2480 $\pm$ 60	785-405	595
BCH	NZ5488	Layer 5; from pit cut into layer 6	2230 $\pm$ 60	410-180	285

The excavations at Ban Chiang Hian and Ban Kho Noi

Ban Kho Noi NZ5133 Concent. in L.3	2520 $\pm$ 70	805-420	815
Ban Kho Noi NZ5134 Concent. in L.3	2540 $\pm$ 70	810-430	820

On the basis of the above dates, the following chronological framework is proposed. It is noted that the inception of layer 5 is placed later than the date from that layer. This reflects the possibility that the pit yielding the sample contained charcoal uplifted from below when the pit was cut.

TABLE 11-3

Ban Chiang Hian: suggested chronological sequence by layer

LAYER	PROPOSED DATES
11	1300-900 BC
9-10	900-800 BC
8- 8	800- 0 BC
5	0-500 AD

THE MATERIAL CULTURE

This section is concerned with all the artefacts found with the exception of the pottery.

BRONZE ARTEFACTS AND EVIDENCE FOR BRONZE WORKING (fig 11-2)

The incidence of bronze detritus per layer is set out in table 11-4. It indicates that on the basis of actual metal fragments, metallurgy was undertaken from layer 8 onwards, with most of the activity concentrated in layers 6 and 7. It was in these layers, that the remains of two bronze artefacts were found: a piece of bracelet and a fish hook. At first sight, it would appear that bronze working was not undertaken at Ban Chiang Hian during the initial occupation there. This however, may be an over-simplification. The lowest layers may not have incorporated the actual area used for bronze working during the early occupation. Moreover, when we turn to the provenance of the crucibles, it is noted that one specimen from layer 11 bore metal staining, while a second piece from layer 9, although not bearing traces of metal, does conform in shape, thickness and fabric, with undoubted crucibles. Again however, the main concentration of crucible fragments is in layers 6, 7 and 8. There are two specimens from layer 8, seven from layer 7 and three from layer 6.

The excavations at Ban Chiang Hian and Ban Kho Noi

All have in common, bronze corrosion adhering to the interior surfaces and a rich admixture of rice chaff in the clay fabric. The thickness of these specimens ranges between 9.0 and 18.6 mm.

The remains of three clay moulds for bronze casting were also found, one in layer 7 and two in layer 6. These comprise an inner core of very fine clay in which is found the negative of the object to be cast. The outer skin is made of a coarser, fibre tempered clay. It is not always possible to ascertain the nature of the artefact to be cast, but one from layer 6 was clearly intended for casting a bell, and another was found in the form of a bracelet (fig 11-2).

TABLE 11-4

Ban Chiang Hian: the incidence of bronze fragments per layer

LAYER	N FRAGMENTS	CATALOGUE NOS
8	3	133, 134, 286.
7	8	124, 120, 119, 110, 117, 108, 109, 106.
6	28	49, 54-6, 59-64, 66, 70, 72-3, 76-7, 79, 87-9, 91, 96, 101-4, 116.
5	2	40, 42.
3	1	5.

IRON REMAINS

The distribution of iron fragments is set out in table 11-5. There are only four pieces in layer 7, most specimens coming from layers 4-6 inclusive.

TABLE 11-5

Ban Chiang Hian: the incidence of iron per layer

LAYER	N FRAGMENTS	CATALOGUE NUMBERS
7	4	111, 113-4, 121.
6	13	46-8, 52, 67, 69, 71, 78, 83, 86, 92-3, 98.
5	6	29, 32, 34, 39, 45.
4	5	14, 18, 21, 26, 27.
3	2	2.

BONE TOOLS (fig 11-2)

The four bone tools were found in layers 6 and 7. The single specimen in layer 7 (cat. 118) was sharpened at both ends, and the surface is polished by use. It has a length of 32.7 mm. and breadth of 2.7 mm. The surviving part of a fragment from layer 6 (cat. 99) had been sharpened, the length of the piece being 28.5 mm. The second specimen (cat. 94) was broken at a point where there had been a circular perforation through the shaft. Its surviving portion is 78.4 mm in length and has a sharpened end. The final bone implement (cat. 82) is quite distinct, probably being incomplete. It comprises the central shaft of a large animal's limb bone which has been cut into from both sides, perhaps to remove a blank for subsequent working.

BEADS: GLASS (fig 11-2)

Two glass beads were located. The first (cat. 10) was found in layer 3/4, and is coloured 2.5B 5/8-5/6 (ref. Munsell Book of Colour, Macbeth, Baltimore). It has a length of 2.5 mm and a diameter of 3.45 mm. The manufacturing technique involved its being broken off a tube of glass and then reheated sufficiently to smooth the surface without altering the general shape. The second specimen was found in layer 4 and is coloured 5PB 3/8. It has a cylindrical shape, with a length of 50.25 mm. and diameter of 4.67 mm. It was probably made by placing a blob of molten glass around a rod and gently rolling it. Both ends are flattened in shape after removal from the rod.

BEADS: SHELL

The remains of approximately 50 shell-disc beads were found in the neck area of burial 4. The diameter is approximately 10 mm, the central perforation 3 mm and their thickness, between 2 and 5 mm. They were found in an extremely fragile condition, and it is not at present possible to ascertain whether or not they derive from a marine or a local species.

MARBLE BRACELET (fig 11-2)

This white marble bracelet was found on the wrist of burial 6. It is 81.2 mm in height and has straight but inward sloping sides which give it the appearance of a truncated cone. The wider side (with a diameter of 78.5 mm) has a flat end which was cut to a square shape. The narrow side (the wrist end) is rounded and varies markedly in thickness. The diameter of the bracelet is so small, that it must have been placed on the person's wrist when young.

ORGANIC REMAINS

The excavations at Ban Chiang Hian and Ban Kho Noi

This material comes from layer 7. Its physical appearance resembles glass crystal but its stratigraphic context would make the presence of glass most unexpected. After melting a fragment, it was found to be lacquer sap, and probably derived from a dipterocarp tree.

CLAY ARTEFACTS

There are several categories of clay artefact from the site. The first comprises pieces of broken potsherd which were converted by abrasion into circular counters (fig 11-2). Four were found in layer 5 and one in layer 8. One of the commonest ceramic finds in the Khorat Plateau prehistoric sites is the pellet bow shot. This comprises a fired, rounded ball of clay which in living memory, was used as a projectile to hunt small birds. One was found in layer 11, one in layer 8 and four in layer 4. The diameters vary between 13.5 and 18.2 mm.

There are three enigmatic, carefully shaped pieces of fired clay, two from layer 11 (cats. 140 and 180) and one from layer 10 (cat. 138). The first two were moulded into a circular disc and then fired. The one complete specimen has a diameter of 22.0 mm. The later find from layer 10, is shaped into the form of a small boat, and then red-slipped all over. It is 32.3 mm. in length.

There is a clay spindle whorl from layer 5. It has a diameter of 27 mm. It is not unusual to find the remains of clay potters anvils in Northeast Thai sites, and Ban Chiang Hian is no exception. Two fragmentary specimens were found, one from layer 7 (SF 181), and the second from layer 5 (cat. 41, fig 11-2). A further, and most intriguing clay artefact, comprises potsherds made with circular perforations. The details for those found at Ban Chiang Hian are set out in table 11-8.

TABLE 11-8

Ban Chiang Hian: the perforated sherds (in mm)

LAYER	CAT.No.	DIA. OF PERFORATION	THICKNESS
7	105	11.0	15.0
8		7.5	17.2
	53	7.2	18.6
		21.5	17.2
		14.0	5.0

The excavations at Ban Chiang Hian and Ban Kho Noi

There are no complete clay ladles like those from Ban Na Di and Ban Chiang, but ladles are represented at the site in the form of broken handle fragments. They are restricted to layers 7 and 10.

THE EXCAVATION OF BAN KHO NOI (fig 11-3)

During the 1980 site survey in the Middle Chi area, a small 1x1 exposure was excavated in the middle of the site of Ban Kho Noi (site no 142, fig 11-3). The cultural stratigraphy reached a depth of approximately 8 m and was divided into three major layers. This in part, reflects the extreme difficulty of identifying layer changes in so small an excavated area. All the artefacts described below were found in layer 3 (the lowest). These include three fragments of clay mould, two for casting bracelets and one for casting a small, decorated bell. One of the bracelets had an unusual shape, comprising a band of herring bone decoration and two plain bands below it. The same layer also yielded five perforated potsherds, three complete clay pellets, the handle of a ladle and a piece of iron slag. The principal, indeed only inference made at present is that the material culture of this site is clearly closely related to that of Ban Chiang Hian.

THE BIOLOGICAL REMAINS

Amphan Kijngam has kindly identified all the faunal remains, and the following review is based on his conclusions. Conditions for the preservation of bone and shell at Ban Chiang Hian were excellent, although the small excavation square limited the sample size and conclusions which may be made. Early faunal reports from Northeast Thailand were hampered by the way in which samples were collected. At Non Nok Tha, no screens were used and therefore, only the bones of large species were recovered. Screens were used at Ban Chiang but they had a large mesh size (c. 25 mm). The analysis of the bones therefore, identified those of relatively small species, but missed the microfauna. At Ban Na Di, the use of a smaller screen size resulted in the recovery of the bones from small fish and amphibians.

This same procedure was followed at Ban Chiang Hian, in that 25% of all excavated soils were screened through a mesh of only 1 mm breadth. As at Ban Na Di, the bones of small species were recovered (table 11-7).

TABLE 11-7 Ban Chiang Hian: the faunal spectrum

Species	Layer 11	10	9	8	7	6	5
<i>Bibos</i> sp.	1	1	1	2	1	2	1
<i>Bubalus bubalis</i>				1	1	1	1
<i>Sus scrofa</i>		1	2	2	3	4	7
<i>Canis familiaris</i>			1		1		
<i>Cervus unicolor</i>			1	1	1	1	1
<i>Cervus eldi</i>		2	1	2	3	1	2
Small deer	2	1	1	2	1	1	
Small rat		1	1		1		
<i>Crocodylus siamensis</i>						1	
Soft shelled turtle	1		1				
Turtle indet.	8	3	35	18	15	9	4*
Water turtle		1					
<i>Channa</i> sp.		1	1		2	4	2
<i>Anabas</i> sp.		1	2	3	1	1	1
Pangasidae					1	2	3
Bagridae	4	6	7	7	5	2	
<i>Pristolepis</i> sp.	1	1					1
Clariidae	1			1	3	2	
Cyprinidae						1	

*this figure refers to carapace or plastron fragments identified. All other figures refer to the number of individual animals represented.

The basic faunal spectrum has a number of interesting points. In the first instance, although the fish bone came from only a quarter of the excavated soil, it predominated numerically. This dominance would be even more marked if, as at Ban Na Di, their numbers were increased in proportion to the area which was not fine-screened. It is therefore, evident that fish were exploited to a considerable extent at Ban Chiang Hian. Other aquatic species include the turtle and crocodile. A proportion of the carapace fragments assigned to the general group "turtle indet." probably comes from an aquatic rather than terrestrial species.

It would be unwise to draw too firm a set of conclusions from such a small sample. Nevertheless, it is interesting to note that the water buffalo appeared for the first time in layer 9, and was never common. This level dates to the period after c. 800 BC. It is becoming increasingly clear, from the evidence of Non Nok Tha, Ban Chiang, Ban Tong and Ban Na Di, that the domestic water buffalo made its appearance in Northeast Thailand during the first millennium BC. The few dimensions available for the water buffalo match those deemed to be domestic at Ban Chiang. Cattle were present in all levels. Some correspond in size to the domestic variety recovered in greater numbers in Sakon Nakhon Basin sites. One cuneiform from layer 11 however, falls within the range of size for the wild gaur. Because it is very difficult to distinguish between wild and domestic cattle on the basis of fragmentary bone, all specimens are described as *Bibos* sp. The same situation applies to pig remains, which were found more commonly than the bones of cattle. A considerable proportion of the pig bones come from immature animals.

The excavations at Ban Chiang Hian and Ban Kho Noi

Wherever reliable samples have been obtained from Northeast Thai sites, deer play a prominent part. Ban Chiang Hian is no exception. The large sambar deer and medium sized Eld's deer are relatively common. Since the muntjak and pig deer are very similar in size, it has not been possible to distinguish between them, and they are grouped together as "small deer".

There are insufficient specimens to detect any changes with time, apart from the introduction of the water buffalo. The recurrent Northeast Thai pattern of raising domestic cattle and pig, and collecting and fishing is clearly represented at Ban Chiang Hian.

SUMMARY

There are few sites with which to compare the material culture and biological remains from Ban Chiang Hian and in all cases, it is necessary to rely on brief reports or personal knowledge rather than detailed publications. The closest site is Non Chai, and the others are Ban Chiang, Ban Na Di and Non Nok Tha.

The mortuary ritual comprises extended inhumation. It is usual in Northeast Thailand to find complete pottery vessels as grave goods, and the limited exposure at Ban Chiang Hian failed to reveal any. According to the present inhabitants however, when the main road through the village was constructed, many burials with complete pottery vessels were disturbed. Two burials were found with jewellery, one having a necklace made of shell-disc beads and the other, a bracelet made of marble. Although there are no precise typological parallels with the material from Ban Na Di, the commonest form of personal ornament there was the shell-disc bead, while one burial was associated with a bracelet made of marble. It is also worth noting that in each case, the marble bracelet must have been worn since childhood.

It is not possible yet to demonstrate beyond reasonable doubt, the practice of bronze working in the earliest layers. This might reflect no more than sampling bias. If the first settlers were unaware how to cast bronze, however, then it would present the intriguing possibility that metallurgy in Northeast Thailand during the second millennium BC was restricted. Areas possessing the knowledge include the Upper Songkhram Valley and the Phu Wiang region.

The evidence for bronze working found in layers 8-8 comprises fragments of corroded metal, artefacts, and fragments of both the crucibles and clay moulds. This assemblage belongs to the period c. 500-0 BC. It is closely paralleled at Non Chai in terms of the clay moulds and artefacts produced, and at Ban Na Di, there are detailed similarities with material from the level 5 bronze working atelier. There however, the assemblage probably dates to the early years of the first millennium AD. Iron is found in the Middle Chi from c. 300-400 BC. This closely parallels its first appearance at Ban Na Di and by inference, at Ban Chiang. Iron is also found in the lowest occupation layers at Non Chai and Non Dua. The close conjunction between the first presence of iron and the water buffalo has been noted in the Upper Songkhram sites and at Non

The excavations at Ban Chiang Hian and Ban Kho Noi

Chai. It is also a feature of Ban Chiang Hian

There are also close similarities between the artefacts found during the excavations and those known from earlier work. The bone point with a circular perforation (cat. 94) for example, recurs at Ban Na Di and Ban Chiang. The clay pellet bow shot is ubiquitous. Potsherds chipped to a circular shape (the clay counters) are found at Ban Na Di in levels 5-7. The perforated clay sherds are restricted at Ban Na Di to levels 5-6. Similar vessels with perforation have been interpreted by Nguyen Viet (1981) in Vietnam as rice steamers.

Blue glass beads are present in basal Non Chai, Ban Na Di level 4 and Ban Chiang during the Late Period (Gorman and Charoenwongsa's phase 6). Indeed, the conjunction of "rice steamers", clay moulds for casting bells and bracelets, iron, the water buffalo, and chaff-tempered bronze working crucibles form a group which Higham has noted (1984), links the sites in the Chi and Upper Songkhram valleys towards the end of the first millennium BC. While the pottery from the various sites displays distinct regionality (see chapter 15 below), the material culture, economy and mortuary rites in both areas reveal close similarities, similarities which are particularly apparent during the period from approximately 500 BC.

