

The Excavation of Khok Phanom Di

a Prehistoric Site in Central Thailand

Volume VII: Summary and Conclusions



By

C. F. W. Higham and R. Thosarat

with contributions by B. F. J. Manly and R. A. Bentley

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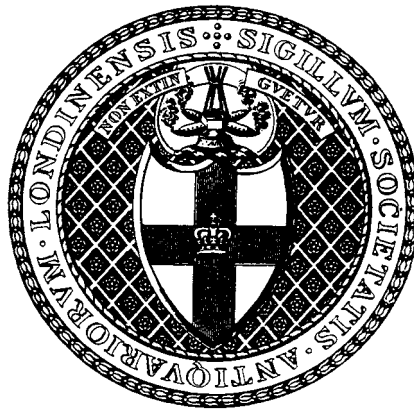
a Prehistoric Site in Central Thailand

Volume VII : Summary and Conclusions

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C.F.W. Higham, Sc.D., F.S.A., F.B.A. and R. Thosarat, MSc, Ph.D.

With contributions by B.F.J. Manly, D.Sc., F.R.S. N.Z. and R.A. Bentley, M.A., M.S., Ph.D.



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PREFACE

Khok Phanom Di is a large prehistoric settlement, located in Chonburi Province, Central Thailand. There have been four archaeological investigations there. This volume and its six predecessors report on the excavations conducted under our direction, between December 28th 1984 and July 17th 1985. During those seven months, we opened an area measuring 10 by 10 metres to a depth of 6.8 metres. The contents of this volume are best appreciated with access to the previous issues in the series. We are deeply indebted to the institutions which through their funding, made our excavation possible. These begin with the Thai Fine Arts Department and the University of Otago, New Zealand, our employers, who allowed us the time to bring this project to a completion. Funding was provided by the Ford Foundation, the Shell Company of Thailand, the Wenner-Gren Foundation, the Evans Fund of the University of Cambridge, the New Zealand University Grants Committee, the British Academy, the Society of Antiquaries of London, and Earthwatch and its Research Corps.

Without the dedication and enthusiasm of our many colleagues during the course of the last 19 years of research, this report could never have been contemplated. We thank Dr N.G. Tayles, Dr. G.B. Thompson and Dr. B.A. Vincent for their individual volumes. We also thank those who have contributed chapters to the series: Dr. R.A. Bentley, Mr. D. Cassaidy, Mr. A. Grant, Dr. P.H. Greenwood, F.R.S., Mrs. M.D. Hall, Dr. A.C. Harris, Dr. T.F.G. Higham, Dr. J. Hylleberg, Dr. L. Kealhofer, Dr. A. Kijngam, the late Dr. B.K. Maloney, Professor B.F.J. Manly, Mr. G.M. Mason, Dr. K.G. McKenzie, Ms. L. Moore, Ms. M.N. Moore, Dr. D.J. Morseth, Mr. A. Nateewathana, Dr. A. Patterson, Mr. N. Phongsuwan, the late Mrs. J. S. Pilditch, Dr. D.R. Piperno, Mr. P. Pisnupong, Dr. G. Ramsay, Professor I. Rovner, Mrs. D.M. Wailes (née Higham) and Ms. B. West.

Dr B.A. Vincent and Dr. N.G. Tayles kindly read and commented on the text of this book during its final stages of completion. Finally, we record our thanks to the Fine Arts Department and the National Research Council for permitting the excavation of Khok Phanom Di to take place.

I. INTRODUCTION: RESEARCH OBJECTIVES

KHOK Phanom Di is a prehistoric settlement in Central Thailand that is, in many respects, unique (Figs. 1 and 2). Its cultural layers, which reach a depth of at least 8.5 m and probably over 12 m in parts of the site, accumulated rapidly between about 2000 and 1500 BC. It began as an estuarine settlement of maritime hunter-gatherer-fishers, but the initial population interacted with intrusive rice cultivators in its hinterland. A succession of human burials that extended over 17-20 generations has revealed both subtle and deep-seated changes, while the biological data evidence transitions from marine to freshwater, back to marine and finally, to dry land conditions. Each was accompanied by modifications to the subsistence base. While salinity would have discouraged rice cultivation, the rise of freshwater conditions saw the manufacture of granite hoes and shell harvesting knives probably linked with agriculture. We excavated an area of 10 by 10 m of Khok Phanom Di in 1984-5. The ensuing 19 years have involved a series of major specialist studies, culminating in 2004 with the completion by Brian Vincent, of the herculean task of the ceramic analysis (Vincent 2004). This last study is a prerequisite to the final review of this site's prehistoric past, because throughout the five or more centuries of its occupation, it was a major ceramic manufacturing centre. As each specialist report has been completed, so our understanding



FIG. 1. Khok Phanom Di in 1985, looking to the east

of Khok Phanom Di has matured and been refined. Nevertheless, we are convinced that we have barely scratched the surface of this remarkable settlement, and confidently anticipate that with the course of time, our interpretations presented below will require enlargement and modifications.