The excavations at Ban Chiang Hian and Ban Kho Noi

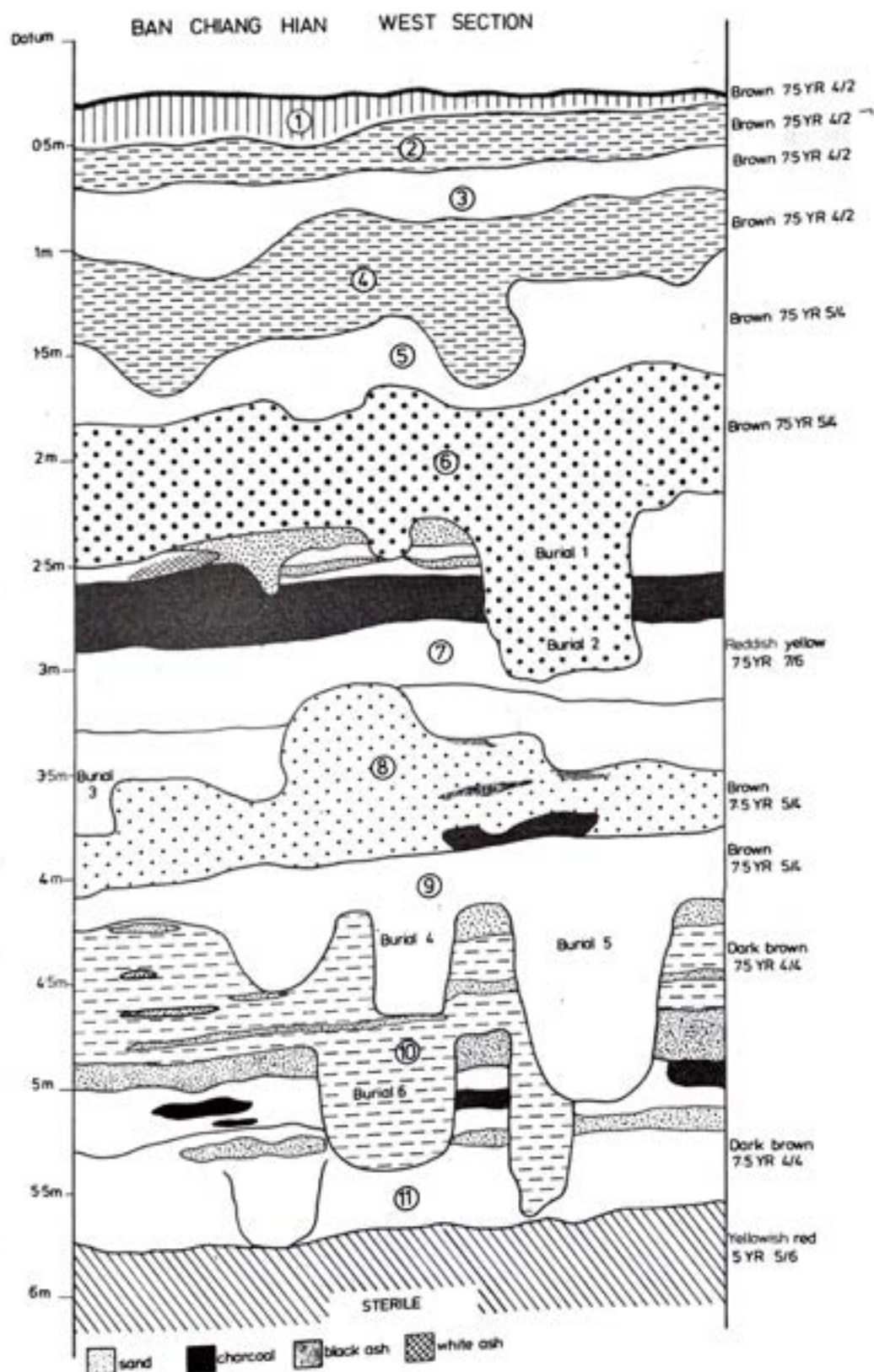


FIGURE 11-1

Ban Chiang Hian: the stratigraphy of the west section

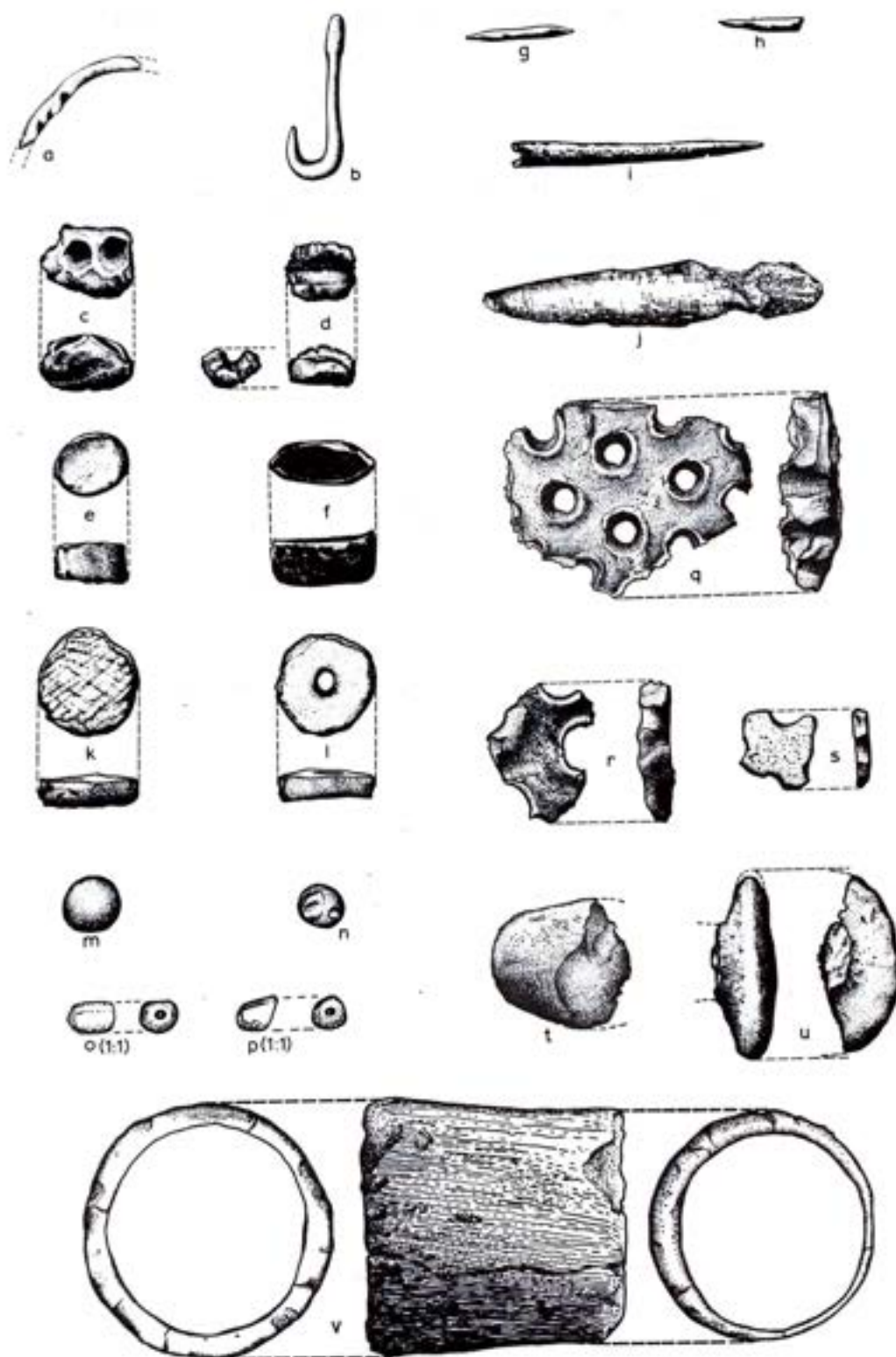
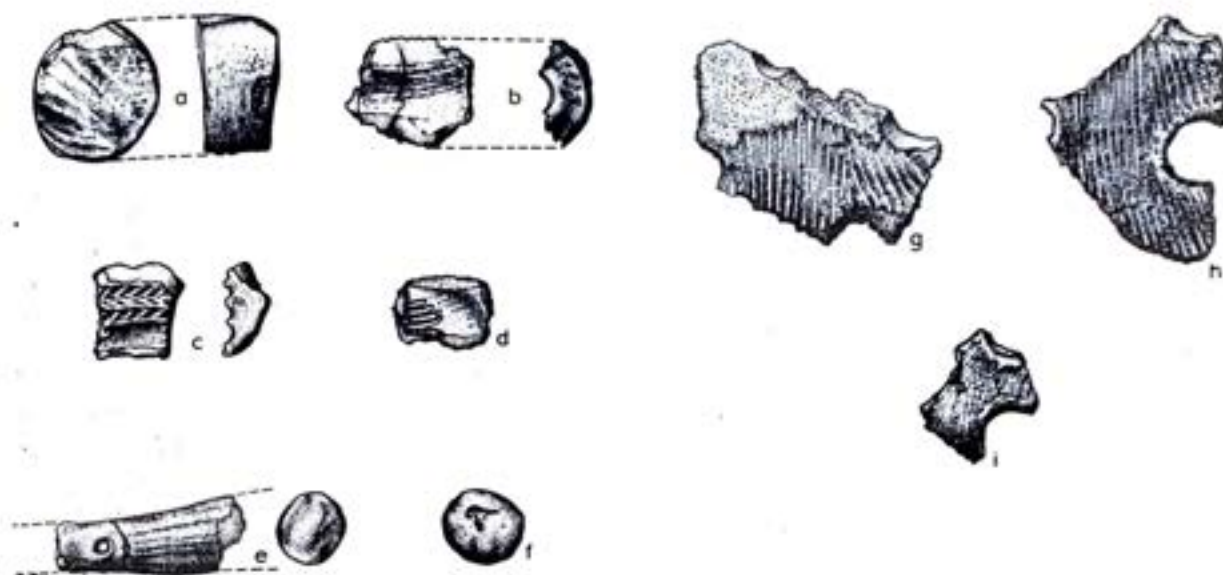


FIGURE 11-2 Ban Chiang Hian: the material culture. A. bronze bracelet L.7. B. Bronze fish hook L.7 C-D Clay moulds L.6 E. fired clay L.11 F. fired clay L.10 G. bone point L.7 H-J bone points L.6 K. clay counter L.8 L. clay counter L.4 M. clay pellet L.4 N. clay pellet L.3 O. glass bead L. 3/4 P. glass bead L.3 Q. rice steamer L.7 R. rice steamer L.6 S. rice steamer L.4 T. clay anvil L.7 U. clay anvil L.5 V. marble bracelet Burial 6. The scale is 1:2

The excavations at Ban Chiang Hian and Ban Kho Noi



A, CLAY COUNTER B, CLAY MOULD C, CLAY MOULD D, CLAY MOULD E, PERFORATED CLAY
F, CLAY PELLET G-H "RICE STEAMERS"
ALL FROM LAYER THREE. THE SCALE IS 1:2

FIGURE 11-3
The material culture from Ban Kho Noi

CHAPTER TWELVE

THE POTTERY FROM BAN CHIANG HIAN AND RELATED SITES

A basic element in Higham's model on the settlement of the Khorat Basin, was an assumed similarity between the prehistoric pottery of Ban Chiang during the later phases there, and the three sites excavated in Roi Et Province. The pottery assemblage from Ban Chiang Hian may certainly be approached with this problem in mind, but there are two further issues which are equally relevant. Bronson (1976), in his analysis of the material from the moated site of Chansen in the Central Plain of Thailand, noticed that his phase 3 and 4 pottery was distinctive at a regional level. The following phase 5 material however, was similar to that found over much of the Lower Chao Phraya Valley. Bronson saw the localised distribution of the former as indicative of a territorially small polity. The latter by contrast, he identified with the establishment of the Dvaravati state. This is an interesting possibility. Applied to the Middle Chi, two questions are apparent. The first relates to the degree to which Ban Chiang Hian pottery was regionally distinctive, or presents close and consistent similarities with that from other sites in the Chi Valley or indeed even further afield. Secondly, it is important to establish if possible, significant changes in the Ban Chiang Hian pottery assemblage with time.

During the site survey of the Middle Chi area, it became clear that prehistoric pottery was quite different to that already described for Non Chai or the Roi Et sites (Rutnin 1979, Higham 1977). It was therefore, not possible to estimate the occupation phase or phases of the prehistoric sites discovered.

The sample of provenanced pottery recovered while excavating Ban Chiang Hian and the other two sites in the survey area may, then, be relevant in several ways. As has been shown by Sanders *et al.* (1979), the basic ceramic sequence for a given region is helpful in estimating the date of occupation of sites recovered during site surveys. Where the same types occur in different sites or regions, integration in terms of chronology is made possible. More detailed studies incorporating for example, mineralogical analyses of clays and tempers, naturally open up avenues in determining inter-site or inter-regional relationships. Hodder (1982) for example, has considered the implications of pottery typology for exchange and the identity of ethnic groups in contemporary Africa.

While the same potential exists in Northeast Thailand as in the Basin of Mexico or the African Rift Valley, there is a notable lack of information. The main objective of the present chapter then, is to propose the basic framework for the prehistoric ceramic sequence in the Middle Chi survey area. The procedure began with the stratified sample from Ban Chiang Hian. The first step was to subdivide the sample into rims, bases, shoulders and body sherds. With the exception of the last, all specimens were labelled to the site and appropriate layer. Since there were very few clearly basal or shoulder pieces, most attention was paid to the rims and body sherds. The former were sorted into groups based on size, form and elements of decoration. These criteria are those proposed by Shepard (1956) and included a consideration of whether rims come from

The pottery from Ban Chiang Hian and related sites

vessels with open or restricted mouths. The presence of a direct, internally or externally enlarged end as well as the variety of decorative styles and sizes were also considered.

Having established a series of form-groups, each specimen was studied at a fresh break and a decision taken on the main characteristics of the fabric. This procedure was undertaken with the aid of a low-powered binocular microscope. At this level of magnification, it was possible to recognise a variety of materials used for tempering. In the earlier material, the most abundant was grog, a name given to crushed clay, such as potsherds, mixed with potters clay prior to shaping the vessel. Some specimens included a mixture of grog and chaff, while a third group incorporated chaff alone. It is clearly recognised that such groups are of a very general nature, and this reflects a considered decision. A detailed description of clays and their non-plastic inclusions is a highly specialised task requiring the preparation of thin sections and mineralogical identification. In the absence of such skills, it is considered preferable not to proceed beyond reasonable bounds in identifying different fabric groups. For example, the temper category "laterite" has been proposed by Bayard (1977) on the basis of low powered microscopic analysis, yet it is not possible to be sure that laterite was present without more sophisticated techniques. Again, "sand" has been suggested as a temper category despite the fact that sand is usually found naturally in clays in Northeastern Thailand (Vincent pers. comm.). The presence of sand as a temper additive would therefore, require a grain-size count and demonstration of a valid bi-modal size distribution.

The broad groups of fabric based on temper inclusions were incorporated with form, decoration and size to determine the basic rim types found at Ban Chiang Hian. In some cases, rims similar in form were found to have quite distinct fabrics, and they were therefore separated into different types. In nearly all cases, the types were defined for rims in which the junction of the rim with the body of the vessel has survived intact. Following the establishment of the basic types, all specimens initially described as "indeterminate" were re-examined. With the added experience of considering so many specimens, many fragmentary rims could with confidence be removed from the indeterminate category and assigned to one of the established types.

Having obtained a series of groups sorted by rim and fabric, the assemblage as a whole was compared with the samples of rims from Non Chai and Non Dua. The former site is located in the Upper Chi, about 80 km from Ban Chiang Hian. The latter is found in the Lam Siao Yai Valley, about 80 km downstream from Ban Chiang Hian. It was soon apparent that all sites had their own distinctive types, but that some rims found at Ban Chiang Hian were strikingly similar, both in form and fabric, to types which were abundantly represented at either Non Chai or Non Dua. Since the detailed analysis of Chi Valley prehistoric ceramics is in its infancy, a flexible approach towards nomenclature was felt necessary. This recognises the regional nature of traditions which is evident when comparing the three assemblages, and leaves open the possibility of refining the system as more material becomes available. The procedure is as follows. All rim types which were both abundant and found within a limited period of time at Ban Chiang Hian were given a prefix "MC" and then a number. The prefix stands for "Middle Chi", the area in which they were first identified. It was initially decided to call them "Mahasarakham"

The pottery from Ban Chiang Hian and related sites

TYPE BCH 2 (figs 12-1r, 12-2p-q, 12-4a)

These specimens lack the rim-body junction. They come from a vessel with an unrestricted mouth. Type BCH 2a has a red painted band at the rim tip, and a row of red painted dots situated above two horizontal red lines on the rim exterior. It is grog tempered. Types BCH 2b and 2c have either red slip or a red painted horizontal band, while type BCH 2d is plain and smoothed.

TYPE BCH 3 (fig 12-1s)

There are two examples of this rim type. It comes from a vessel with a restricted opening and rim with a marked internal concavity. The tip is red painted, as is the internal rim-body junction. The same grog temper was used as in types MC 1-3 and BCH 2-3.

TYPE BCH 4 (fig 12-1t)

This unique type has an out-turned rim angled at about 90 degrees to the neck. The flat top of the rim and outer surface of the neck bear red paint. Again, the clay is grog tempered.

TYPE BCH 5 (figs 12-1u-v, 12-1aa)

Rims of this type come from a vessel with an enclosed mouth and sharply everted rim. In sub type BCH 5a, the interior rim surface bears red paint, but in 5b, (n = 1), only the tip is painted, while the exterior rim surface has vertical cord-marked impressions. The form of this vessel closely resembles that for type MC 2 above, except that there is a sharper angle between the rim and the body. The grog temper is common to each.

TYPE BCH 6 (fig 12-1x)

The single specimen has the form of an open bowl with plain, rounded rim tip. Both surfaces are smoothed, and the temper comprises fragments of grog.

TYPE BCH 7 (fig 12-1y)

The two rims ascribed to type BCH 7 are so small, that the rim-body angle is difficult to determine. They probably come from vessels with an unrestricted mouth. The ends are plain and rounded. One has red paint on the lip and a broad vertical band on the interior surface. The other has red slip on the exterior and rim tip only. Both are grog tempered.

TYPE BCH 8 figs 12-1z, 12-3g

This type comes from a vessel with a restricted opening and simple, rounded rim tip. The exterior surface on the rim from layer 11 is red slipped over smoothed, vertical cord-marking. The interior surface bears a deep, red painted band. There are four similar rims from layer 9. These are very small fragments, but sufficient remains to identify at least the presence of broad vertical red painted bands. All specimens are grog tempered.

TYPE BCH 9 (figs 12-2r, 12-3h)

The pottery from Ban Chiang Hian and related sites

These two specimens are so similar, that they almost certainly come from the same vessel. They were found at the junction between layers 9 and 10. The rim comes from an unrestricted vessel, and has a pronounced external beading. The surface of the sherd has been polished and the interior of the rim, red-slipped. The clay was tempered with a mixture of clay and rice chaff.

TYPE BCH 10 (figs 12-3l, 12-4q)

This type of rim incorporates those specimens with an enlarged beaded end point, some element of red-painted decoration and grog temper. Beyond these points of similarity, it must be stressed that the shape of the beading is very variable, and that many rims are so fragmentary, that the group as a whole almost certainly incorporates specimens from quite different pot forms. Consequently, this type has little diagnostic value in defining ceramic phases.

TYPE BCH 11 (fig 12-2t)

This is the only example of type 11. It has a broad, probably horizontal flange, but the angle with the body is unknown. The upper part of the flange is red-slipped and polished, the lower is plain. It is grog tempered.

TYPE BCH 12 (fig 12-2u)

This rim type comes from a vessel with unrestricted opening or very slightly incurving rim. The rim ends are variable; some are rounded, others have a beaded or slightly flattened top. Not one specimen reveals a rim-body junction. Surface finish is plain and smoothed. Three specimens reveal smoothed over cord-marking. Six specimens were found in layer 8, one in layer 9 and three in layer 10. Grog was used as a tempering agent.

TYPE BCH 13 (figs 12-2v, 12-5e, 12-6a)

This type resembles type BCH 12 in having a plain, rounded end to the rim, and notable lack of decoration. No rim-body junctions survive. We may be dealing with a tall, slightly everted rim of a vessel with a restricted opening, or a straight walled form resembling a "flower-pot". Grog is the predominant temper, though one specimen from layer 7 also contained a slight admixture of chaff.

TYPE BCH 14 (fig 12-2w)

There is only one example of this type. In the absence of a rim-body junction, all that can be said is that the rim is slightly everted, and has an outward facing bead at the tip. The upper surface of the beading is red-slipped. It is grog tempered.

TYPE BCH 15 (fig 12-4b)

This rim lacks a shoulder junction. It is everted and has a slight exterior bead. The exterior surface has been vertically cord-marked and then smoothed, while the rim tip has been polished. The temper comprises grog.

BCH TYPE 16 (fig 12-2x)

The pottery from Ban Chiang Hian and related sites

The body-rim junction is missing in these two specimens. Nevertheless, the rim is everted and has a slight bead. The exterior is painted with horizontal red on buff lines. The interior surface of one has a red-painted vertical band. Grog was applied as temper.

BCH TYPE 17 (fig 12-4c)

One of the seven specimens ascribed to type BCH 17 has a surviving rim-body junction. It is marked by a clear groove. Above this groove, the rim is everted, plain, and ends with a round, direct tip. Below the groove, there is vertical cord-marking and evidence for a markedly constricted opening. The remaining six rims are fragmentary. All are grog tempered.

BCH TYPE 1 (fig 12-3i)

The single specimen has a sharply angled rim-body junction. It is plain and smoothed on both interior and exterior surfaces, though the former bears a row of impressions which may be deliberate decoration. It is grog tempered.

BCH TYPE 19 (fig 12-3n)

One of the three specimens ascribed to this type has a rim-body junction intact. The vessel had a restricted opening and low, rounded rim. Both surfaces are plain and smoothed, but the surviving part of the body has vertical cord-marking up to a straight line situated about 1 cm. below the rim-body junction. These rims are grog tempered.

BCH TYPE 20 (fig 12-4d)

The surviving section of rim slopes inward, and has a pronounced external bead bearing red slip. It is grog tempered.

BCH TYPE 21 (figs 12-3p, 12-4e)

Only the terminal ends of these rims have been assigned to this type. They are distinctive because they have a marked internal and external thickening, the flattened top of which is red-painted in BCH 21a and plain in BCH 21b. Again, they have grog temper. There are a few pieces of rice chaff in the two 21b specimens.

BCH TYPE 22 (fig 12-3j)

The single specimen of this type has an everted rim, external painted bead and a line of red, painted strokes along the inner rim edge. The fabric comprises rice chaff with small quantities of grog.

BCH TYPE 23 (fig 12-4f)

There is one example of this type from layer 9. The tip has a marked external bead and internal convexity. The exterior is red-painted, and the interior, smooth and plain. The fabric is grog tempered.

BCH TYPE 24 (fig 12-3o)

This single specimen has a restricted opening and externally thickened rim. The surface is worn, but the exterior at least, was probably red-painted. It is tempered with grog.

BCH TYPE 25 (fig 12-3q)

The pottery from Ban Chiang Hian and related sites

No rim-body junctions survive. The everted rim has a slight external thickening and flat end, which is red-painted. Both specimens are grog tempered.

BCH TYPE 28 (fig 12-3r)

Only the rim area has survived. It has a pronounced external flange which is red-painted at the tip, and is tempered with grog and rice chaff.

BCH TYPE 27 (figs 12-4i, 12-5a, 12-5h, 12-5o)

These ten specimens derive from vessels with a restricted mouth. The inverted neck supports a broad, down sloping rim. In type BCH 23a, the upper surface of the rim has parallel ridges and is red-painted. BCH 23b has a plain rim, and in type 23c, the extreme outer edge of the rim is impressed with notches.

BCH TYPE 28 (figs 12-5g, 12-5p)

These specimens have a constricted neck and everted rim the enlarged end of which has a slightly concave or convex surface. Type 28a is plain and smoothed all over. In type 28b, the end bears red-painted decoration. The fabric is grog-tempered.

BCH TYPE 29 (fig 12-5b)

This single specimen has a cylindrical neck and sharply everted rim terminating in a vertical bead. The effect is to produce an internal ledge. It is plain and smooth, and the temper comprises rice chaff in association with small amounts of grog.

BCH TYPE 30 (fig 12-5d)

This type is represented by a single specimen. It has a restricted mouth, and simple, everted rim which forms a sharp angle with the body. It is plain and smoothed, and the temper comprises grog.

BCH TYPE 31 (fig 12-5c)

The two examples from layer 7 have a restricted opening and a simple externally beaded rim. The exterior is red-painted, and the interior plain and burnished. It is grog tempered.

BCH TYPE 3 (fig 12-5q)

This rim form is everted, with an expanded, red-painted end. The fabric however, is quite distinctive, comprising grog and chaff.

BCH TYPE 33 (fig 12-5i)

These two specimens have vertical shoulders and rims everted at about 90 degrees. The rim tips are impressed and the body in each case is impressed with vertical cord-marks. The fabric is grog tempered.

BCH TYPE 34 (fig 12-8j)

This type has an external swelling which is red-painted. The actual tip bears a series of parallel oblique strokes. There is one example from layer 8.

BCH TYPE 35 (fig 12-7b)

The pottery from Ban Chiang Hian and related sites

The form of this type matches that for one of the types from Ban Tha Nen. There is however, no evidence for red-painted decoration, and the fabric incorporates grog.

BCH TYPE 36 (fig 12-6g)

This single specimen has a markedly restricted opening. The exterior part of the mouth is thickened to form a rim which was smoothed, perhaps with a leaf, to leave a series of irregular ridges. The temper comprises rice chaff.

BCH TYPE 37 (fig 12-7c)

These three specimens come from vessels with very large, beaded rims. The finish is plain and smoothed, with grog used as a temper.

BCH TYPE 38 (fig 12-7d)

There are no rim-body junctions for this type. The four rims have an everted form and direct end. The interior surface was painted with parallel red strokes. The temper comprises small quantities of grog. The clay also contains much sand which may be natural to the clay source or added as a temper.

BCH TYPE 39 (fig 12-7e)

This specimen has a restricted mouth, plain sharply everted rim and rice chaff temper.

BCH TYPE 40 (fig 12-8c)

An everted rim with external bevel at the tip, but no shoulder junction survives. The top of the rim and interior is red-slipped, the exterior smoothed and plain. The clay contains much sand and little grog.

BCH TYPE 41 (fig 12-8d)

This type has a markedly restricted opening and deep external thickening. It was horizontally smoothed and grog tempered.

BCH TYPE 42 (fig 12-8e)

No rim-body junction survives. The remaining part of the rim is everted, and has a slight exterior expansion. A band of red paint covers this bead on both internal and external surfaces. There is also a single horizontal and single red-painted line with a dog-tooth pattern. It is grog and chaff tempered.

BCH TYPE 43 (fig 12-8f)

The collar of this rim sherd is cylindrical, and the rim itself is externally beaded. The tip of the bead has a series of impressed notches. It is grog tempered.

BCH TYPE 44 (fig 12-8g)

The shoulder-rim junction is missing in this one specimen. The rim itself ends with a slight swelling and groove, and is plain on both surfaces. It is tempered with grog. There is much sand which may have been mixed with the clay as temper.

BCH TYPE 45 (fig 12-8a)

The pottery from Ban Chiang Hian and related sites

This specimen has a restricted opening and external thickening. The outer surface has red slip, but the interior is slipped and polished. The fabric contains very little grog and considerable amounts of sand.

BCH TYPE 46 (figs 12-7p, 12-8b)

The rims are slightly everted and terminate with a slight interior and exterior beading between a flattened top. One specimen retains a rim-body junction, which indicates a vessel with a restricted opening. All are plain and chaff tempered.

BCH TYPE 47 (figs 12-7j, 12-7q)

This type has an unrestricted opening, and everted rim. Both surfaces are plain. Rice chaff was used as temper.

BCH TYPE 48 (figs 12-7k-l, 12-7r)

The surviving fragments come from a straight-sided vessel with a rim everted at an angle of about 90° to the body. The original form is unknown. All surfaces are plain, and the specimens are chaff tempered.

NON CHAI CLASS 2 TYPE CC (fig 12-5l)

There are nine fragmentary specimens of a rim which parallels Non Chai class 2 type cc in form and fabric. The Non Chai specimens contain grog and chaff, those from Ban Chiang Hian have only grog. The rim is everted, with a pronounced distal swelling the end of which is painted red.

NON CHAI CLASS 1 TYPE A (fig 12-5m)

Although very fragmentary, these six specimens have all the hallmarks of Non Chai class 1 type A. They have a sharply everted rim tip with a rounded expansion at the tip and one or two red-painted bands on the inner surface. The fabric contains grog and chaff.

NON DUA STYLE RIMS (figs 12-5k, 12-8h-i)

The rim forms described by Higham (1977) for Non Dua were not given numbers, and therefore it is not possible to refer to them specifically. The shoulder and rim areas of the type being described (type "a") are markedly everted, the latter having a pronounced external bead which lips over the tip to produce a deep ledge. The flat top of the rim is decorated, either with parallel strokes of red paint or in a red-painted herring-bone pattern. The fabric incorporates grog and chaff.

THE POTTERY FROM BAN KHO NOI

This site is located approximately 15 km west of Ban Chiang Hian. During the course of the site survey, a section 1 m wide was cut back into an exposed bank within the central part of the village. This bank revealed much pottery eroding, and it was intended to ascertain through such an exposure, the nature of the ceramic sequence and depth of cultural buildup. The prediction of a 2 or 3 m stratigraphy proved quite wrong, and it became embarrassing to work within the confines of a tiny 1x1 m square as the cultural buildup reached a total depth of c. 8 m. Clearly, this "excavation" is a prime example of Flannery's "telephone

The pottery from Ban Chiang Hian and related sites

booth", approach, and only the most limited information was obtained. For the present, the rims from Ban Kho Noi will be described and compared with those from Ban Chiang Hian.

The rims were even more fragmentary than those just described. Indeed, not one specimen has an intact rim-body junction. Consequently, this analysis is restricted to the form of the surviving pieces, the decoration and fabric. The same system of nomenclature was adopted as for Ban Chiang Hian, with the following results:

TYPE MC 2/3

The characteristic MC type 2 or 3 has a restricted opening and everted, direct rim. There is much variety in the painted motifs used at Ban Kho Noi, there are numerous specimens which match type MC 2/3, in terms of shape, decoration and fabric, but none has a surviving rim-body junction.

TYPE MC 4

Not one rim-body junction survives for this group, though the available specimens have the direct everted rim, plain finish and grog temper characteristic of type MC 4 at Ban Chiang Hian.

TYPE MC 5

There are four very fragmentary specimens which are similar to MC 5e and a at Ban Chiang Hian.

TYPE MC 6

Level 3, spits 5 and 21 have each yielded one rim which, though fragmentary, matches MC 6.

TYPE MC 8

There are three specimens, from layer 3, spits 16, 23 and 27. All are fragmentary, but clearly relate in form and fabric with MC 8.

TYPE MC 9

This very characteristic plain, chaff tempered ware is found in the upper 3 spits of layer 2. There are 33 specimens.

BCH RIM TYPES FOUND AT BAN KHO NOI

Most of the remaining rim types recognised at Ban Kho Noi match those assigned the BCH prefixes described above. Parallels are also evident in the fabrics identified. Details are as follows:

Ban Kho Noi layer	BCH type	n
3, spit 39	40	1
3, spit 39	2b	1
3, spits 37 & 38	41	7
3, spits 36, 37 & 38	10	3
3, spits 35 & 38	21	2
3, spits 34 & 35	23	3

The pottery from Ban Chiang Hian and related sites

RIMS WITH PARALLELS AT NON CHAI AND NON DUA

There are four rim types from Ban Kho Noi with clear parallels in form and fabric with specimens recovered in abundance at Non Chai. The first is NC Class 1 type a. There are two examples from layer 3 spits 16 and 32. The fabric includes grog and chaff. This type predominates at basal Non Chai. There is a single specimen very similar in form and fabric to Non Chai Class 2 type aa. It probably had a cylindrical neck and everted rim, with enlarged, flat red-painted end. The interior part of the rim has two parallel red-painted lines. Finally, Three further rims have close affinities with NC Type 2 class cc. They have an everted rim, the tip of which expands upward and downward to form a pronounced ledge. The exterior surface of the ledge is painted red in one of the three Ban Kho Noi specimens. The clay was tempered with grog and chaff. Finally, there is one rim which is close to NC Class 2 type bb. It has a broad external flange, and the recurrent grog and chaff temper. These specimens were found in layer 3, spits 16 to 35, a location which is in accordance with our understanding of the chronology of both sites.

The same horizon, layer 3 spit 16, also yielded one rim which in form and decoration, clearly matches those bearing parallel red-painted lines found in phase 1 contexts at Non Dua.

THE RIMS FROM NON NOI

Non Noi is a small mound located in the upper reaches of the Kham Phu Stream (site 150, fig 10-3). It has been badly eroded by river flooding, and in February 1980, many gullies cut through the mound revealed pottery in section, and human bone on the present ground surface. Before further destruction occurred, it was decided to cut back one face 1 m wide on an exposed gully edge to obtain at least some information on the site's stratigraphy. The cultural build-up was only c. 1.5 m deep, and divisible into three layers. The pottery was badly weathered. Many rims lacked surface finish altogether through erosion. At the time of the fieldwork, the red painted pottery styles bore no resemblance to any part of the known sequence in nearby Roi Et, nor did the forms match those known from Non Chai. It is, however, now possible to recognise close affinities with the samples from basal layers at Ban Chiang Hian and Ban Kho Noi. These parallels are reflected in the presence of type MC 2 or 3, and in particular, the same geometric painted motif comprising sets of parallel red lines (fig 12-8h).

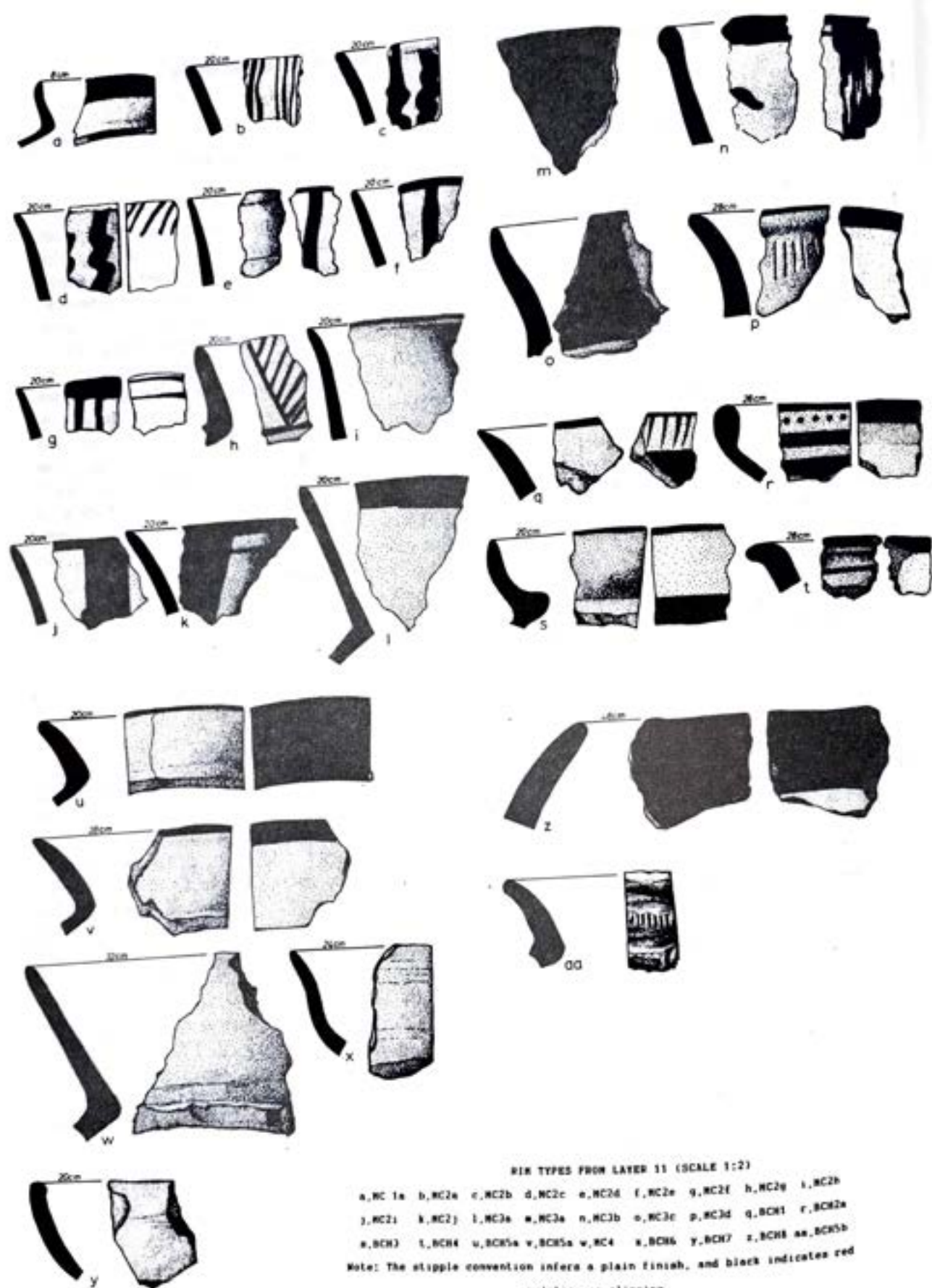


FIGURE 12-1 Ban Chiang Hian: rim types from layer 11

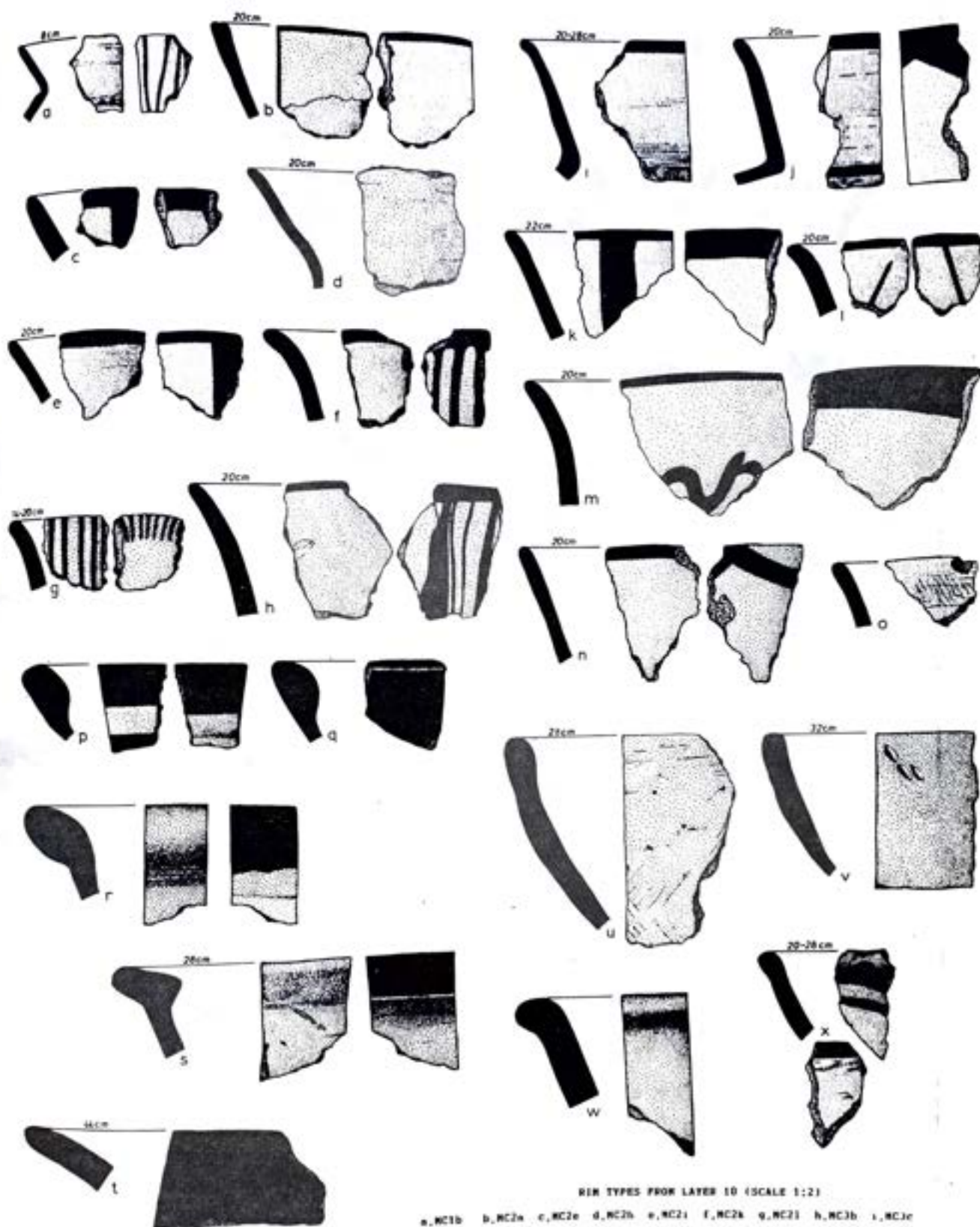
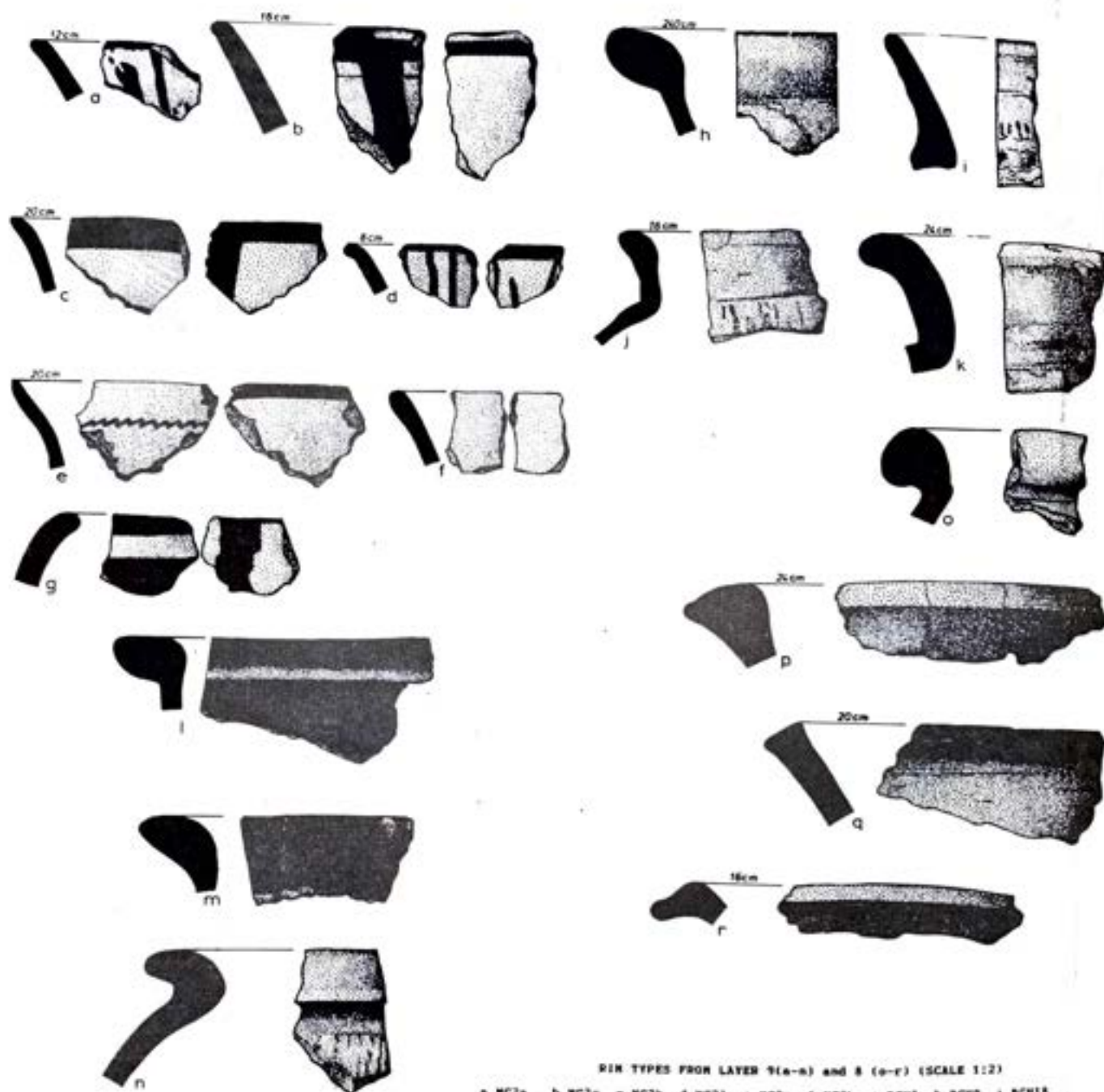


FIGURE 12-2 Ban Chiang Hian: rim types from layer 10

Ban Chiang Hian: illustrations of rim types



RIM TYPES FROM LAYER 9(a-n) and 8 (o-r) (SCALE 1:2)

a, NC2a b, NC2c c, NC2k d, NC2l e, NC2m f, NC3h g, BCH8 h, BCH9 i, BCH18
j, BCH22 k, NC5a l, BCH10 m, BCH19 n, BCH24 o, BCH21b q, BCH25 r, BCH2k
Note: The stipple convention infers a plain finish, and black indicates red
painting or slipping.