In 1984, we began with only the most limited knowledge of this site. Its size, depth and coastal location presented us first with the opportunity to illuminate an ill-lit chapter in South-East Asian prehistory, the cultural adaptation to a marine environment. This we considered in conjunction with a more specific goal, to test models for the transition to rice cultivation. Our excavation had been preceded by three earlier investigations, the largest of which had been undertaken in 1979 by Damrongkiadt Noksakul. He encountered a stratigraphic sequence in which cultural material had accumulated to a depth of about 8.5m. Eleven inhumation burials were uncovered, bone from the

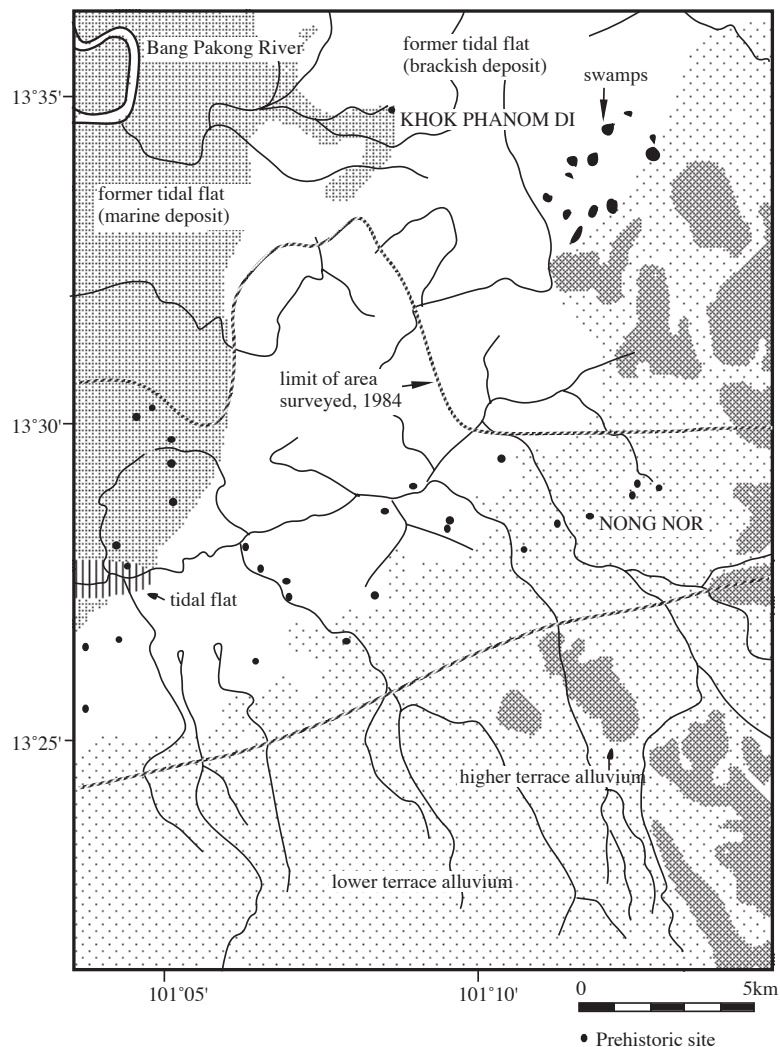


FIG. 2. The Bang Pakong Valley showing the location of Khok Phanom Di and other prehistoric sites



FIG. 3. Khok Phanom Di, towards the end of the 1984-5 excavation season

lowest providing a C14 determination of 6800 ± 400 BP (calibrated range at 2 sigma, 6460-4910 BC). The highest burial was dated 2100 ± 290 BP (795 BC-AD 434). These dates were associated with cultural remains which included pottery vessels, polished stone adzes and rice, although the stratigraphic contexts within which rice occurred were not known in detail (Noksakul 1981). The early determination corresponded with the date for the establishment of a shore higher than at present, following a rapid Holocene rise in sea level. We felt that this rise in the level of the sea would have drowned many human settlements, and that the inhabitants of Khok Phanom Di would have inherited a mature tradition of marine adaptation.

Our initial ideas on the transition to rice cultivation took account of the available data, and the

history of previous attempts to describe the later prehistory of South-East Asia. Perhaps influenced by the establishment of European colonial regimes, early overviews sought evidence for migrations into South-East Asia, often originating in China and beyond to India and even Europe. One of the most influential was formulated by Heine-Geldern (1932) on the basis of the distribution of adze forms. His first wave of migration was based on the *walzenbeil* or oval adze, which involved the expansion of human settlement from northern China or Japan into eastern Indonesia and Melanesia via Taiwan and the Philippines. The second brought speakers of Austroasiatic languages, and their shouldered adzes from North-East India into South-East Asia while the spread of Austronesian languages was represented by the distribution of the quadrangular cross-sectioned adze. This last migration, said to have originated ultimately in the Danubian Neolithic, involved rapid movement through South-East Asia into Malaysia where, with the development of outrigger canoes, further progress was made to east and west.