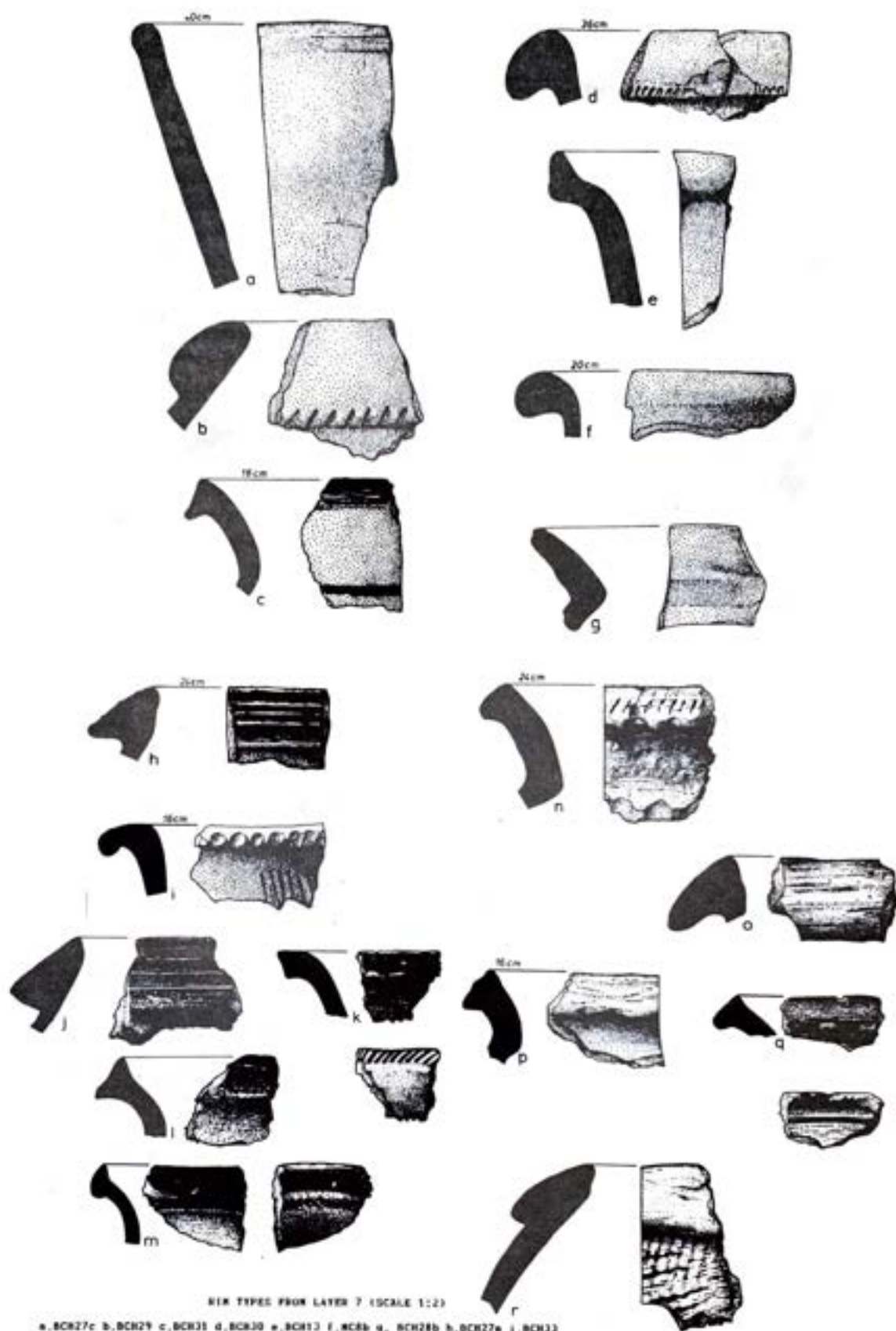
FIGURE 12-3 Ban Chiang Hian: rim types from layer 9 (a-n)
and layer 8 (o-r)

Ban Chiang Hian: illustrations of rim types



RIM TYPES FROM LAYER 10 (a,b,e,f), 9 (c,d), 8 (g-k), and 7 (l-q), (SCALE 1:2)
a, BCH2d b, BCH15 c, BCH17 d, BCH20 e, BCH21a f, BCH23 g, MCSa h, MCSa i, MCSb
j, BCH27a k, MC class 2 type CC l, MC2h m, MCSa n, MCSa o, MCSb p, MCSb q, BCH10
Note: The stipple convention infers a plain finish, and black indicates red
painting or slipping.

FIGURE 12-4 Ban Chiang Hian: rim types from layers 10 (a,b,e,f)
9 (c,d) 8 (g-k) and 7 (l-q)



RIM TYPES FROM LAYER 7 (SCALE 1:2)

a, BCR27c b, BCR29 c, BCR33 d, BCR30 e, BCR13 f, NC8b g, BCR28b h, BCR27a i, BCR33
j, NC8c k, BTM l, NC class2 type CC m, NC class 1 type A n, NC5c o, BCR27b
p, BCR28 q, BCR32 r, NC8a

Note: The stipple convention infers a plain finish, and black indicates red painting or slipping.

FIGURE 12-5 Ban Chiang Hien: rim types from layer 7

Ban Chiang Hian: illustrations of rim types

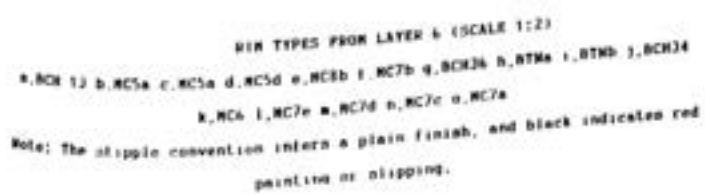
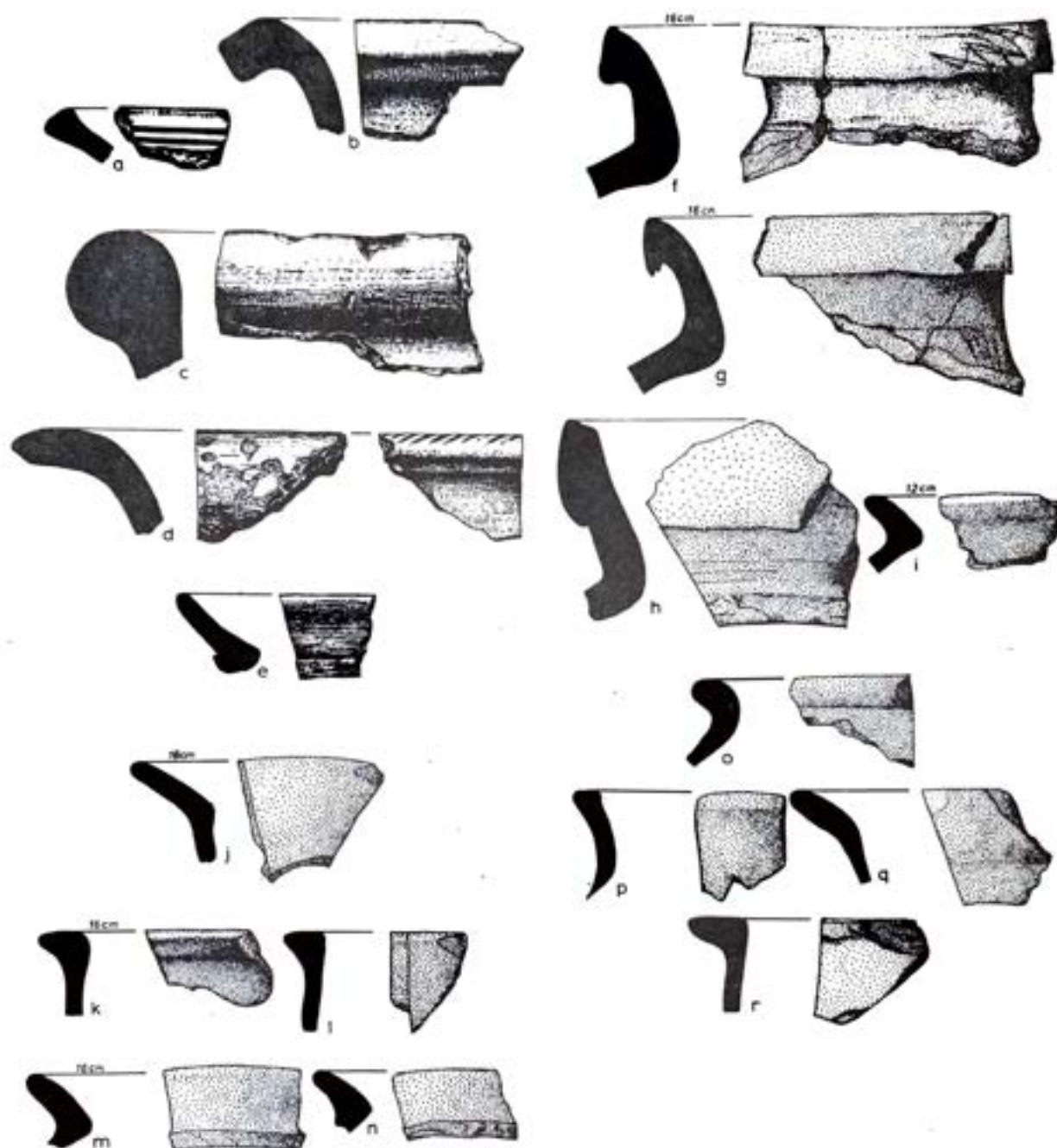


FIGURE 12-8 Ban Chiang Hien: rim types from layer 6

Ban Chiang Hien: illustrations of rim types



RIM TYPES FROM LAYER 6 (a-i), LAYER 5 (j-n) AND LAYER 4 (o-r). SCALE 1:2

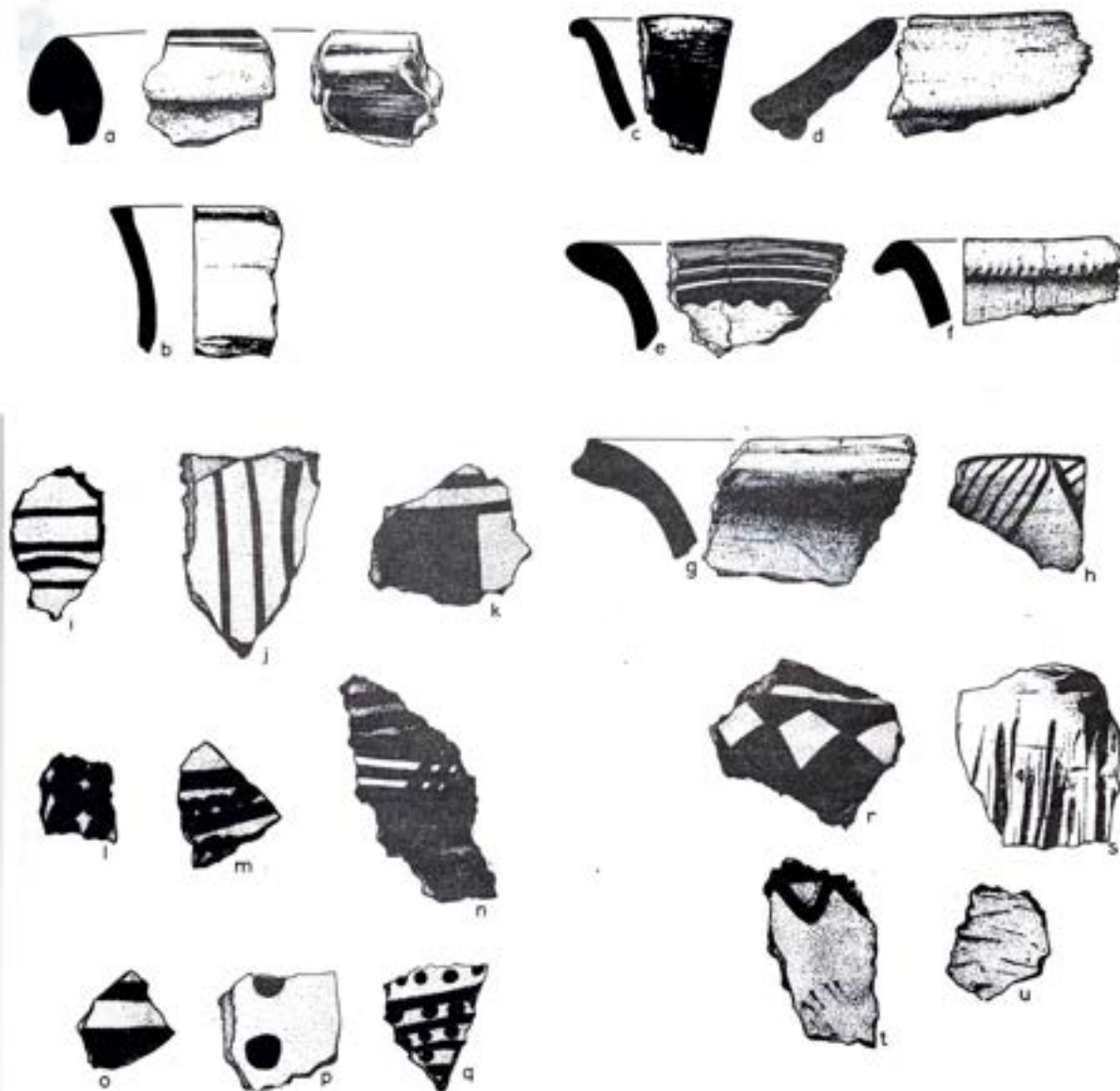
a, MC class 1 type A b, BCH35 c, BCH37 d, BCH38 e, BCH39 f, MC6 g, MC6 h, MC7a

i, MC9 j, BCH47 k, BCH48 l, BCH48 m, MC9 n, MC9 o, MC9 p, BCH46 q, BCH47 r, BCH48

Note: The stipple convention infers a plain finish, and black indicates red painting or stipping.

FIGURE 12-7 Ban Chiang Hien: rim types from layers 6 (a-i), 5 (j-n), and 4 (o-r)

Ban Chiang Hian: illustrations of rim types



RIM TYPES FROM LAYER 5 (a-b) AND LAYER 6 (c-g)
AND SURFACE FINISH TYPES FROM LAYER 11 (i-l) AND 10 (m-u),
SCALE 1:2

a, BCH45 b, BCH46 c, BCH40 d, BCH41 e, BCH42 f, BCH43 g, BCH44 h, WOH 801 design
i, 1a j, 1b k, 2 l, 3 m, 4 n, 5 o, 6 p, 7 q, 8 r, 9 s, 12 t, 17 u, 19.
Note: The stipple convention infers a plain finish, and black indicates red
painting or slipping.

FIGURE 12-8 Ban Chiang Hian: rim types from layer 5 (a-b) and 6 (c-g)
and surface finish types from layer 11 (i-l) and 10 (m-u) a, BCH 45

BAN CHIANG HIAN: THE BODY SHERDS

The body sherds from Ban Chiang Hian were considered with the same objectives as the rims. These were the establishment of a regional typology for the Middle Chi, and recognition of affinities with the material already described for the Upper and Lower Chi sites of Non Chai and Non Dua. The first stage in the analysis was to lay out the material by layer, and extract the rims, shoulders, bases and specimens bearing applique ornament. This was followed by subdividing the resultant body sherds into groups according to their surface finish. Further subdivisions were then made on the basis of thickness, decorative detail and fabric. Groups with particularly variable decoration, such as red-on-buff painted designs, were capable of still finer subdivision.

There was so much cord-marked and plain ware from some layers that lack of time ruled out a microscopic examination of the fabric for all specimens. In consequence, it was decided to use personal judgement in choosing which to examine in detail. This involved selecting any specimen which looked unusual, to consider the broad characteristics of the fabric, and to sample only 25% of the balance.

In placing sherds into a temper category, it was decided to employ only the most general criteria. Indeed, only five groups resulted. Of these, grog predominated. This comprises fragments of baked clay probably derived from crushed potsherds. Specimens of this group often included a few fragments of rice chaff. The second group, which is temporally restricted to the later levels, comprises specimens tempered with much rice chaff. A third group, also late in the sequence, comprises a thin white ware with no temper being visible under a low-powered binocular microscope. There are also groups in which clay was tempered with weathered, rounded grains of sandstone, and in which the clay incorporates sand which may or may not be deliberately added temper.

As with rims, it is clearly understood that the petrographic examination of fabrics requires specialised skills and that in fact, there are certainly far more groups of fabric than have been set out below. Identification of them will permit more detailed problems to be considered. Consequently, thin sections have been prepared for each identified type, and it is hoped that these will be analysed in due course.

As with the rims, 11 major layers were recognised. The assemblage found in the basal one, layer 11, was dominated numerically by plain, smoothed sherds with a grog tempered fabric. The grog comprises crushed clay, probably derived from potsherds, with the occasional presence of rice chaff. The most variable type of surface finish comprises sherds with red-on-buff painted designs. These have been subdivided on the basis of the painted motifs, but it should be remembered that where relatively large sherds have survived, more than one motif may be found in combination. Thus, specimens ascribed to types 1 to 9 may well have come from the same vessel, a situation supported by the presence of the same grog tempered fabric found in all pieces. The principles underlying the motifs employed, comprise combinations of parallel, red-painted straight lines which, to judge from the fine striations left by the surface smoothing, were vertically applied. Some however, were curvilinear and others were wavy. It is clear that some areas of the vessels bore cross-hatched panels, or bands where parallel lines were interspersed with

red dots (the range of motifs is set out in figs 12-8 i-r, 12-9 a-w, dd). Some sherds still bear the faint traces of cord-marking, though it is usually the case that any impressions made by a cord-wrapped paddle were subsequently erased by smoothing before the painted designs were applied.

Type 10 includes all sherds bearing all-over red slip or paint on the exterior surface only. There are some specimens within types 1-9, in which the red-painted designs give way to an expanse of red paint, again suggesting that the characteristic vessels had large areas of red paint or slip, and a relatively small panel of painted designs just below the neck body junction. This situation is supported by the fabric, which is common to types 1 to 10 inclusive. It is considered probable that body sherds falling into types 1 to 10 correspond to rim types MC 2 and 3.

The remaining types fall into two groups. The first (types 13-15) comprise sherds bearing cord-marked impressions. There is some variation in surface finish and thickness, but all have a fabric in which grog is the main tempering agent. The second, type 16, includes all those sherds which have a plain, smoothed outer surface and grog temper. These are numerically dominant.

The body sherds from layers 9 and 10 are very similar in finish and fabric, as well as in their frequency of occurrence, with the layer 11 assemblage. Only four new types were encountered, and all were rare. Type 17 (fig 12-8t), of which there are only eight specimens in level 10, was first cord-marked and then painted with a combination of straight lines and zig-zags. They were grog tempered. In the case of type 19 (fig 12-8u), the surface bears the impressions of a carved paddle, and the fabric includes some rice chaff. Type 20 was also paddle impressed, but the fabric includes grog with a few fragments of rice chaff.

In level 8, there is an apparently major change in the make-up of body sherd types when compared with the three preceding levels. Types 1-10, the red-on-buff painted wares, are now rare. The paddle impressed pottery (type 20) became much more abundant than in layer 9, and three new types appeared. The next type includes sherds which were burnished with single strokes probably to form a pattern. They are all grog tempered, and on the surface, look very like the black burnished pottery found in such quantities at Phimai (Solheim and Ayres 1979). As with the system of nomenclature for rims, these will be referred to as "Phimai Black". Type 21 was first cord-marked and then burnished. Only four specimens were found at Ban Chiang Hian, all from layer 8. Finally, type 22 is a plain ware containing much chaff temper. In considering the abundant plain and cord-marked grog tempered material (types 14 and 16), it is recognised that detailed petrographic studies would very probably lead to a considerable number of types based on different fabrics.

The red-on buff painted types continued to decline in layer 7, and disappeared in layer 5. The paddle impressed ware (type 20) which became relatively popular in layer 8, remained so. The ware reminiscent of "Phimai Black", was found fairly frequently in layers 6 and 7. The latter also yielded two specimens with smoothed-over surfaces to leave low parallel ridges. The surface was then painted with red bands. There are nine such pieces in layer 6 and one in layer 5. These are particularly interesting, because they closely resemble the so-called "Roi Et" ware so common at Non Dui, and dated by Higham (1977) to the local phase 2 (0-700 AD). Three other new types found in layer 7. One has a surface

with parallel, red burnished lines (type 23 fig 12-8t). The second comprises thick sherds (7-10mm thick) bearing smoothed cord-marking subsequently painted with red bands (type 24, fig 12-8u). There is also a red-slipped and polished ware. All were rare, the first two being confined to layer 7 and the last, recurring infrequently in layer 8.

Layer 8 itself contained a very high proportion of plain and cord marked wares in which the fabric was grog tempered. Nine new types were found, but all were rare. Type 26 is a thick ware with interior and exterior surfaces being red-slipped and the fabric, tempered with grog (figs 12-8co, 12-8x). There are ten specimens ascribed to type 27, which was painted on the exterior surface with parallel lines (fig 12-8y). Type 28, of which there are only two sherds in the entire assemblage, has smoothed over cord-marking painted with a line of red circles (fig 12-8z). The 52 specimens assigned to type 29 were pattern burnished as in type 21, but then painted with designs including red parallel lines (fig 12-8aa). Type 30 is represented by one sherd: it was horizontally smoothed, and then over-painted with a vertical red band which began straight and became wavy. The interior bore horizontal burnished lines. The next type is particularly interesting. It comprises a thin (2.5-7.0 mm) matt white ware devoid of any temper. While rare in layer 8, it became very abundant in layers 4 and 5. It also closely resembles the white ware so characteristic of phase three at Non Dua, and will be described as "Roi Et thin white". Type 31, found only in layer 8, was lightly burnished over the exterior surface. Finally, there is one most interesting specimen, the decoration of which precisely parallels the "Om Kaeo" ware found in abundance at Ban Chiang Hian during phase 4, and at Ban Na Di towards the top of layer 7 and in layer 8 (fig 12-8ee). The pottery from layers 4 and 5 reveal a sharp break from earlier traditions. Paddle impressed, "Phimai Black" and red-painted wares ceased being found, and their place was taken by many new types in which fabrics tempered with rice chaff became common. There are 13 new types in layer 5. In addition to the thin, untempered white ware, sherds with a very similar finish were found but they were distinguished by having a chaff temper. This type (no 32) was frequently found in levels 4 and 5. A new type of plain ware (type 39) came to predominate in these levels, being characterised by a smooth, matt surface and a fabric containing much chaff temper. Cord-marked sherds were never as abundant as the plain ones but again, those with chaff temper (type 40) were more abundant than those in which the fabric was tempered with grog.

Apart from three numerous types, there are nine new ones in layer 5 and a further ten were identified in layer 4. Type 33, of which there is one sherd only in layer 5, was red-painted, but has the distinctively late chaff temper. Both surfaces of type 34 sherds were red-slipped and polished, the temper comprising grog. Types 35 and 38 are cordmarked, and respectively grog or chaff tempered. They are set apart on the basis of their great thickness (13.0-25.0 mm). Type 37 has a plain surface and chaff temper, but again, attained considerable thickness (12.5-16.5 mm). Four specimens belong to type 38, which has a plain or possibly formerly incised surface, and a fabric containing inclusions of a rounded red stone. These may come from laterite or a weathered sandstone. Type 41 was cord-marked and then smoothed. The fabric lacks temper. The one specimen belonging to type 42 has the same white fabric as Roi Et thin white, but bears paddle impressions which match those found commonly at

Non Dua during phase three. Type 43 has a cord-marked and smoothed surface and chaff tempered fabric, while type 44 has a similar finish, but grog tempered fabric.

The numerically dominant types found in layer 5 continued to be well represented during the build-up of layer 4. There are also ten further types which occur only in the latter deposits. Type 45 again has cord marked impressions, but the fabric contains much sand. Only detailed petrographic analysis will show whether the sand was present naturally or as a deliberate additive. Sand as well as some chaff was also present in the fabric of type 46, the surface of which was cordmarked. The solitary specimen of type 47 has two impressed lines, close inspection of which reveals very fine meshed impressions resembling a fine fabric. Types 48 and 49 are made of clay containing much sand. The former was incised and the latter, plain. There are three specimens of stoneware (type 50). Types 51-54 are all decorated with red slip, and are distinguished on the basis of fabric. There is a solitary specimen of each.

THE APPLIQUE DECORATION FROM BAN CHIANG HIAN

A very small proportion of the pottery sherds from Ban Chiang Hian bore a band or strip of applied clay. To judge from the larger and better preserved pieces, this strip was applied horizontally round the upper part of the vessel's body. Such applique decoration was found on complete pots at Ban Na Di layers 8 to 8, and at Ban Chiang during Early Period d.

An important characteristic of the applied bands is their variability in terms of size, shape and manner of decoration. At all sites mentioned above, they were modified by a range of techniques, including finger pinching, jabbing or impressing. Since one objective of the present analysis is the establishment of successive typological phases, a review of the different type of applique decoration is clearly desirable.

Applique decoration from the basal layer at Ban Chiang Hian is found on plain, red-slipped and red-on-buff painted wares. On the basis of the moulding, four groups are recognised. Type 1 is restricted to the red-on-buff painted pottery, and comprises a raised ridge indented with shallow, ovoid depressions (fig 12-9gg). The second type is found on both plain and red slipped pottery. The applique band was, it seems, impressed with a regular series of depressions from a human finger, since in nearly all cases, finger prints are still visible (fig 12-10a). Type 3, which is found on red -slipped pottery only, was raised to a sharp ridge without any impressions (fig 12-9ff). The last type is found on only one specimen of thick, plain pottery and was raised to a point without any further treatment (fig 12-10b).

Type 2 applique, that with the finger-tip impressions, is the only type found in layer 10 (fig 12-10e-f). It is restricted to one plain, five cord-marked and 11 sherds with red-painted designs over a cord-marked and then smoothed surface. This type is also found on seven sherds of red-on-buff ware from level 9, and 29 cord-marked specimens from the same layer (fig 12-10c). In lesser frequencies, it was also applied to red-slipped and plain sherds. There are in addition, three types not found in the lowest two layers. Type 5, found only on red-slipped and

cord-marked sherds, is shallow and impressed with a sharp, broad implement. Type 6, also restricted to cord-marked and red-slipped pottery, has a higher profile, and was also jabbed at intervals with a sharp implement. The last new type (no 7), has a rounded profile, raised about 2 mm above the sherd surface (fig 12-10p).

Layer 8 saw three new applique styles, as well as examples of types 4 and 6. The former, type 4, is found only on one specimen of red-slipped ware, and was placed as a band c. 30 mm below the rim-body junction (fig 12-10j). Type 6, which is jabbed at intervals with a sharp implement, is found only on plain pottery. Type 8 is a departure from earlier ones, in that an instrument was run continuously over the band, and jabbed at intervals to create a ridged surface (fig 12-10m). This type is found on paddle impressed, plain and cord marked pottery. Type 9 comprises a band between 5-8 mm wide, bearing shallow oval impressions. It is found only on plain pottery (fig 12-10n). The last type (no 10) has a band raised about 4-5 mm from the sherd surface, together with jabbed impressions set at regular intervals about 2-3 mm apart. Only one specimen was found (fig 12-10o).

With layer 7, any form of applique decoration became extremely rare. In fact, there are only eight specimens. Types 6 and 9 are found on plain ware, and types 7, 8 and 11 are found on paddle impressed sherds (fig 12-10p). Type 11 has a broad (13.5 mm) band with human finger nail impressions (fig 12-10q).

There are only five sherds from layer 6 which bear applique ornamentation. One has been assigned to type 6, but the remaining four come from a new type (no 12, fig 12-10r-s). It is particularly large, standing between 5.5-10 mm from the sherd surface. The band was placed in the angle formed at the rim-body junction, and has large oval impressions probably made with bare fingers. Finally, layer 4 contained six sherds with a plain, raised band assigned to type 4 (fig 12-10t-u).

Ban Chiang Hian: analysis of the body sherds



FIGURE 12-9 Ban Chiang Hian: surface finish and applique types

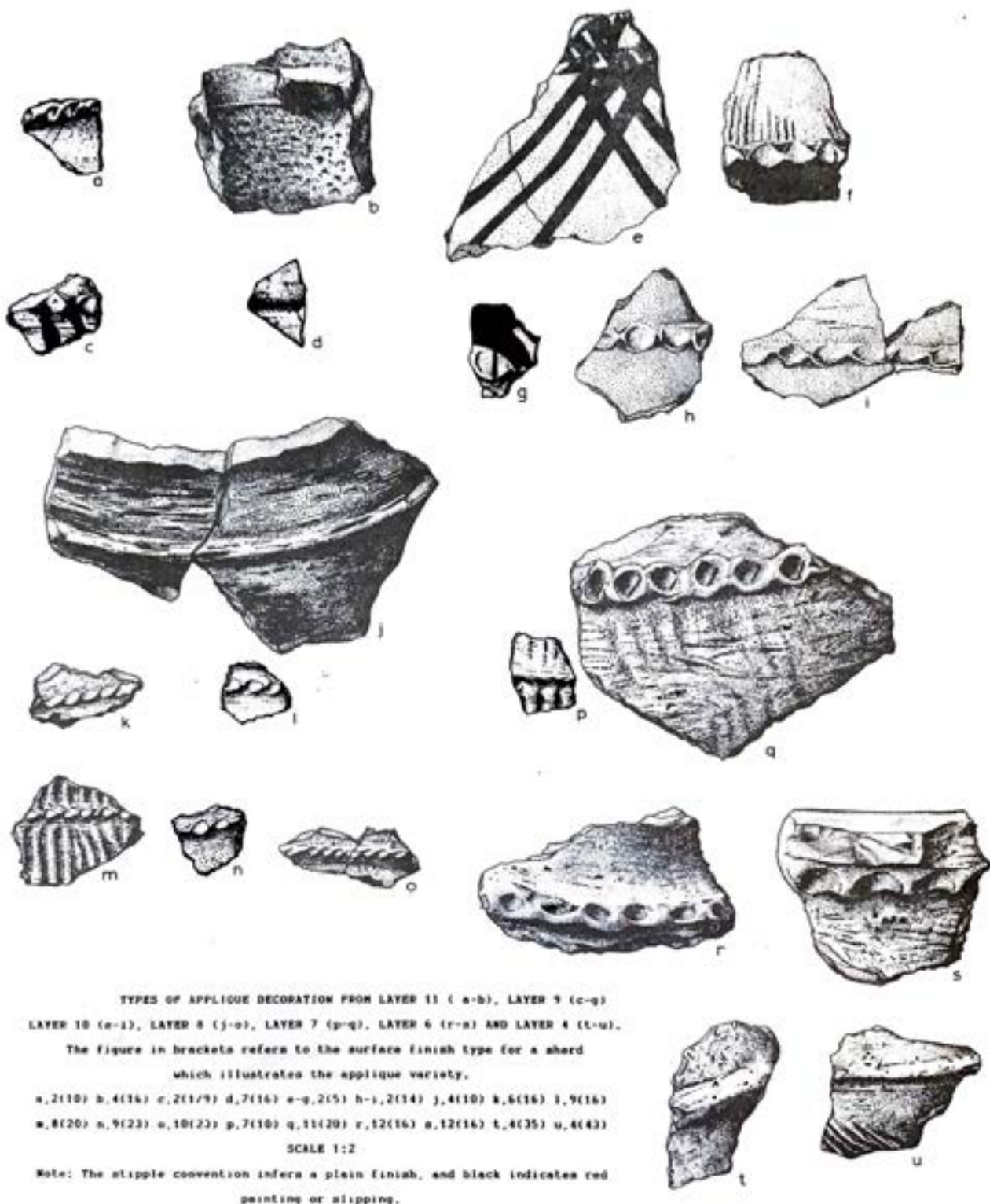


FIGURE 12-10 Ban Chiang Hian: types of applique decoration

CONCLUSIONS

One of the main aims of the analysis of pottery from Ban Chiang Hian was to identify instances where types changed significantly. If such changes were found, then the different groups could be assigned to ceramic phases. Such phases are seen as an essential part of future fieldwork strategies aimed at more sophisticated settlement pattern studies. They are also necessary in reviewing with more confidence, the surface pottery collected during the initial survey.

A common fault with earlier attempts at devising such phases in Thailand has been failure to appreciate what properly constitute ceramic types, and then lack of statistical rigour in assessing their relative frequencies. In this work, a type results from a consideration of form as well as fabric. Having sorted the sample into such types, it is not difficult to select intuitively those parts of a sequence which display the clearest evidence of change. In order to add some objectivity to the establishment of such phases, the following steps were taken.

Firstly, the actual number of rim types in all layers was subjected to a cluster analysis of cases. The results are set out in fig 12-13, which in effect, represents the degree of similarity between the different level assemblages. As may be seen, the program links layers 9, 10 and 11 together, as well as layers 7 and 8. The rims from layers 4 and 5 are linked at a rather low level only. The actual values for the distance between cases are set out in table 12-1. The results of the cluster analysis reveals the probable presence of three groups, which conform precisely with their known chronological relationships.

TABLE 12-1

Ban Chiang Hian: the mean square contingency coefficients
between layer assemblages

LAYER	11	10	9	8	7	6	5	4
RIMS	0.38	0.53	0.90	0.44	0.55	0.76	0.56	
BODY SHERDS	0.14	0.23	0.45	0.18	0.41	0.74	0.33	
BODY SHERDS (less plain)	0.23	0.27	0.63	0.23	0.56	0.92	0.32	
BODY SHERDS (less plain & cordmarked)	0.25	0.29	0.76	0.31	0.70	0.97	0.28	

In order to enquire further into the possible presence of ceramic phases at Ban Chiang Hian, the same cluster analysis was applied to the number for each type of body sherd per layer. The results confirm the

distinctiveness of samples from layers 9-11, and 4-5. The samples from layers 7 and 8 are also very similar, but layer 8 appears more distant. It should, however, be remembered that a considerable proportion of body sherds fall either into the plain or cord-marked categories (types 14 and 16). These sherds would surely be subjected to finer subdivision if detailed mineralogical studies were undertaken. It was therefore, decided to analyse the body sherds further by first removing the sample of plain ware, and secondly after removing both the plain and the cord-marked wares.

Removal of the plain wares, as expected, accentuates the differences between layers, the most intense change lying between layers 8-9 and layers 5-8. The same trend accompanies the further removal of cord-marked pottery, the difference between layers 5 and 8 now rising to 0.97 out of a maximum of 1.00. That between layers 8 and 9 rises to 0.78. These differences are reflected in the style and distribution of the applique bands.

It is therefore, proposed that three successive phases be recognised. The first includes the rim and body sherds which characterise layers 9-11. These are predominantly red-on-buff painted, red-slipped and grog-tempered plain wares. With phase 2 (layers 8-8), carved paddle-impressed pottery and a new set of rim forms are particularly diagnostic. With phase 3 (layers 4-5, chaff tempered plain ware and thin white pottery were particularly common. Whereas phase 1 and 2 wares are largely confined to the survey area, those from phase 3 are very similar to phase 3 wares at Non Dua. Towards the end of phase 2, the Ban Chiang Hian assemblage included a few specimens with clear parallels at Non Chai, Non Dua, Phimai and the Ban Chiang area. In all cases, the dates fall into the period c. 300 BC-100 AD.