These proposed migrations had long since been discredited when we began to investigate Khok Phanom Di, but movement by agriculturalists into South-East Asia from China had in the interim been proposed on the basis of Danish research in Kan-
chanaburi during the early 1960s (van Heekeren and Knuth 1967, Sørensen and Hatting 1968). Two major sites are involved, Sai Yok and Ban Kao. The former is a cave in which Hoabinhian remains, including one burial, were found beneath Neolithic interments with a novel material culture. At Ban Kao, an open cemetery site, a larger sample of Neolithic burials was uncovered, together with a set of radiocarbon dates which suggest contemporaneity with Khok Phanom Di. The material items associated with these burials, in particular the form of some pottery vessels, recalled southern Chinese examples. The possibility that the ingress of agricultural communities involved a Chinese source was not widely accepted. Indeed, the pendulum of opinion was then swinging towards local transitions to rice cultivation within early contexts.

This trend was stimulated by research at three sites, Spirit Cave, Non Nok Tha and Ban Chiang (Solheim 1968, Bayard 1971, Gorman 1972, Gorman and Charoenwongsa 1976). Gorman (1977) provided the clearest statement in favour of indigenous origins for the transition to agriculture when he formulated a model which placed this development in the piedmont area of Thailand. In the context of the available data, his proposal was plausible, for he argued that the initial settlement of Non Nok Tha and Ban Chiang took place by about 4500 BC while similar agricultural communities in the Yangzi Valley involved the Qujialing culture, thought to date to the third millennium BC. The transition, as Gorman



FIG. 4. The grave silhouette of burial 151, mortuary phase 1

stressed, was hypothetical and designed for testing in the lower piedmont annual swamplands, where hunter-foragers might have expanded their area of settlement from the surrounding uplands. This proposal was tested, and found to be wanting: no transitional sites were found (Penny 1984).

When we began our research at Khok Phanom Di, we were firmly on the side of a local transition to rice cultivation in South-East Asia, rather than an expansionary movement from the north. In view of Noksakul's early dates (Noksakul 1981), and recognizing the biological vigour of marine, and in particular estuarine habitats, we first formulated a model which saw Khok Phanom Di as a sedentary hunter-gatherer community which tapped into the marine eco-system. Such sedentism fostered population growth and settlement fission which involved the filling of the available coastal tract by new settlements. Once filled, social circumscription encouraged expansion into marginal zones behind the seashore, which would have included seasonal freshwater swamps. It was in such areas that rice would have been incorporated into the diet and in due course, cultivated. This process could then have stimulated further population growth and expansion into the hinterland where we knew of agricultural settlements, such as Non Pa Wai and Ban Kao, dating from the late third millennium BC.

The second model incorporated stress within communities such as Khok Phanom Di as the sea level fluctuated. Sites might have been distanced from the shore, reducing the predictability of coastal resources and encouraging rice cultivation as an adaptive strategy to offset the effect of a deteriorating habitat. This would have seen a transition from a coastal foraging subsistence base to one incorporating rice cultivation. Both alternatives took account of occupation spanning several millennia, as indicated by the radiocarbon dates from earlier excavations, and the depth of the cultural deposits.

As we have seen, Heine-Geldern's migratory theories linked material culture with language. Many subsequent workers have attempted to integrate the archaeologically documented expansion of human settlement into island South-East Asia and Oceania with the distribution of languages. In 1987, Renfrew published an influential book in which he identified the expansion of agriculture into Europe with people speaking early Indo-European languages. As we weighed the data from Khok Phanom Di, so we considered the possibility that the proposed expansion of Neolithic groups from the coast to the interior involved the expansion of Austroasiatic languages. This language family is widespread in India and South-East Asia, involving as it does Vietnamese, Mon, Khmer, Nicobarese and Munda.

Late in 1993, this proposal was dealt a death blow when Reid (1993) and then Blust (1996) advanced convincing evidence in support of the Austric hypothesis. Schmidt (1906) proposed that Austronesian and Austroasiatic languages share a common ancestry in the Austric phylum. Reid's research on Nancowry, a language spoken on the Nicobar Islands, provided vital information in support of Schmidt. Blust then suggested that the Austroasiatic languages originated in the upper Yangzi Valley and early speakers expanded into South-East Asia via the major rivers, bringing agriculture with them.

THE 1985-6 EXCAVATION

The excavation, which lasted for seven months in 1985, produced a far wider range and a greater quality of evidence than had been anticipated. Moreover, subsequent excavations at the nearby site of Nong Nor, have provided evidence for coastal settlement five centuries earlier than

the initial settlement of Khok Phanom Di (Higham and Thosarat 1998). This new information has not only allowed us to test the above hypotheses, but has also contributed to the construction of a further model for the origin and spread of settled, agricultural villages in South-East Asia which will be described later in this volume. At this juncture, it is stressed that the excavation at Khok Phanom Di provided a range of data which greatly extended the scope of our research. Against a background of a consistent set of radiocarbon dates from the Australian National University which suggest occupation over a period of four to five centuries (2000-1500 BC), we have obtained a well-preserved sample of human remains. These were inhumed with mortuary offerings, and the first objective of this volume, is to define some social variables and their changes over time on the basis of the human interments. The relevant chapters will draw on the information set out in volume 1 of our report (Higham and Bannanurag 1990).