Ban Chiang Hien: analysis of pottery surface finish

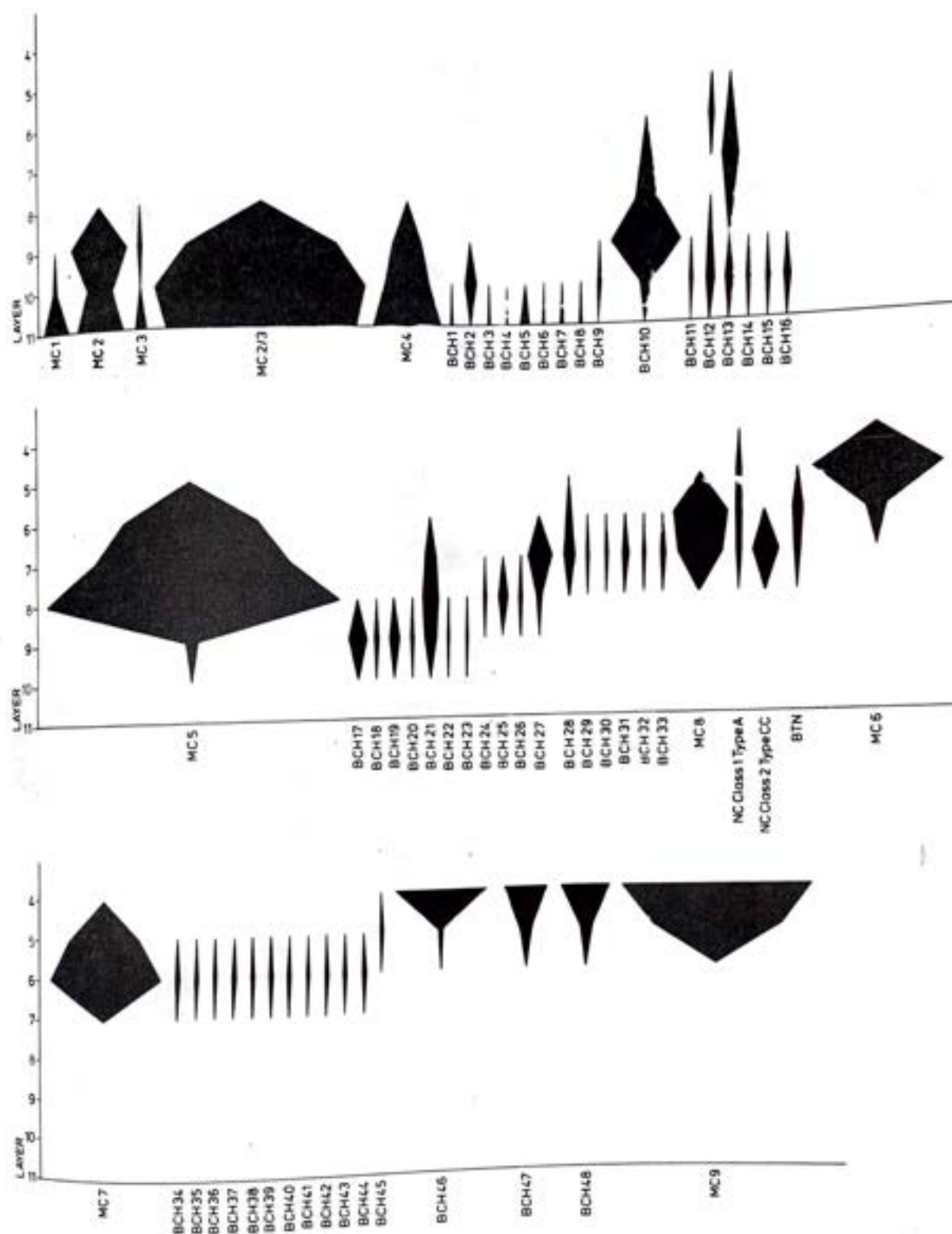


FIGURE 12-11

Ban Chiang Hien: the percentage frequencies of rim types per layer

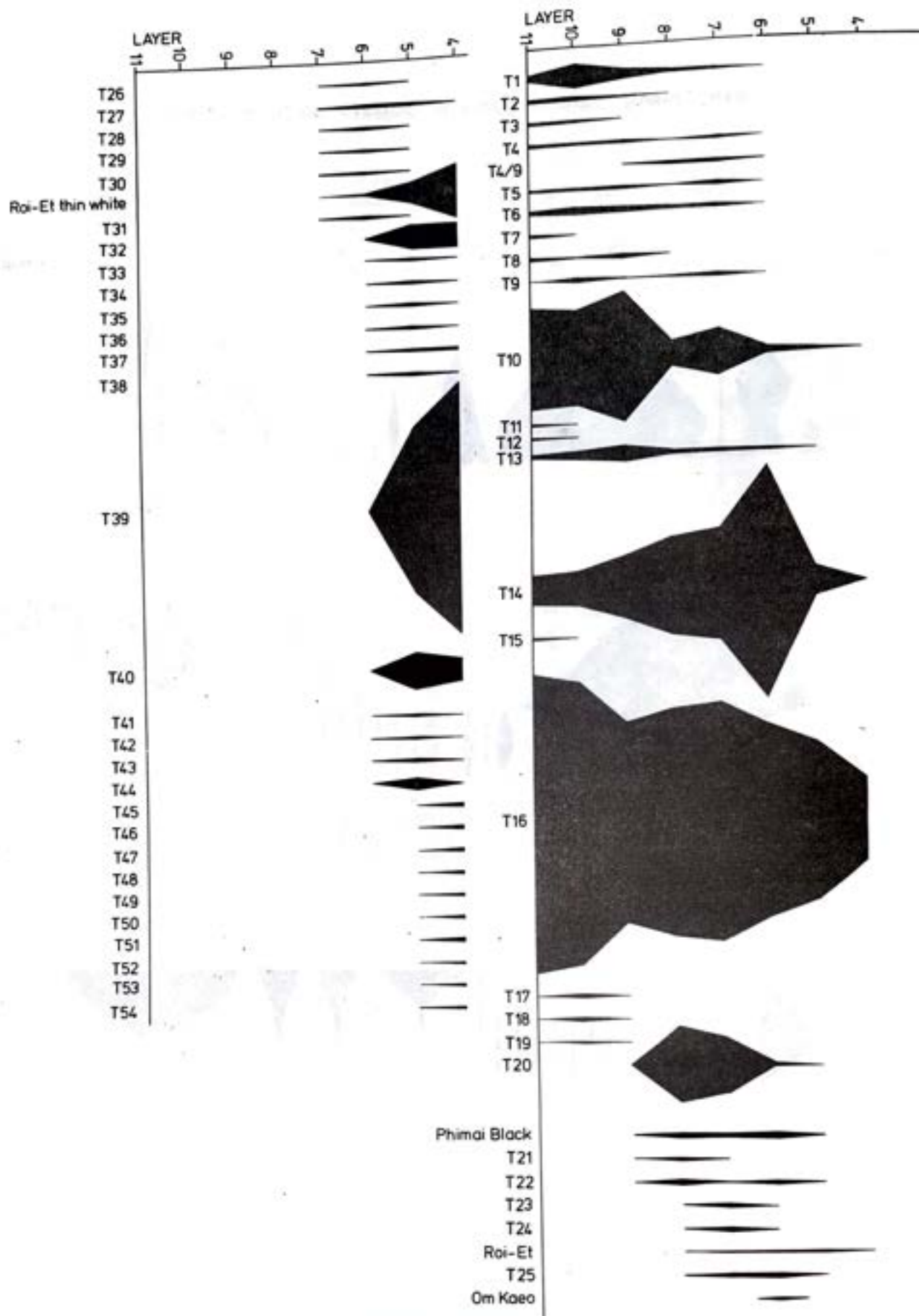


FIGURE 12-12

Ban Chiang Hien: the percentage frequencies of surface finish by layer

Ban Chiang Hian: analysis of pottery surface finish

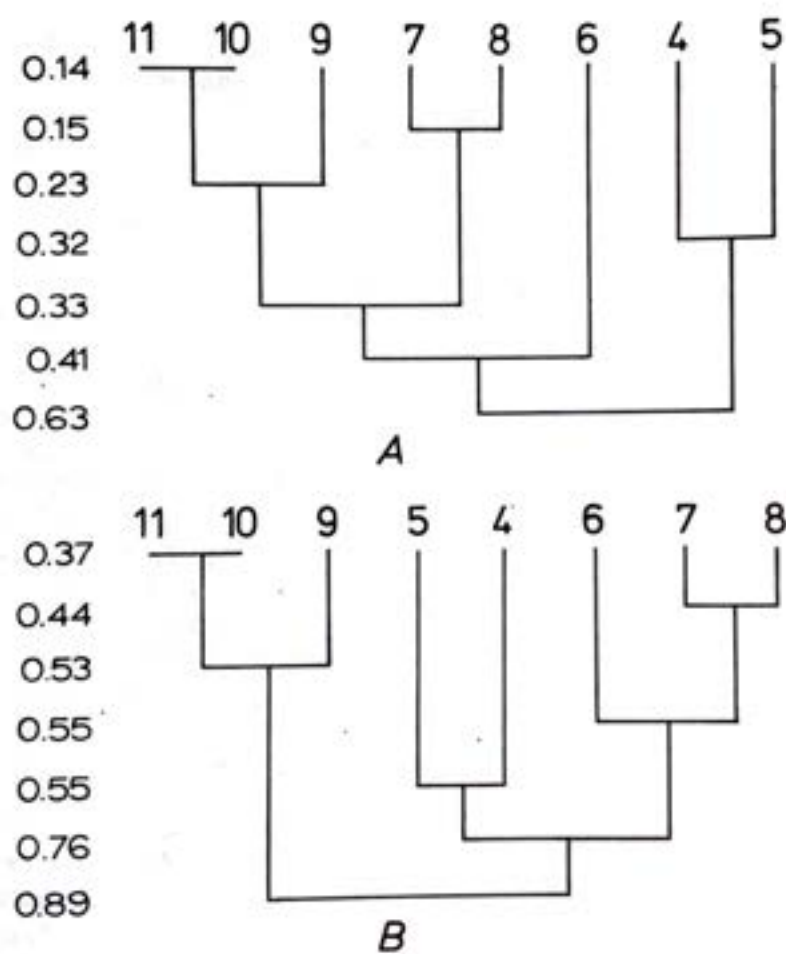


FIGURE 12-13

Ban Chiang Hian: cluster diagrams for A. body finish and B. rim types per layer

CHAPTER THIRTEEN

THE MIDDLE CHI AREA: THE SETTLEMENT PATTERN

In their preliminary report on the Middle Chi site survey, Kijngam *et al.* (1980) considered two main questions. The first was concerned with site size and the possibility of a site hierarchy. They subdivided the sites into two broad groups: historic and prehistoric. The former was distinguished by stoneware, and the latter by the presence of pottery assumed to be of prehistoric origin. The excavations at Ban Chiang Hian, and analysis of pottery from all three excavated sites has made it possible to establish regional phases on the basis of pottery typology.

This chapter will consider issues not covered in the earlier report. Clearly the added knowledge gained from the excavations makes it necessary to review the dating of individual sites initially labelled prehistoric on the basis of field impressions only. The second is the relationship between prehistoric sites and soil types. This will be considered along rather different lines than earlier, while some attention will be given to site territories.

At least three ceramic phases have been identified on the basis of the rims and body sherds from Ban Chiang Hian. All the surface assemblages recovered during the 1980 site survey have been compared with the diagnostic specimens. The results are disappointing for anyone wishing to trace changing prehistoric settlement patterns on the basis of such surface collections. Thus in Mesoamerica, Sanders *et al.* (1979) and Blanton (1978) have dated sites by analysing potsherds recovered from ground surveys, and used the information gained to trace the settlement history of their regions. If this same approach were applied to the Middle Chi area, results would bear little relation to reality. This situation is best illustrated by referring to the distribution of Middle Chi phase I pottery in surface collections. It will be recalled that this phase has very distinctive grog-tempered red-on-buff painted pottery. All those excavated sites revealed this ware. At Ban Chiang Hian and Ban Kho Noi, it was found stratified over 5 m below the present ground surface. This situation was not known when surface collections were made. It is, therefore, interesting to note that no phase I pottery was found in the surface collections at either site.

At Ban Chiang Hian, the diagnostic surface material almost entirely comes from types which belong to the latest prehistoric phase. The same situation was found for Ban Kho Noi. This is not surprising, in view of the depth below the ground surface of levels containing the phase I pottery sherds. The situation is different at Non Noi, because the mound there had been severely eroded by river action, and in any case occupation was practically restricted to phase I. Therefore, the surface collection, which stood out during and after the survey for its unusual red-on-buff painted style with grog temper, almost exclusively comprises phase I wares. Site 194 was also found in a severely eroded condition and it too yielded small fragments of red slipped ware as well as a whole vessel from a looted grave. This material has affinities with phase I pottery found at Ban Chiang Hian.

The remaining sites classified initially as prehistoric remain in this category on the basis of a re-examination of the surface collections. Yet, apart from Non Noi and site 194, in no case could the pottery be ascribed with confidence to any phase other than the latest. The few diagnostic rims found are also invariably late in the prehistoric sequence. No surface sherds bore applique bands. These were very rare in the latest prehistoric material.

Uncritical interpretation of the survey data could lead to the conclusion that the phase I sites tend to be found in the tributary valleys, and that later prehistoric settlement expanded into the margins of the Chi Flood Plain. Excavations at Ban Chiang Hian and Ban Kho Noi however, show that this would be untrue. Even the tiny 1 m wide exposure at the latter site revealed a deeply stratified and sealed phase I occupation level.

Without much more excavation, it is not feasible to establish chronological changes in prehistoric settlement patterns. There are however, at least one and possibly two sites along the tributary streams which do appear to have been occupied only during phase I and it is most unlikely that all the remaining sites were occupied at the same time. Because of this situation, it must be asked whether further analyses of site location are justified. Rather than terminate further discussion, some consideration will be given to the location of prehistoric sites. This is undertaken in the knowledge that no conclusions on changes in settlement patterns with time are yet possible. The following preliminary steps have been taken to identify factors which may have influenced the location of prehistoric settlements. In the first place, the Middle Chi area has a series of different types of soil. These vary considerably in their capacity for rice cultivation. Soil types are taken from the Thai soil surveys of Mahasarakham Province. Type 2 is suitable for rice, but prone to flooding. In the Middle Chi this is the soil found on the Chi Flood Plain. Type 3 is the soil of the low alluvial terrace. It has a high water table, low permeability, gentle slope and is suited to rice cultivation. The soils which fall into types 4 and 5 are not favourable to rice cultivation because, being located on the middle terrace, they are generally too dry. Their elevation and dryness however, are attractive for the location of settlement, provided there is immediate access to reasonable soil for rice cultivation. This situation reflects the advantages of flood protection.

Some insight into prehistoric settlement preferences, would, therefore, be obtained if it could be demonstrated that there was selection for a particular soil or combination of soil types. Therefore, the area of different soil types within a one and a three km radius of the presumed centre of each prehistoric site was calculated. The actual figures (table 13-1) were obtained by using the digitiser facility of the University of Otago Geography Department. The same technique was used to obtain comparable data for the same number of points chosen at random. The latter points were selected by first assigning sequential numbers to each 1x1 km square in the standard 1:50,000 maps of Thailand, then choosing numbers by random means and taking the centre of each square selected. This procedure differs from that used in the preliminary report of the site survey. Firstly the precise values of each soil type were calculated, rather than estimated. Secondly, the data computed for circles centred on each site rather than squares with an area of 9 km².

The Middle Chi area: the settlement pattern

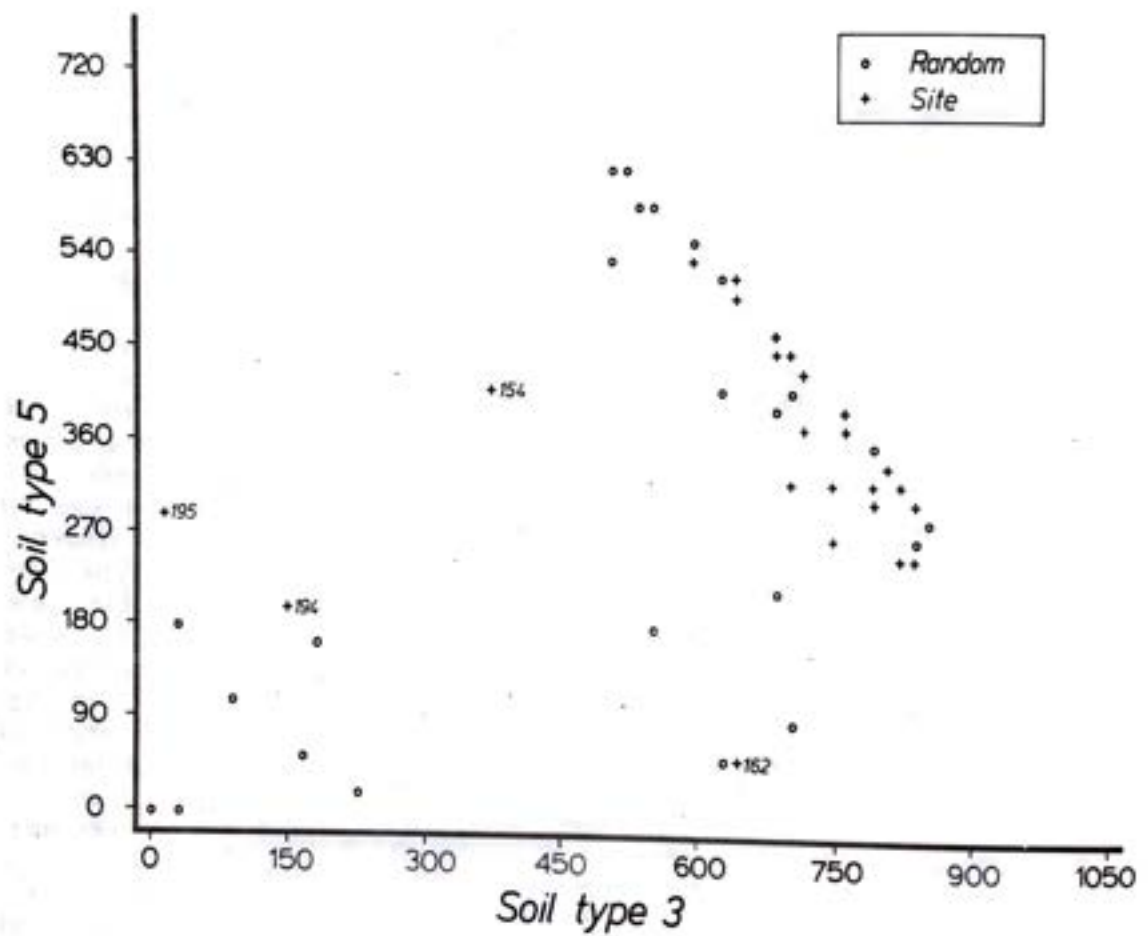


FIGURE 13-1

The relationship between sites and soil frequencies
in the Middle Chi area

The Middle Chi area: the settlement pattern

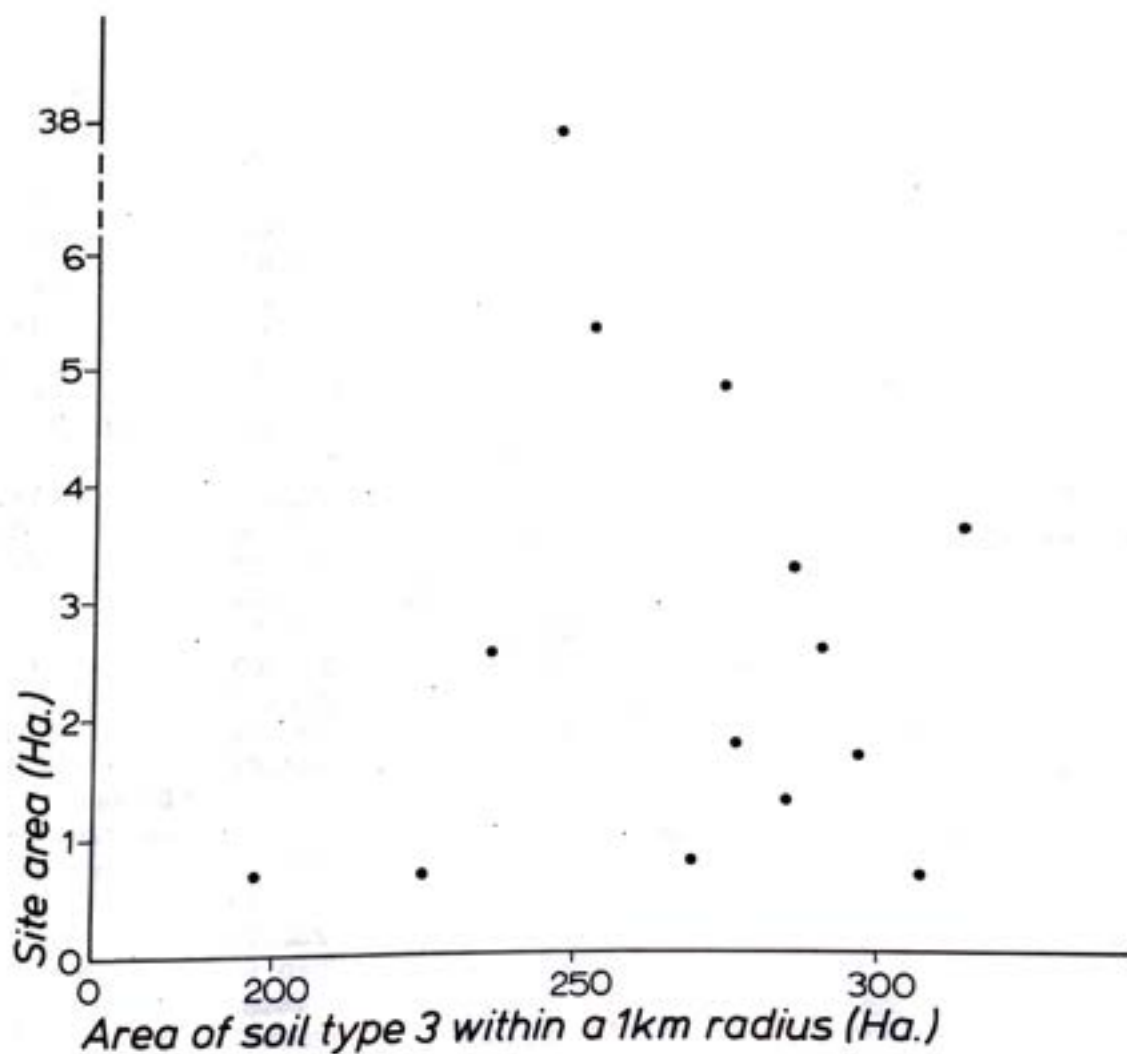


FIGURE 13-2

The relationship between site size and catchment productivity
in the Middle Chi area

The Middle Chi area: the settlement pattern

TABLE 13-1

The Different amounts of soil types within one
and three km radii of prehistoric sites

Site No.	Area of soil type: 3 km radius				Area of soil type: 1 km radius			
	Soil Type							
	2	3	4	5	2	3	4	5
142		1829.52		997.9		314.15		
143		1746.25		1081.18		285.47		28.68
144		1769.09		1058.34		286.67		27.48
145	11.16	1798.03	1018.24			307.04		7.11
146		1665.16		1162.27		135.78		178.37
147		1427.58		1399.85		196.79		117.36
150		1691.17	23.20	1113.06		224.63		89.52
151		2032.09		795.34		251.69		62.46
154		867.45	952.99	1006.99		129.26	65.49	119.40
158	95.13	1788.45		943.85		291.22		22.93
159	211.11	1790.27		826.05		235.25		78.90
160	257.73	1794.26		775.44		297.28		61.87
161	188.54	2003.08		635.81		246.99		67.16
162	1236.10	1427.85		163.48	60.20	253.95		
164		1477.76		1349.67		218.07		96.08
174		2024.82	186.09	616.52		252.90		61.25
182	387.88	1709.00		730.55		277.12		37.02
183	362.26	1655.10		810.07		226.15		88.00
186	152.35	1788.88		886.20		180.82		133.33
194		446.64	1840.57	540.22			291.80	22.35
195		53.60	2047.83	762.00			269.77	44.38
202		1542.91		1284.52		255.57		58.58
204		1643.06		1184.37		274.74		39.41
205		1788.78		1038.65		252.27		61.88
206		1582.55		1204.88		240.02		74.13
209		1626.45		1200.98		244.85		69.30
210		1653.73		1173.70		235.73		78.42
mean	107.49	1578.65	224.77	916.37	2.23	226.46	23.22	63.90

The following data record the percentage of soil types within the
same radii for squares chosen at random

13		28.89	1758.18	1042.56		266.28	47.87
21	2185.72	502.59		159.12	314.15		
25		106.82	2197.08	523.53		312.70	1.45
44		269.55	2245.00	312.88		306.42	7.73
65		494.57	1954.41	378.45		12.36	238.54 63.25
129	2700.37	107.81		19.25	314.15		
151	2083.74	681.34		62.35	314.15		
161		1376.33	76.69	1374.41		116.34	197.81
164		1479.58		1347.85		152.04	162.11

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174		1200.39	1101.18	525.80		224.34	75.38
201		1753.05	911.97	182.41	238.77	75.38	
221		1827.05		1200.38		231.91	82.24
231	2827.43					314.15	
296		1598.82		1228.61		141.99	172.16
325		2068.17		759.26		65.86	248.29
371		1573.61		1253.82		151.59	162.56
383		1363.00	214.58	249.85		93.70	35.81 184.64
386		1830.38		997.05		271.20	42.9
408		1584.42	84.89	1178.12		277.39	36.76
422	933.59	1809.63		284.21	46.83	262.77	4.55
442		1470.93		1356.50		38.69	275.66
486		1249.11		1578.32		205.44	108.71
493	631.33	1692.39		503.71	42.30	192.27	79.58
515	31.89	2005.14		790.40		280.45	33.70
532		1337.12		1490.31		121.50	192.65
537		1859.15		968.28		237.07	77.08
540	128.38	2112.37		588.68		192.60	121.55
573		1592.29	8.54	1226.60		216.46	97.69
mean	410.80	1234.01	376.88	770.03	58.68	123.88	55.17 75.88

the final line gives the soil distribution for the entire survey area

9096.55 32075.84 4024.84 18176.40

Note that it has not been possible to estimate the soil values for site 190 due to the effects of flooding by the Aeng reservoir

The radii of 1 and 3 km were chosen because it was felt that the most intensive agricultural activity before wheeled transport would probably have occurred within 1 km of the settlement, while some activities, such as feeding domestic stock as well as some rice cultivation could have occurred at least up to 3 km distant.

The objective of taking the areas for different types of soil within a given radius of a site, is to determine whether or not prehistoric settlements exhibit preference for a particular soil or combination of soil types. Statistical analysis may be undertaken on the basis of the actual or transformed data. It was decided to subject the soil area data to a stepwise discriminant function analysis using three different soil figures. The first was simply the soil configuration within 1 km of the site centre. The second was based on the area of different soils within a region between 1 and 3 km from the centre of the site ("the peripheral area"), and the last was the area weighted such that the value of soils within the inner 1 km circle was multiplied by a factor of three ("the weighted area"). The rationale for these figures lies in the assumption that prehistoric people exploited the area closest to their settlement more intensively than peripheral terrain.

The mean areas of soils, both for prehistoric sites and random points, are set out in table 13-1. It is assumed initially that sites do not display preference for any particular soil. If this is so, then the distribution of soils for random and actual sites should be similar. This

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hypothesis was tested by the application of first a stepwise discriminant function analysis and then a non-parametric Mann Whitney test. The former analysis identified one variable as being sufficient to discriminate between squares and random points. It is the area under soil type three, and the preference of sites for this soil is so marked, that on its basis, the discriminant analysis correctly identified 23 out of 27 prehistoric sites when the area of 1 km radius was considered. This rose to 24 out of 27 sites for the weighted data.

This apparent rejection of the nul hypothesis was further considered with the Mann Whitney test. The observed differences for the soils 2, 4 and 5 for the weighted data were not significant ($P=0.05$). There was however, a significant difference for the soil type 3. It is most interesting to find that soil types 2, 4 and 5 within a 1 km. radius are similar between random and site areas, whereas for soil type 3, the difference is highly significant. This situation contrasts markedly with that for the outer periphery, where soil distributions for sites and random points fail to reveal significant differences.

It is therefore, concluded that prehistoric sites are significantly clustered near soils of type 3. This situation is represented graphically in fig 13-1, where the weighted values for soils of type 3 and 5 (the two most abundant) are represented both for sites and random points. The clustering of prehistoric sites contrasts markedly with the more scattered nature of the random distribution. Four prehistoric sites appear as exceptions however. Site 154 has much peripheral soil type 4. No. 182 is near the edge of the Chi Flood Plain, and type 2 soils are common there. The remaining two sites were considered anomalous even in the field. Both have evidence for one or two burials, but surface sherds were for all intents and purposes, absent. The former was heavily eroded, and there was no evidence there for occupation, at least expressed as concentrations of potsherds.

The basic assumption of site territory analysis is that the characteristics of the soils within a given radius of a prehistoric site provides information relevant to assessing the economy of the inhabitants (Higgs and Vita-Finzi 1972). It is however, important to consider each site or group of sites on the basis of specifics rather than as a centre simply of different types of soil with different capacities. It is a statistically significant fact that prehistoric sites in the Middle Chi are preferentially located near soils of the low terrace. Such soils are today invariably under cultivated rice. There are therefore, strong *prima facie* grounds for concluding that rice agriculture was a determinant in the choice of settlement during prehistory. This is supported by the discovery of rice chaff as a tempering material in prehistoric pottery. The data, however, do not disclose the method or methods of rice cultivation and these are of considerable significance.

There are three principal techniques of rice cultivation, each having its own constraints and potential. These have been summarised by Hanks (1972), and are respectively shifting cultivation, broadcasting and transplanting. The first entails the clearance of natural vegetation and creation of temporary fields. Yields may be high initially, but soon decline. Shifting cultivation involves little capital equipment, much labour in ground clearance and variable yields as soil fertility declines. Broadcasting requires land prone to flooding. Floodwaters introduce fresh nutrients to the soil, so land can be used practically without any breaks. The soil is

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improved by ploughing and harrowing, though field preparation by hoeing and or puddling with domestic stock can be undertaken. Above all else, broadcasting depends on tracts of land which receive predictable, but not severe, watering.

Transplanting requires a nursery from which rice seedlings are uprooted and placed in prepared fields. A further technique which is today closely linked with transplanting, involves the creation of banked fields to retain water, its flow between fields being regulated by opening and closing culverts. This retention of rainwater in fixed fields rather than reliance on natural flooding, means that the rice fields can be expanded to cover any terrain which includes water-retentive soils and which receives sufficient rainfall.

Hanks (1972) has shown that broadcasting today requires more labour input than swidden agriculture but less than transplanting. With each increase in labour input, per-area yields also increase and their variability falls. Geertz (1963) has shown that cultivation in fixed fields can sustain a much denser population than either of the other techniques, not least because the area under rice increases with terracing or bunding, and yields are usually heavier.

There is at present no evidence for or against the practice of any one of these techniques in the Middle Chi area. It is however, possible that some inferences may be made on the basis of the location of prehistoric sites. The distribution of villages today, covers several different soil types. There is a network of sites on the former Chi Flood Plain, where fields are protected from flooding by the Chi control banks. Settlements also found along the tributary stream valleys, where the formerly flooded areas are now covered by a network of embanked paddy fields. It is also important to note, that modern settlement has extended over the slightly elevated terrain between the main tributary streams, where bunded fields reliant on rainwater are necessary for rice cultivation and domestic water is supplied from wells.

It is clear that where agricultural sites are located some distance from riverine areas prone to regular flooding, then some form of water control in fixed fields is probable. On the other hand, close proximity to the margins of river valleys could have sustained either floodwater or the fixed field cultivation, or a combination of each. When we turn to the Middle Chi settlement distribution, it is clear that the tributary stream valleys were chosen for locating sites. Sites were also found along the southern fringe of the Chi Flood Plain soils (type 2). This is the area which van Liere (1980) has described as the classic back swamp terrain, which would probably have experienced a "gentle flood regime". The abundant shellfish from the base of Ban Kho Noi, a site now remote from a stream, do suggest the presence of swampland nearby in prehistory.

Although the Chi River and its tributaries do not regularly flood, there are solid grounds for concluding that this is only a recent development. Firstly, the Chi River is now embanked to retain water. Secondly, the widespread creation of embanked rice fields retains water in fields rather than allowing it to flow downstream into the Chi. It is possible that flooding of a swollen Chi River would cause its tributaries to fill, back up and in turn, break their banks (White 1982a).

The location of Chi Valley sites does reveal a preference for areas near which flooding was a likely occurrence. While it is not possible to determine whether rice was broadcast or transplanted, or whether bunded

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fields were developed, it is held that the focus of attention should not be solely on the raw data of soil distribution within a given radius, but rather the area of land particularly prone to regular transgression by floodwater. This area will clearly vary with the depth and aspect of the river's flood plain. In the case of the survey area, it was probably very extensive, since the land adjacent to the river is broad and flat. For streams with a narrow belt of flatland however, the area was probably relatively narrow. For example if a 100 m belt either side of a 1 km length of stream were regularly available and used for rice cultivation then the available area would comprise 20 ha. The soils of the remaining 294 ha within a 1 km radius of the site would not be relevant at least as far as rice growing was concerned, unless of course, the area under crops was increased by bunding and field creation.

If it is assumed that c. 20 ha is even approximately near the real figure, what are the implications for the prehistorian? This very question has recently been considered by MacDonald (1980), when reviewing Higham and Kijngam's (1979) summary of the Ban Chiang Hien faunal spectrum. He assembled certain basic figures. The first is, that prehistoric sites in Thailand supported about 100 people per ha. The second concerns individual food requirements. He concluded that an individual requires one ton of rice per annum. Regarding rice yields, he assumes 1.5 tons per ha. Finally, he quotes a verbal communication from Gorman that Ban Chiang, even in its earliest occupation phase, covered approximately 20 ha.

These figures, if correct, suggest that early Ban Chiang had a population of 2000 people, needing 2000 tons of rice a year, which could be derived from the cultivation of 1330 ha. Since the cultivable area within a 1.5 km radius for Ban Chiang is calculated as only 287 ha by MacDonald, there was either a serious food deficiency or Ban Chiang received rice supplies under a tribute system from dependent settlements. Such is MacDonald's evidence for the existence of a chiefdom in Northeast Thailand by 1500 BC.

MacDonald gives no references for his figures, but there are several grounds for suspecting their accuracy and in consequence, the validity of his conclusions. With reference to rice yields, Hanks (1972) has summarised the available data for Southeast Asia, and his table recalculated into metric values, is as follows:

TABLE 13-2

The yields of rice per ha under different methods of cultivation

Mode of Cultivation.	Yield (kg / Ha)	
	average	range
Shifting	1449.4	741.0- 2272.4
Broadcasting	1333.8	790.4- 4843.6
Transplanting	2188.3	494.0- 643.6

(1 ton = 1016 kg)

The figures show very wide variation, and it is felt prudent to take the minimal figures when applying yields to prehistoric contexts. Hanks (1972) has also assembled data which suggest that the average per-capita consumption of rice in lowland Southeast Asia is about 1.1 lb of rice a day (0.49 kg/day or 179 kg year). This figure is only 17.6% of MacDonald's unreferenced claim for 1016 kg per year. MacDonald's estimate of 100 people per ha is extremely high when compared with even present day Northeast Thai villages. Half that density, as argued for below, is also probably on the generous side. Finally MacDonald's figure of 20 ha for early Ban Chiang is very wide of the mark. In fact the maximum area which has yielded evidence for prehistoric occupation is approximately 5.5 ha.

Although such exercises tend to rely as much on faith as judgement, it is considered necessary to examine the data available using more reliable variables than those advanced in MacDonald's study. The first issue is, how many people could be sustained by the product of a given area under rice? Secondly, how many people under varying techniques, would be needed to cultivate such an area? The next question, and one which cannot at the present be answered, is the size of communities which could be sustained by various available areas, types of soil and techniques of cultivation. If we take the minimum yield from broadcasting, 20 ha would yield 15,800 kg of rice annually. Hanks (1972) has further recorded that the average annual consumption of rice is 179 kg. Consequently, the 20 ha area could sustain 88 people.

Of course, such figures are only the most general approximations. The faunal spectra of prehistoric sites in Northeast Thailand reveal that domestic stock were maintained, shellfish were collected and fish, trapped. The figure of 88 people is, however, an interesting basis for some further calculations. On the basis of five to ten people per household, it would suggest between eight and sixteen houses in a village. The raw data assembled by Hanks for labour input under broadcasting suggest that between 35 and 80 man-days are required to cultivate 1 ha. For 20 ha therefore, between 700 and 1200 man-days would be necessary. Each of 30 people (assuming one third of the 88 people of a presumed village community worked in the fields) would therefore be committed to up to 40 days agricultural work per annum.

At first sight, this seems a very low input. It must however, be remembered that the figures assume the use of a buffalo-drawn plough, and exclude any time spent in making and maintaining agricultural implements. Moreover, the figure should be set not against the whole year, but rather against the part of the wet season spent in agricultural tasks. During the periods of field preparation and harvest, and without the aid of a plough, it is most unlikely that a settlement of just under 100 could cultivate as much as 20 ha.

Without more basic data, we are clearly entering a position of circular argument. This includes a realistic estimate of settlement size and population, and the methods used in cultivating rice. No excavation in

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Southeast Asia has yet provided even the barest information on population numbers. We do, however, have some extremely rudimentary information on settlement area. Thus, the excavation squares at Ban Chiang reveal a site area of 4-6 ha. The 14 measured sites in the Middle Chi survey area (excluding Ban Chiang Hian) covered between 0.7 and 5.4 ha, with an average of 2.3 ha.

How many people could have lived in an area of say, 2 ha? Modern Northeastern Thai villages comprise fairly widely spaced stilt houses, with lanes, rice stores and food trees taking up much space. Estimates for Ban Chiang Hian and Ban Na Di (Khon Kaen) reveal a figure of c. 15 households per ha, with a household having between five and ten occupants.

The resultant population figures per ha are probably a little high, given the comparative data from Ban Na Di (Khon Kaen Province) and Ban Chiang. The former has a population of 800-1000 people in 23 ha (35-43 people per ha) and the latter, 4500 people in 75 ha (60 people per ha). For the sake of argument, let us take a figure of 50 people per ha. This is not too different from estimates made for rural Mexican settlements (see Sanders *et al.* 1979:39). These are as follows:

1. Light occupation, 5-10 people per ha
2. Light to moderate occupation, 10-25 people per ha
3. Moderate occupation, 25-50 people per ha
4. Heavy occupation, 50-100 people per ha.

If this figure were applied to prehistoric villages in the Middle Chi survey area, then populations of between 35 and 270 people could have been in question. Again, were rice a substantial part of their diet, between 17 and 62 ha would have been required. For the assumed population of Ban Chiang Hian 449 has would have been necessary (table 13-3).

TABLE 13-3

The relationship between rice consumption and population

	n people	rice consumption per year (kg)*	ha needed
Smallest village	35	6370	8.0
Largest village	270	49,140	62.0
Ban Chiang Hian	1950	354,900	449.0

*(Assuming an average consumption of 179 kg of rice per annum and yield of 790 kg/ha)

It is self-evident that, where a settlement was occupied for several centuries if not millennia, the population would have fluctuated. The figures produced above do emphasise a critical need for area excavations to furnish necessary population data. Is it possible to make any useful conclusions? If the minimal figures of village size and population are anything like reality, then the settlements covering 0.7 to 5.0 ha in the interior tributary stream valleys could have produced sufficient rice for survival from a 200 m wide strip of flooded river flat never more than 200-1500 m from the bank closest to their settlement. The same is true of small settlements clustering along the edge of the Chi Flood Plain.

This, however, introduces a further interesting question. Manly (in Kijngam *et al.* 1980) has applied a broken stick model to the settlement-size data collected in the Middle Chi area, and has shown that Ban Chiang Hian is significantly larger than the other sites discovered. The area of this particular site is easily calculated as the land enclosed by the innermost moat. Of course, the phase when the moats were excavated is not known. The site may well have grown to cover 39 ha over a lengthy prehistoric time span. If we assume that the 39 ha area was occupied and the moats excavated during the later prehistoric period, what inferences are possible for the social organisation in question?

This problem can be approached in several ways, though all are at present, inferential. The first point is the purpose of the moats and circular "reservoir" (see fig 10-4). Two are immediately apparent. The moats may have been for water storage, and the mounds of earth, or "ramparts" may have been defensive. Only excavation will reveal whether the latter have structures necessary to hold in place a permanent defensive wall. The question of water is particularly interesting. This is a critical resource during the dry season. It is inconceivable that a large permanent population could survive without adequate water storage facilities. At nearby Muang Fa Daed, the reservoir alone covered an area of about 15 ha. The reservoir and moats at Ban Chiang Hian when combined cover 10 ha. If they were only 1 m deep, then a total of about 100000 m³ of earth would have been moved. If on average, a man shifted 2 m³ of earth a day, and two further people were required to move the fill and simply dump it on the edge of the moat, then it would take 500 well-fed adults equipped with iron tools, 300 days simply to remove the soil to a depth of 1 m. The figure will vary of course, with different estimates for the amount of fill moved daily.

If the area within the moats was occupied to the same density as the modern villages referred to above, then Ban Chiang Hian would have had about 1950 occupants. These would have needed a sustaining area under ploughed, broadcast rice fields of approximately 450 ha (table 13-3). These figures are only the crudest of estimates, but they do hint at certain possibilities which require intensive research to document properly. The area of Ban Chiang Hian and extent of work involved in moat excavation, suggest a type of settlement distinct from that of the smaller "villages". If the population levels and sustaining area under rice are even remotely correct, then sites like Ban Chiang Hian could not have existed in the narrow confines of tributary stream valleys, and it must be asked if they could have been viable even next to the Chi Flood Plain without a form of tribute or extremely intensive local rice cultivation.

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Clearly, the raw figures produced above rely on certain basic assumptions. These are :

1. A population of approximately 50 people per ha
2. Average rice consumption of 179 kg per annum
3. Broadcast rice cultivation based on the use of the buffalo-drawn plough and iron tools.
4. Rice production of 790 kg/ha/year.

If these figures are accepted as a basis for discussion, then the communities living in tributary stream valleys would have had enough land for rice cultivation without needing to build embankments to retain water on slightly elevated terrain. The area needed to sustain the occupants of Ban Chiang Hian, estimated to be c. 2000 people, was 450 ha permanently under cultivation. This would have required a belt bordering the Chi Flood Plain 400 m deep and about 11 km in length.

By altering basic assumptions, we derive different figures. The buffalo and iron tools were available only from c. 500 BC. During earlier periods, input of human labour, assuming the soil was tilled, would have been greater and yields perhaps lower. Changing input figures however, cannot alter the two conclusions which have been advanced. These are that the site of Ban Chiang Hian represents a different type of site when compared with all others examined. The second is that the interpretation of the settlement data argues against any settlement being located sufficiently far from regularly flooded land that bunding and water retention would have been necessary for the predictably successful cultivation of rice.

It is possible to explore the issue of site size further by employing the model of settlement hierarchy and political centralisation advanced by Steponaitis (1981). This is based on certain basic premises. The first is that settlement size is related to available food. This may be obtained from the site's catchment or as tribute, or both in combination. Secondly, it is held that the population includes primary producers, and non-producers. The size of a given settlement may, therefore, be increased beyond the level of its own productive capacity by the receipt of tribute from dependent settlements.

Where settlements are autonomous and self-sustaining, there should be a significant relationship between size and the productive potential of the surrounding terrain. If a proportion of food produced is passed as tribute to a higher centre however, that centre has the capacity to grow in population and size. Therefore, it should stand out as in fig 13-2. Further tiers of settlement hierarchy add increased complexity to the resulting distribution of site size against local productivity.

Steponaitis (1981) found that, when applied to the Valley of Mexico, the model confirmed successive increases in settlement hierarchy between the middle and terminal formative periods. He then related the amount of vertical difference between tiers to the degree of centralisation. The greater the vertical difference, the more tribute is needed to sustain the greater number of central non-producers. Steponaitis then calculated the relative amount of food needed to sustain the non-producing elite as the ratio of non producers to the population as a whole. Since population is assumed to correlate with site area, calculation is relatively straightforward.

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Application of this model requires the most rigorously acquired data. Clearly where larger centres are easily identified but small villages are not, every unlocated village will take the investigator further from reality. The Middle Chi survey has its shortcomings. It certainly has not been surveyed with the same intensity as the Valley of Mexico. It is, however, one of the few regional surveys to have been undertaken in Southeast Asia and the results obtained have been considered in the framework of Steponaitis's model. It is initially assumed that any non producers were sustained by the food tribute obtained from dependent settlements. It is further assumed that site area and population co-vary, though the possibility that the site in the higher order also contained an unoccupied area cannot be ruled out. The calculation of catchment productivity presents vexing problems. The analysis of biological remains from excavated sites reveals an interest in hunting, fishing, stock raising, collecting and rice cultivation. Steponaitis (*op. cit.* 334) simply estimated the area of arable land within a 1.5 km radius of the site, assuming equal levels of fertility for different soil types. For the Middle Chi area, this is not so easy, because certain soils are not suited to rice cultivation and others are. Again, those soils on the middle terrace not used for rice, could have been critical resources for hunting or pasturing domestic stock. Nor is it necessarily acceptable to ignore the site area itself, for today, the village is a centre of food production. There are food-bearing trees, vegetable gardens, pig pens and cattle or water buffalo byres.

In consequence, the trial application of the model in question began by calculating for catchment productivity the area of soil within a 1 km radius of the site's centre, of soils suited for rice cultivation. In the case of the single large site (area = 39 ha), the soils covering 314 ha from the site's periphery were considered. The second variable was site area. This too presents problems, because although it is possible to estimate the maximum area of a prehistoric mound, the area under occupation during successive phases is not known. The figures presented in fig 13-2 must be seen as very general estimates only. Finally whereas Steponaitis could consider three successive patterns with timespans of a few centuries each, the Middle Chi sites cannot be subdivided for the reasons set out already. Figure 13-2 shows the relationship between the site size and catchment productivities. Two results are self-evident. Ban Chiang Hian stands out for its unusual size, and middling catchment productivity. Secondly, there is no clear, linear relationship between size and catchment productivity for the remaining 14 "village" sites. At first glance, this distribution violates the model, but this is not necessarily the case. As has been said, Southeast Asian material must be considered specifically, even when reviewed within a general model.

One point about the Middle Chi data, is that with the one exception of Ban Chiang Hian, sites are very small. Hardly any nuclear villages in the Valley of Mexico for example, were smaller than 10 ha, yet the largest village in the Middle Chi covered about six. Only a small fraction of the rice soils in the 314 ha catchment would have needed cultivation to produce a surplus over requirements. Thus, no site was even close to requiring all the rice soils available, and therefore, there is no need for a close correlation between size and catchment productivity. It has been shown already, that rather less than 500 ha would have sustained the estimated population of Ban Chiang Hian. This however, overlooks a critical

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point. What mattered to the prehistoric rice farmer reliant on broadcasting, was not so much the area of amenable soil, but the proportion which was predictably flooded. Recast in this way, it may well be that the distribution seen in fig 13-2 should have incorporated on the horizontal axis, data on such flooded wetlands rather than the entire area of type 3 rice soils which are under cultivation today principally due to the adoption of the banded field. Here however, we are passing into an area still archaeologically invisible. It can only be said that a very small area would have been necessary to sustain the occupants of sites varying between 0.7 and 5.4 ha in size. Again, if there were only a small area available for broadcast wetland cultivation, then site size could have had a low ceiling as well.