The range and quality of the data recovered, linked with tight chronological control, then permit a synthesis of other variables. These include the skeletal evidence for the diet, health, demography and physical development of the prehistoric people (Tayles 1999). The material culture is rich and diverse, involving ceramics, bone, stone, ivory, turtle carapace, fabric and shell (Higham and Thosarat 1993, Vincent 2004). We will refer to these artefacts, the availability of the raw material, their function, their relationship to gender or age, and how their frequencies changed with time. Evidence for the changing environment is drawn from the molluscs, forams, ostracodes, pollen, phytoliths, fish, mammals, birds, insects, coral, seeds, charcoal and crustacea. The coastal habitat, particularly in the vicinity of a major estuary, is subject to swift as well as subtle change. Biological remains reflect changing patterns of subsistence, and the major results will be referred to (Higham and Bannanurag 1991).

Our foremost objective following these summaries, will be to portray the history of this community through about 20 generations. This endeavour was greatly assisted by the remarkably clear stratigraphy encountered, in which many graves, for example, were recognized by their silhouette long before reaching the contents (Fig. 4). Linked with the survival of organic remains, this permitted the integration of changes in the social organisation, the material culture, health of the people, the environment, the exchange system and the subsistence. To what extent, for example, did habitat changes contribute to the success or otherwise of rice cultivation? Was there a relationship between the attainment of social status and gender, craft skill, the nature of the subsistence base or of the exchange system? As will be seen, one of the most challenging aspects of this site is that it does not present an image of a community constrained by a limited or unknown span of time, but rather of one featuring a series of kaleidoscopic changes involving many interacting facets of human behaviour and modifications in the natural environment.

This situation should be considered in the context of at least two major advances in the study of prehistoric societies achieved since our fieldwork was planned. The first concerns the nature of complex hunter-gatherer societies and the second, the interactions between such societies and intrusive agriculturalists. As we will argue, the earlier inhabitants of Khok Phanom Di were coastal hunter-gatherers, and undertook some rice cultivation only as local conditions became suitable. They also showed outstanding skill in making pottery vessels and commanded the coastal resources necessary for the manufacture and exchange of shell jewellery. As Arnold has shown on the basis of her studies of the Chumash, coastal hunter-gatherer communities, no less than those involved in agriculture, have the capacity to sustain craft specialists and social elites (Arnold 1994, 1996a, 1996b). The data from Khok Phanom Di provide an unusual, possibly unique, op-

portunity to trace social change through the successive generations. Keeley (1992) and Price *et al.* (1996) have considered the interactions between coastal hunter gatherers and intrusive farmers in northwestern Europe, and it is necessary to review the evidence for a similar situation in the land behind the Gulf of Siam. In doing so, it is possible to deploy the results obtained from a number of specialist studies. Thus Vincent (2004) has now completed his analysis of the ceramic industry of Khok Phanom Di, and has identified not only the changing patterns of imported exotic wares, but also the presence of anvils made of exotic clay interred with the dead. He has argued that this is *prima facie* evidence for people settling to live at the site from other areas. Again, Bentley (see page 159) has investigated the strontium isotope data from individuals interred at Khok Phanom Di, and has isolated some who appear to have been raised elsewhere before reaching the site. This new information has opened the possibility of identifying occupation by people of different cultural backgrounds.

There is also the vital issue of the interactions between an enduring hunter-gatherer community and intrusive rice farmers. This has been considered through the presence at Khok Phanom Di, of cultivated rice, and the manufacture of the hoes and shell knives thought to have been used in cultivating the soil, and harvesting crops. The dog is an exotic species in Southeast Asia, and its arrival at the site is most probably the result of contact between long-established hunter-gatherers, and the first groups of intrusive farmers in the hinterland. In essence, the sequence at Khok Phanom Di reveals strong threads of continuity, as well as periods of change that variously reflected adaptation to both a dynamic environment, and interaction with other communities through exchange of goods and the incorporation of immigrants.

Having set the inhabitants of Khok Phanom Di on their stage, we must then open the curtain on the wider scene. We would like to know the origin of the first settlers, and this requires comparison with earlier settlements. This topic also activates our original interest in the transition to rice cultivation. Were the first occupants of the site, for example, descended from hunter-gatherers long adapted to the coastal habitat of South-East Asia? If so, their settlements will have been drowned with the rising sea. Or were they an intrusive community, whose origins lay inland? Did they bring with them the knowledge and practice of rice cultivation, or were they in exchange contact with farmers from whom they adopted agriculture? Responses to these issues will call on details of the chronology, material culture and subsistence activities at other prehistoric sites in Central Thailand. Finally, as we expand our horizons to South-East Asia as a whole, it is hoped to place Khok Phanom Di within the general framework of that part of prehistory which saw the establishment of sedentary communities involved in the cultivation of rice.

II. A SUMMARY OF THE RESULTS

The excavation of Khok Phanom Di was a voyage of discovery in many respects. In our combined experience of over half a century of excavating in Southeast Asia, we have never encountered a site with such a deep and complex stratigraphic sequence, nor such a remarkable survival of organic remains (Fig. 5). Partially digested food, including rice, for example, provided unique insight into the diet (Figs. 6, 11). Structures survived, including rows of hearths and mortuary chambers (Figs. 7, 15). The many hearths and ash spreads provided exemplary material for radiocarbon dating (Fig. 12).