There are other interesting points to be made on the Middle Chi situation. It is necessary for example, to weigh carefully what sort of tribute may have been appropriate between a hierarchy of settlements reliant on the cultivation of rice. In this respect, it is stressed that the Middle Chi region suffers a long dry season. It may well be that the critical resource in the leanest time of the year was not only rice or riceland, but also water. As concentrations of population developed, so the supply of water in the dry season would have grown more critical. Tribute, as Steponaitis stresses, can take many forms. Food is one, military service or the donation of valuables are others. Another is labour. It has been shown that the moats at Ban Chiang Hian involved moving at least 100000 m³ of fill. Reservoirs are commonly associated with moated sites in Southeast Asia, and Ban Chiang Hian is no exception. Indeed, this requirement was to reach its most intense form in the great barays of Angkor. Concentration on land and food in the particular case of the Middle Chi region may miss the point that tribute also took the form of labour.

This discussion has assumed that the reservoirs and moats at Ban Chiang Hian date well within the prehistoric period. This has yet to be demonstrated. If it is indeed the case, then the Middle Chi data do sustain the presence there of a settlement hierarchy with two tiers. The one site of the upper tier is distinguished by its size and presence of moats.

SUMMARY

It has been shown that prehistoric settlement sites in the Middle Chi survey area were preferentially sited in the vicinity of low terrace soils. Some were found near small, tributary streams and others along the presumed former margin of the Chi Flood Plain. The figures for rice consumption and production provided by Hanks (1972) were used to provide rough estimates of the amount of land necessary to sustain the assumed populations of the settlements in question. It was found that there was sufficient land within a 1 km radius to provide sufficient rice for the occupants of the small village sites. On the other hand, there was probably insufficient land within a reasonable distance of Ban Chiang Hian to sustain all its inhabitants. This site is distinguished not only by its size, but also by the presence of moats and a reservoir. This situation was considered within the framework of a settlement hierarchy model

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advanced by Steponaitis (1981). It was concluded that Ban Chiang Hian attracted tribute probably in the form of labour and food, from its sustaining area. The structure of this settlement pattern resembles that of a "chiefdom".

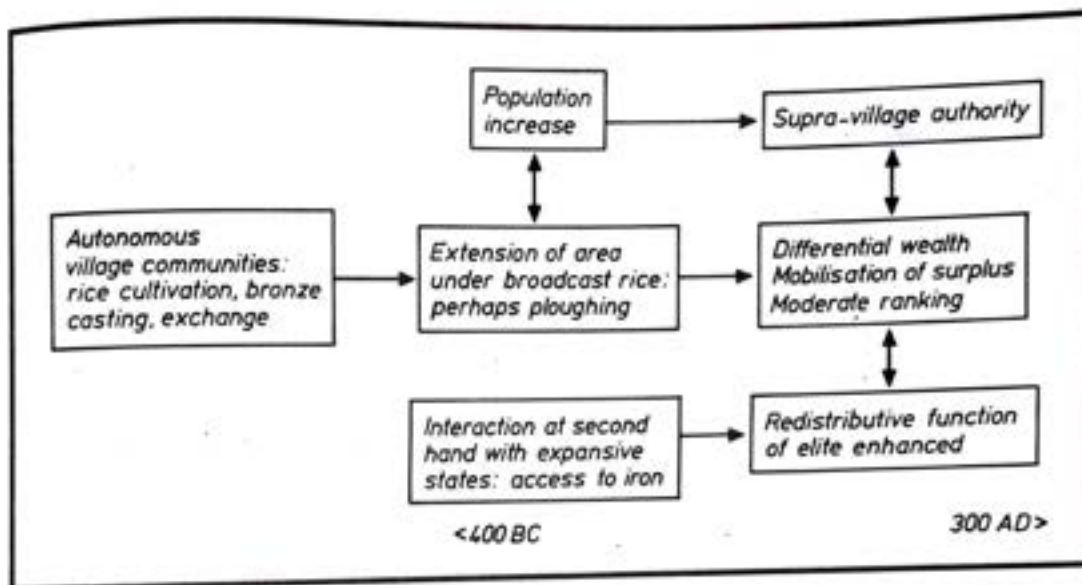


FIGURE 13-3

The main variables in the development of a chiefdom in the Middle Chi Valley (after Higham 1984)

CHAPTER FOURTEEN

THE MIDDLE CHI AREA: CONCLUSIONS

This study began with the limited objective of testing a settlement model for the Chi Valley. After the end of fieldwork and towards the end of the laboratory analysis of finds, MacDonald's doctoral dissertation was completed and it was felt inappropriate to overlook its principal conclusions. It is, as we shall see, indicative of our ignorance that two theses should appear within a year of each other in which the estimated date for the establishment of the first states differs by two thousand years. Higham's attempt to link two distinct areas of the Khorat Plateau in prehistory, suggested that the settlement of the Sakon Nakhon Basin preceded that of the relatively arid Chi Valley by as much as two millennia. The build up of population in the Sakon Nakhon Basin, combined with the development of water control techniques and ploughing underwrote the expansion of settlement in the Chi Valley probably from the mid first millennium BC onwards. This model is significant to Southeast Asian prehistory because it was in precisely such flood plain zones that early states are thought to have originated. Understanding processes involved in their initial settlement and subsequent patterns of cultural adaptation are of importance to the prehistorian.

Consideration was given at the outset, to evidence which would constitute support of Higham's model, and that which would require its rejection or reformulation. It was decided that two approaches were necessary. The first was to establish the prehistoric settlement patterns in a circumscribed area, paying particular attention to the initial pattern and subsequent changes. The second required excavation both to find out the date of initial settlement in one or more sites, and to establish a basic ceramic sequence which would permit the dating of sites by the analysis of surface collections. The latter approach proved successful in Sanders's Mexico Basin surveys, and there seemed no obvious reason why the same approach should not yield useful information in the Middle Chi Valley.

Support for Higham's model could take the form of clear documentation that the earliest settlement phase began no earlier than the establishment of plough cultivation and wet rice farming in the Sakon Nakhon Basin, and demonstration that pottery styles and other artefact types were derived from a Sakon Nakhon source. Exactly such support was, in fact, apparently obtained from excavations at Non Chai. Conversely, the presence of sites in the Middle Chi which were occupied before the development of ploughing and presumed wet rice cultivation in the Sakon Nakhon Basin would require the formulation of a new model and rejection of the old one.

Even during the period since fieldwork was being planned and undertaken, new evidence began to undermine the settlement model under review. For example, the very early chronology for Ban Chiang proposed by Gorman (1978) has been called into question by the results of excavations at Ban Na Di (Higham and Kijngam 1981, 1982). Whereas Gorman dated the first presence of iron and the water buffalo at Ban Chiang to the phase dated c. 1800-800 BC, data from Ban Na Di suggests a date of

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500 BC at the earliest for these two innovations. van Liere (1980) has suggested that later prehistoric settlement in the Mun and Chi valleys was based on broadcast rice cultivation which took advantage of naturally flooded river valleys. If true, then the argument that water retention was a necessary technique for settlement by agriculturalists is countered. Again, although without any foundation in evidence, MacDonald's (1980) reconsideration of the Non Nok Tha material led him to conclude that a state or states existed in the Mun-Chi area by 1000 BC.

The principal results of the Middle Chi fieldwork have been described. One of the basic findings is that the area was settled at least by the second millennium BC. This conclusion almost in itself is sufficient to require a complete reappraisal of the model being reviewed. One can proceed further. The earliest settlement at Ban Chiang Hian yielded a sherd bearing bronze corrosion, indicating that metallurgy may have been part of the repertoire of the earliest known settlers there. Their pottery includes a distinctive red-on-buff ware which is distinct from and earlier than the famous Ban Chiang phase 5 painted pottery by at least 1000 years. This same style was found at basal Ban Kho Noi and at Non Noi The style contrasts markedly with the wares made during the second millennium at Ban Chiang and Non Nok Tha, and makes it evident that the settlement of the Khorat Plateau as a whole was considerably more complex than once appeared. Of particular significance, is the finding that both iron and the water buffalo were introduced to Ban Chiang Hian during the site's prehistoric occupation. Unlike the situation at Non Chai and Non Dua, neither iron smelting nor the domestic water buffalo was introduced at the time of initial settlement. This again requires the rejection of Higham's settlement model.

According to a statistical analysis of the frequencies of rim and sherd types, there was a significant change in the pottery used at Ban Chiang Hian between levels 9 and 8. These saw a new suite of rim forms, and the manufacture of ware decorated with a carved paddle rather than with red painted designs. Radiocarbon dates from Ban Chiang Hian and Ban Kho Noi suggest that the changes first identified in level 8 took place from c. 800 BC onward. It is during phase 2 (Levels 8-8) that a few close parallels with rim forms from Non Chai and Non Dua are evident. The very characteristic Non Chai class 1 type a form is found, similar to the last detail of painted design, with those found in such numbers at Non Chai. They are dated at Non Chai to the last two or three centuries of the first millennium BC. Layer 7 has furnished nine specimens which match Non Chai Class II type cc, while a distinctive rim form found in phase one contexts at Non Dua recurs in layers 8 and 7 at Ban Chiang Hian rims at Non Dua were dated by Higham (1977) to his phase I (500-0 BC). A pit cut into layer 8 at Ban Chiang Hian from layer 5 produced a radiocarbon date with a corrected mid point of 285 BC, and two-sigma range of 160-410 BC. This date does not seriously violate a proposed time span of 0-800 BC for phase 2 at Ban Chiang Hian.

Layers 6 and 7 also yielded a lustrous black ware bearing burnished designs which recalls the so called "Phimai Black" pottery of the Mun Valley (Solheim and Ayres 1979). Again, a date towards the end of the first millennium BC is perfectly consistent with their proposed dates for this style. The discovery in layer 8, of a single sherd of "Om Kaeo" incised and painted pottery hints at contact with the Sakon Nakhon Basin. At Ban Na Di, this style was identified in levels 6 and 7, with dates within

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the second half of the first millennium BC. Finally, a few sherds of so-called "Roi Et" ware were found in layer 8, and one in layer 5. This fabric has been dated at Non Dua to phase 2 (0-700 AD).

The phase 2 pottery at Ban Chiang Hian has, as far as is presently known, a distinct regionality. It is extraordinary how different the styles are to the contemporary material in the upper and lower reaches of the Chi Valley. Yet the style of a few unusual pieces is paralleled at Non Chai, Non Dua, Ban Na Di and Phimai. The implications of this situation will be enlarged on below.

Phase 3 at Ban Chiang Hian represents a major discontinuity in terms of pottery manufacture. Plain chaff tempered wares replaced the grog tempered ones so characteristic of phase 2. This ware was not found at Non Chai, quite possibly because it became current after the site's abandonment. At Non Dua, Higham has ascribed very similar wares to his phase 3, dated to the years 700-1000 AD. There is now a marked similarity between the ceramics in the Middle and Lower Chi areas. If the dates 700-1000 AD are correct, then it seems probable that there was a hiatus in occupation in at least that part of Ban Chiang Hian excavated, during the first half of the first millennium AD.

Before proposing a new model to incorporate the data recovered during the excavation of Ban Chiang Hian, it is also necessary to refer to the results of the settlement pattern analysis. Several points stand out. At all prehistoric phases, there was a significant preference for settlement near tracts of low terrace soils. These were either in the vicinity of tributary streams or the assumed margins of the Chi Flood Plain. The Ban Chiang Hian faunal spectrum certainly reveals a preoccupation with aquatic species. van Liere (1980) has suggested that such locations are compatible with the cultivation of rice in terrain which experienced predictable but not severe flooding. There are certainly no known prehistoric sites situated so far from river or flood zones as to suggest the practice of inundation agriculture. Nor is there any evidence for the use of ploughshares. This is in direct contrast to the situation in the Red River Delta 800 km to the northeast, where the sites of the period equivalent to Middle Chi phase 2 (the Dong-Son material), have yielded numerous bronze ploughshares. If "flood" farming was indeed the basis of agriculture during at least phases 1 and 2 in the Middle Chi, then the relatively lower rainfall there than in the Sakon Nakhon Basin ceases to be a particularly important environmental variable. This situation is due to two facts. The Chi catchment is extensive and its flooding is not dependent on the rainfall of any particular area. The presence of a broad expanse of floodwater from the Chi would have the effect of local tributaries backing up and therefore themselves flooding.

The second important conclusion, is that at sometime during its occupancy, Ban Chiang Hian became significantly larger than all other settlements in the survey area. It was also surrounded by moats, a reservoir and possibly earthen ramparts. There is at present, no evidence for dating the excavation of the moats. This event is of considerable importance, because the presence of such a large site suggests a two-tiered settlement hierarchy.

The Middle Chi area surveyed is not alone in providing evidence for large moated sites, although the lack of intensive surveys means that their overall position in a settlement pattern is hardly known. Kantarawichae is located only 20 km northwest of Ban Chiang Hian, on the opposite bank of

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the Chi. Muang Fa Daed is 30 km to the northeast. Non Dua is situated inside a set of moats. In all these cases, the moats are circular or ovoid rather than angular. Muang Fa Daed and Kantarawichae contain Buddhist edifices dated by Subhadradis (1979) to the 9th or 10th centuries AD. The possible presence of moats at Non Chai is unclear although the site probably covered c. 28 ha at its maximum extent. While there is no firm evidence for moat construction, it is known that the site was last occupied c. 100 AD, at which juncture, its area revealing prehistoric occupation covered 28 ha. It is also true that there is no information on whether or when all that area was occupied simultaneously. If it was, then clearly at least one substantial settlement was present in the Chi Valley during the equivalent of Ban Chiang Hian phase 2. This situation at least opens up the possibility then, that the two-tiered settlement hierarchy had developed by the period 300 BC-100 AD. This would not be altogether surprising, given the clear evidence for supra-village authority in other parts of Southeast Asia at the same time.

Because the situation is so uncertain, it is felt that the proper course is to make an assumption, and then formulate a new model for future testing. The assumption is that the moats and reservoir were constructed during later Ban Chiang Hian phase 2.

Several anthropologists have considered the distinctions between chiefdoms and state societies and outlined archaeological evidence necessary to document their presence. There is a common thread in the suggestions of Steponaitis (1981), Peebles and Kus (1977) and Wright (1977). This is that chiefdoms involve two levels of decision making, and states, three or more. Peebles and Kus (1977) have outlined several ways in which chiefdoms can be recognised on the basis of archaeological data, and these will be used in considering the Middle Chi material. Thus, they require a settlement hierarchy in terms of types and sizes of sites. This is fulfilled in the survey area. Settlements should be located so as to "assure a high degree of local subsistence sufficiency". The relationship between sites and low-lying soils suited for rice cultivation has been shown to be highly significant. Next, "organised productive activities (should) transcend the basic household group".

If a man could dig and move 2 m³ of fill a day from the Ban Chiang Hian moats, it would need over 400000 man-hours. This statistic in itself fulfils Peebles and Kus's requirement. Looking further afield, the size of the mounds resulting from salt extraction near Non Dua is relevant. The salt was being processed there from at least the third century AD (Higham 1977). Again, there should be evidence for a society-wide buffer being provided to counter environmental unpredictability. The moats of Ban Chiang Hian, it is argued, were designed in part to ensure dry-season water supplies. If the mounds of earth which line the moats are ever shown to have had a defensive purpose, then this too would fulfil this requirement. Only the fifth correlate is unsatisfied, but only for lack of data. Peebles and Kus (1977) seek a superordinate social group in the cemetery which was attached to the main settlement. Clearly further excavation is necessary to explore this possibility.

Taken in conjunction, the Middle Chi data are consistent with the presence of a prehistoric chiefdom on the southern margin of the Middle Chi River. It is assumed that this chiefdom was developing during Ban Chiang Hian phase 2. Kijngam *et al.* (1980) have already pointed out the existence of other large, moated sites in the Chi and Mun Valleys and

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suggested that the Ban Chiang Hian chiefdom was not an isolated phenomenon.

There is at least one alternative hypothesis which cannot be ignored. This is that the territory surveyed was one component part of a larger area in which there was in fact a three-tiered settlement hierarchy associated with state development. In this framework, a site like Muang Fa Daed could be the apical settlement, with Ban Chiang Hian one of several middle order settlements above the level of village. Muang Fa Daed is certainly very much larger than other Chi Valley moated sites. Its reservoir alone covers 15 ha against 0.78 ha at Ban Chiang Hian.

Certainly, any new settlement model for the Middle Chi must admit village settlement at least by the mid second millennium BC. Since only 11 m² in three sites have been excavated, and all have revealed second millennium BC levels, the chances of finding earlier occupation are high. The settlement encompassed the tributary stream margins so favoured at the same time in the Sakon Nakhon Basin, but also included the margins of the Chi Flood Plain. It is felt likely that such settlements relied on floodwaters to sustain rice. Higham (1984) has proposed that such settlements were small and autonomous, and mortuary data hint at a ranked social organisation within each. Moreover, the exchange of valuables such as marine shell, metal and exotic stone reveal the existence of interlocking regional exchange networks. There are distinct regional groupings of such "mode 1" societies in the Ban Chiang, Phu Wiang and now, the Middle Chi areas. In the last, there is also evidence for the development of a two-tiered settlement hierarchy. This latter stage has been described as mode 2 (Higham 1984). There may well have been related and contemporary "chiefdoms" centred at the other Chi Valley moated sites.

Now that the simple settlement model has been rejected, it is possible to turn to more interesting areas of enquiry. These include the formulation of a model which might permit appreciation of variables underlying the development of such chiefdoms. Again, Higham (1984) has sought to explain the transition from mode 1 to mode 2 societies in the area (his scheme is reproduced here as fig 13-3). Essentially, he stressed several interacting variables. These include increased production made possible by expanding the area of flood plains brought under rice cultivation. Such expansion, he felt, was much more successful where a given community controlled the best or most extensive land. He also applied Haselgrove's (1982) prestige goods exchange model to the area, suggesting that those communities most favourably placed to control the distribution of exotic goods from ultimately an Indian source, would occupy an increasingly dominant social position in their own local network of sites. Of course, the source of such prestige goods need not be solely or even partially Indian: it could just as well be the rising chiefdoms of the Chao Phraya, Lower Mekong or Red River valleys. It is the notion of control through preferred access to such goods as bimetallic spearheads, glass beads or cowrie shells which is important.

If the present study is in a position to add a further variable, it lies in the results of the settlement pattern study and the establishment of a respectable timescale. There was clearly time - well over a millennium - for the processes at work to take effect. It has also been shown that settlements were located to take advantage of gentle or at least relatively predictable flood zones. Under such a regime, much Middle Chi land would have been inappropriate for such agriculture, due to aridity

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of deep flooding. It is a short step then, for the largest settlement, even in a network of autonomous villages, to seek control of land belonging to others. Carneiro (1981) is adamant that such a process in itself is sufficient to stimulate the development of a chiefdom particularly where physical or to a lesser extent, social circumscription are present. The Chi Valley should not be thought of as an open area offering scope for easy settlement. On the contrary, acceptable land for rice cultivation in the absence of bunding is heavily circumscribed. Higham (1984) has noted that inequality was latent in mode 1 societies. Competition for land and demand for tribute are mechanisms which, in addition to the control of prestige goods, could have stimulated the development of the two-tiered settlement hierarchy described in the survey area.

It has been stressed that no evidence has been found in the Middle Chi area to support MacDonald's contention that a state or states were in existence in the Khorat Basin by 1000 BC. If such an entity did exist before the Khmer annexed the area about 1000 AD, then it should be possible to predict the form of evidence necessary to identify it. By all accounts, a state should reveal at least three levels of settlement hierarchy. We might also, given our knowledge of Dvaravati and Funan expect some monumentality in architecture. Finally, Bronson has noted the broad distribution of ceramics which replaced earlier regionality with the advent of the Dvaravati state in the Lower Chao Phraya Valley. There is some evidence at hand for all three phenomena, but most certainly not as early as 1000 BC. Firstly, Muang Fa Daed is a very large site, and does contain impressive Dvaravati style Buddhist buildings, as well as the noted *sama* stones. Kantarawichae also contains late first millennium AD buddhist buildings, and even pictures of high status individuals on the famous silver votive plaques. Again, the similarities between phase 3 pottery from Non Dua and Ban Chiang Hian hints at a broad regional style noted earlier for its absence. Finally, Smith (1979) has summarised the admittedly shadowy historic evidence for the existence of a state or states in Northeast Thailand during the eighth century AD. It is hoped that the perception of Middle Chi prehistory offered above will be enhanced and modified with the progress of future research there.