When we began the excavation of Khok Phanom Di, we assumed that Noksakul's radiocarbon dates evidenced occupation for several millennia from about 5000 BC. Our excavations supplied 18 radiocarbon dates from layers 6 to 11. No charcoal from *in situ* contexts of sufficient size to

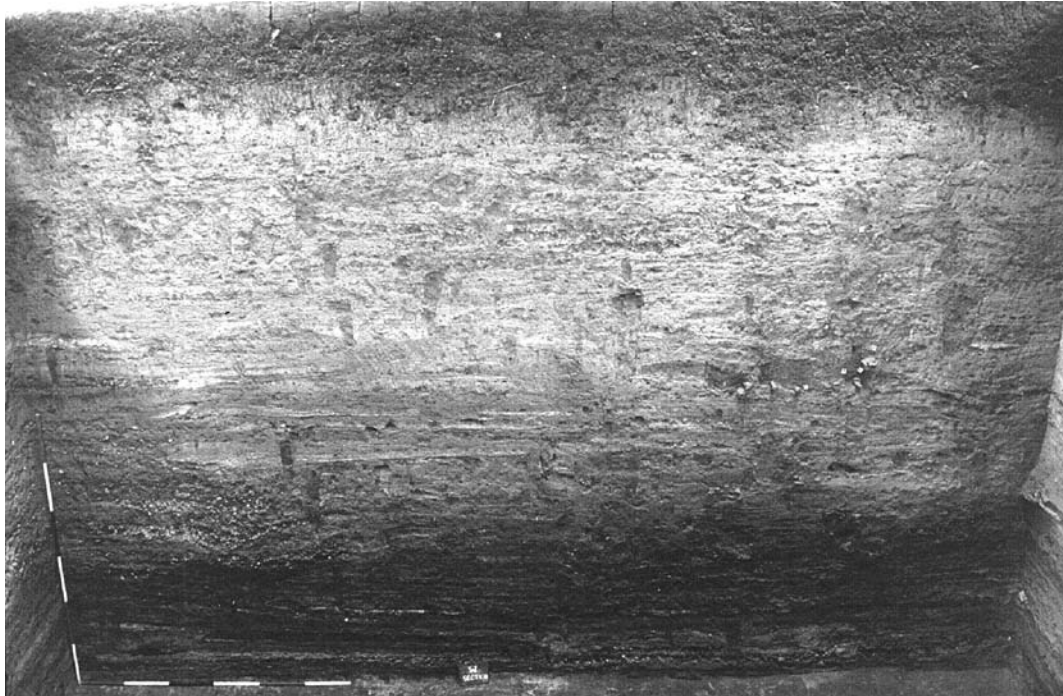


FIG. 5. The west section of Khok Phanom Di

warrant dating was found in layers 1-5. Dates from the New Zealand Institute of Nuclear Sciences were stratigraphically inverted, or too late to be archaeologically acceptable. Those from the Australian National University, however, were consistent, and suggest occupation measured in centuries rather than millennia, between about 2000 and 1500 BC. This span was far later than previous results, and radically changed our perception of the site's position in the cultural sequence of Southeast Asia.

One of the priorities when planning the excavation was to reconstruct the environment before and during the prehistoric occupation, and assess the nature of human impact. Maloney (1991) has re-

constructed the vegetational history by taking sediment cores near the site in order to extract dated biological remains. Two cores reached depths in excess of 6 m, and both provided basal dates in the sixth millennium BC. For the greater part of the sequence, pollen from mangrove species predominated. Core KL2, however, incorporated two rises in the frequency of charcoal fragments (5800-4755 BC and 5330-4555 BC). Neither witnessed a parallel rise in the frequency of grass pollen, but the latter saw an increase in the number of fern spores which reflect more open conditions. Maloney (1991:93) has suggested human interference as one possible cause, but there is no evidence that agriculture was involved. Indeed, deliberately-induced forest fires by hunter gatherers, or natural conflagrations in the catchment of the coring location, could have been responsible.

There was a series of marked changes in core KL2 from a depth of just over two metres. A further rise in charcoal fragments accompanied a decline in mangrove and a rise in grass pollen. The pollen of plants which invade rice fields appeared at this juncture or slightly higher in the spectrum. A small proportion of the grass pollen falls within the size range for modern rice. This, Maloney notes, is circumstantial but not definite evidence for rice cultivation. Does this change relate to the occupation of Khok Phanom Di, or did it predate the settlement phase? The one AMS date from this part of the core is 4710-3960 BC. Two dates from 1.46-1.50 m and 0.87-0.9 m are, however, contradictory, the former being AD 1235-1595 and the latter, 1910-1435 BC. The dating of the rise in grass pollen and charcoal in this core should be considered relative to that seen in the core BMR2, located 30 m away. This phenomenon took place at a depth of about 90 cm, and has some similar features to that seen in KL2: some Gramineae pollen fall within the known size range for rice, and the pollen of some freshwater plants which colonise rice fields rose in frequency. This part of the spectrum at BMR2 has provided an AMS date of 2855-2155 BC. If the two horizons correlate and represent the same activity, the disparity in radiocarbon dates of two millennia cannot be explained other than as an error.

The replacement of a mangrove pollen dominance by one involving grasses and a rise in charcoal is a pattern found in the other, undated cores taken from the vicinity of Khok Phanom Di. Within the period of mangrove dominance, there are episodes which reflect burning and the temporary florescence of plants which prefer open conditions. These could reflect the activities of hunter-gatherers, for burning encourages grass growth and attracts game. Alternatively, as Stott (1988) has shown, natural conflagrations behind the mangrove fringe could have taken place. The major and consistent rises in grass pollen at the upper ends of the spectra, accompanied by



FIG. 6. Food remains found in the pelvic area of burial 56 (arrowed above) contained partially digested rice, and fish bones and scales



FIG. 7. This row of hearths abutted a wall running east to west. Hearths such as these furnished large, *in situ* charcoal samples for radiocarbon dating

evidence for burning and the growth of aquatic plants known to colonise rice plots, is most easily explained in the context of human modifications to the environment involving the cultivation of rice. The occupants of Khok Phanom Di, and of undiscovered sites in its vicinity, could have been responsible. One date from this horizon in a core sample just precedes the settlement of Khok Phanom Di, another is over two millennia too early.

Conclusions drawn from the pollen and charcoal frequencies are confirmed in the analyses of the phytoliths from cores KL2 and BMR2 by Kealhofer and Piperno (1996:219-32). Again, however, there are differences in the patterns observed although the cores are only 30 m apart. In the latter, there was a change in the phytolith frequencies between depths of 0.8-1.3 m, when rice (*Oryza*) made its first appearance, mangrove taxa declined and the frequencies of weedy grasses rose. The same pattern is seen in the upper part of the KL2 spectrum, and the establishment of rice agriculture is the most likely explanation. The problem of dating this change remains. Earlier rises in *Oryza* and weedy grass phytoliths at the expense of mangrove indicators in the latter sequence, however, are absent from core BMR2. Once again, we are left with the tantalising possibility that human activity might be responsible for such modifications to the environment as early as the sixth millennium BC, although it remains necessary to be able to distinguish between natural conflagrations,

the impact of burn-offs to aid in hunting, and land clearance for rice agriculture.

The palaeoenvironment has also been approached through the examination of the ostracodes and foraminifera recovered from core KL2 and layers within the site (McKenzie 1991:139-46). Between depths of 2.13 and 6.04 m, the coring location at KL2 was marine, the forams and ostracodes being adapted to coastal and deltaic conditions. Specimens recovered from layers 9 and 10 in the site reflect nearshore, estuarine habitats, but a sample taken from layer 8 contains the remains of two species of ostracode which are adapted to freshwater conditions, including rice fields. McKenzie has concluded that the site during layers 9-10 was located near an estuary with a low-lying, marshy hinterland. From layer 8, access to freshwater ponds was possible.

The environment during the occupation span has been reconstructed on the basis of the biological remains. Sources, which include shellfish, charcoal, seeds, bird, fish, crustacea, ostracodes, foraminifera and mammalian bones, provide a reassuring measure of concordance. The most detailed information comes from the analysis of shellfish, because of the large sample size and range of habitats represented. Mason (1991, 1996) has shown that species adapted to subtidal and intertidal marine muds dominated during early and middle layer 10, but then went into a long period

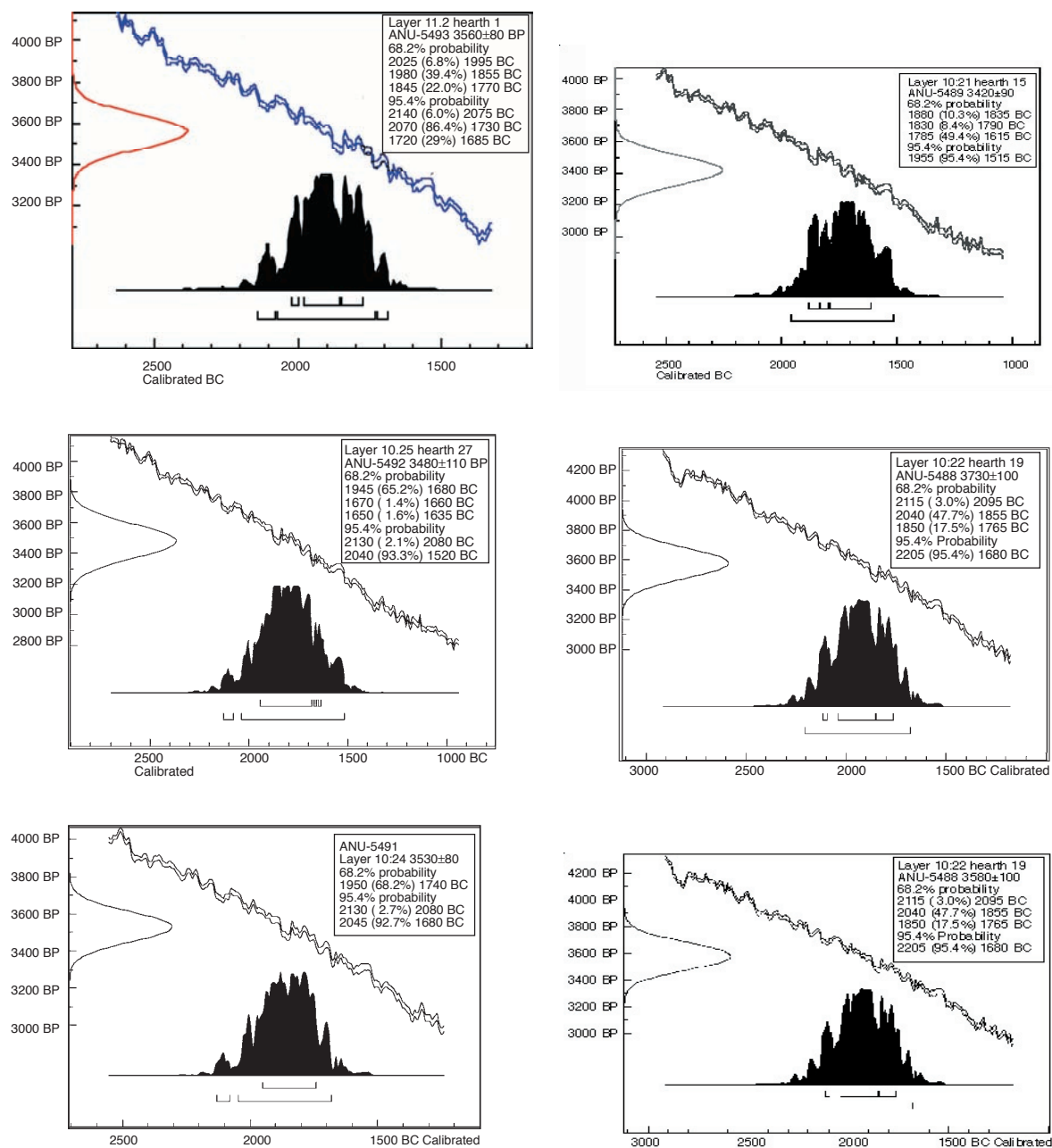


FIG. 8. The radiocarbon dates for Khok Phanom Di, from the Australian National University

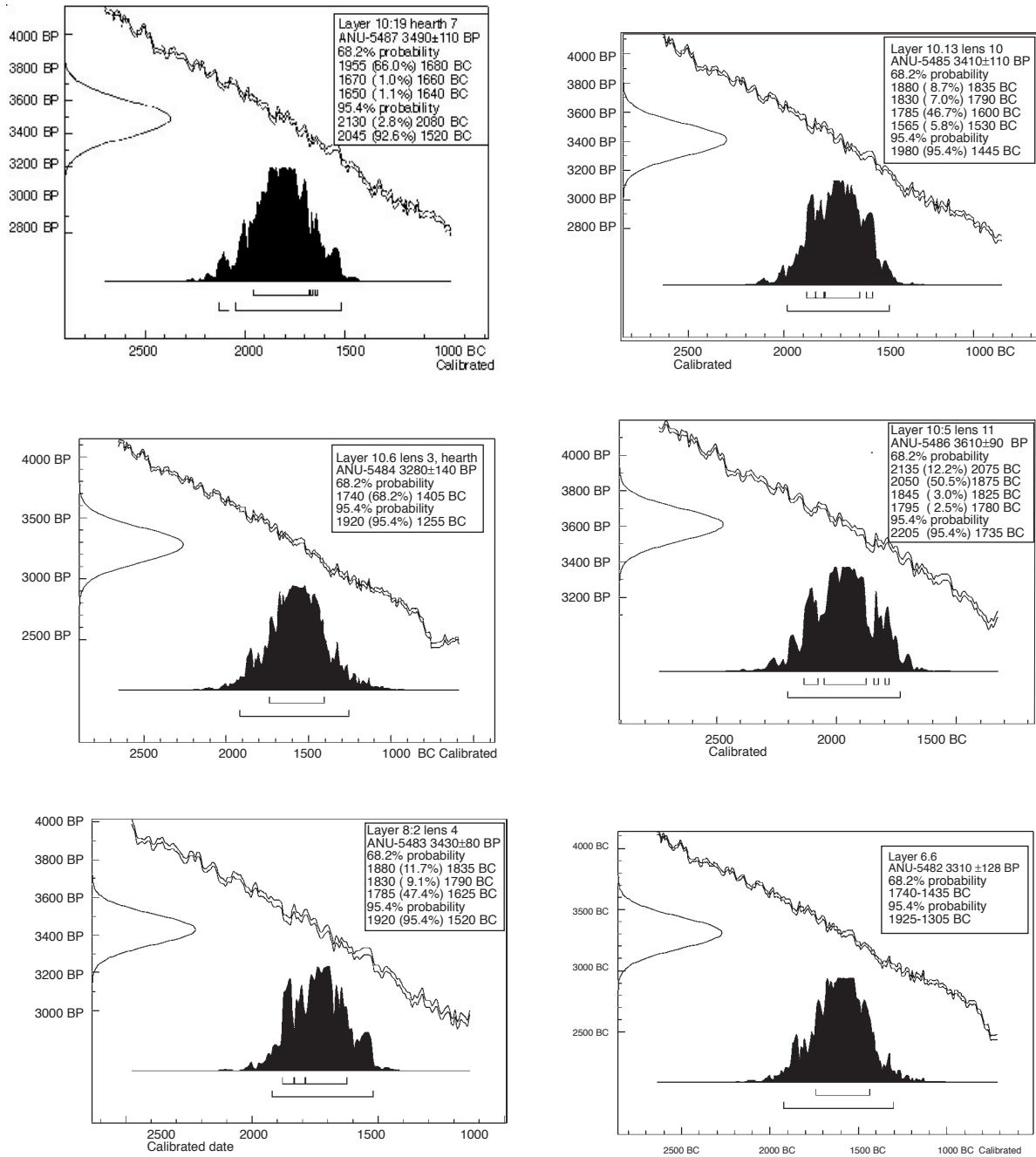


FIG. 8. (cont.) The radiocarbon dates for Khok Phanom Di, from the Australian National University

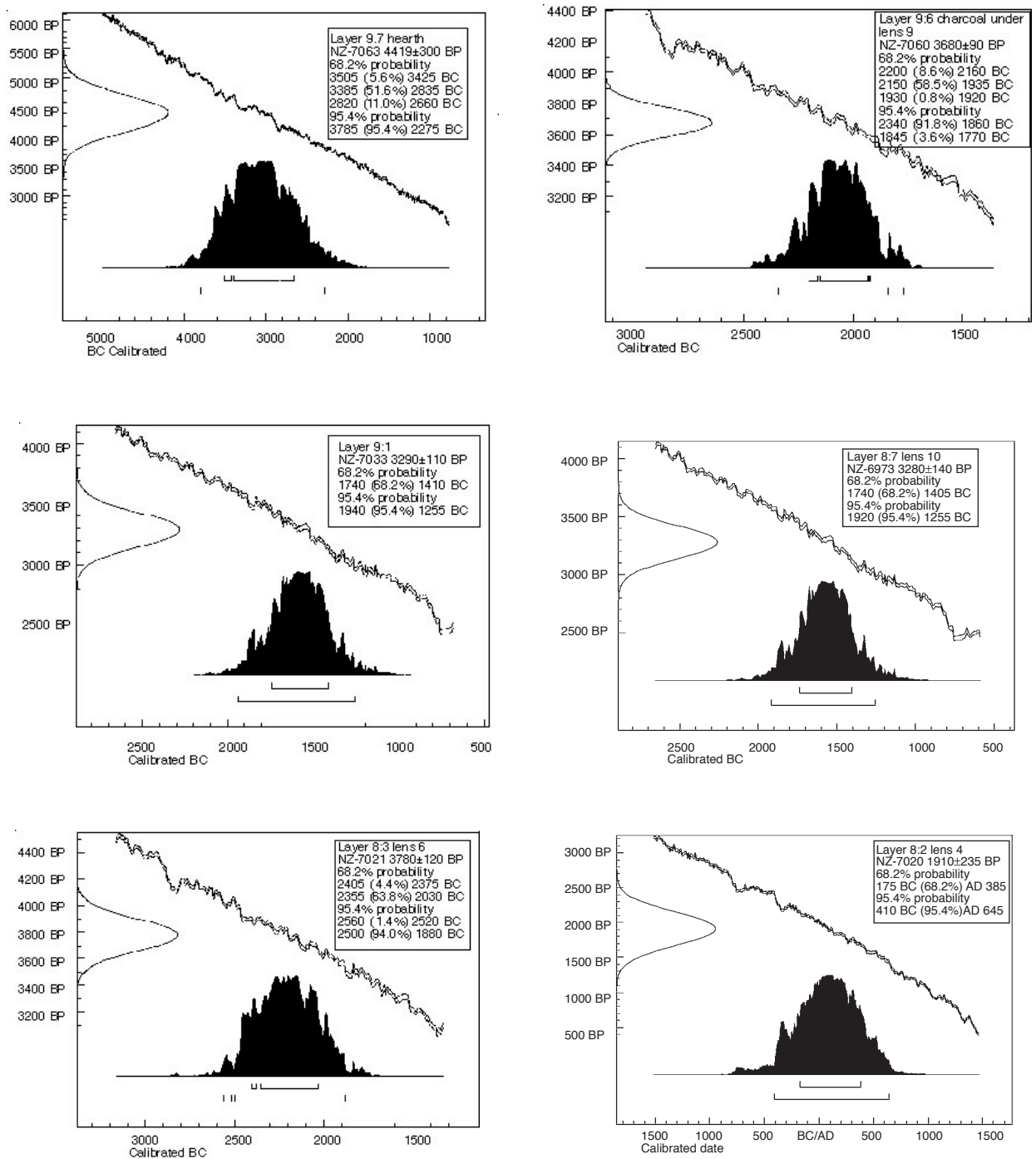


FIG. 9. The radiocarbon determinations from the Insitutute of Nuclear Sciences, New Zealand

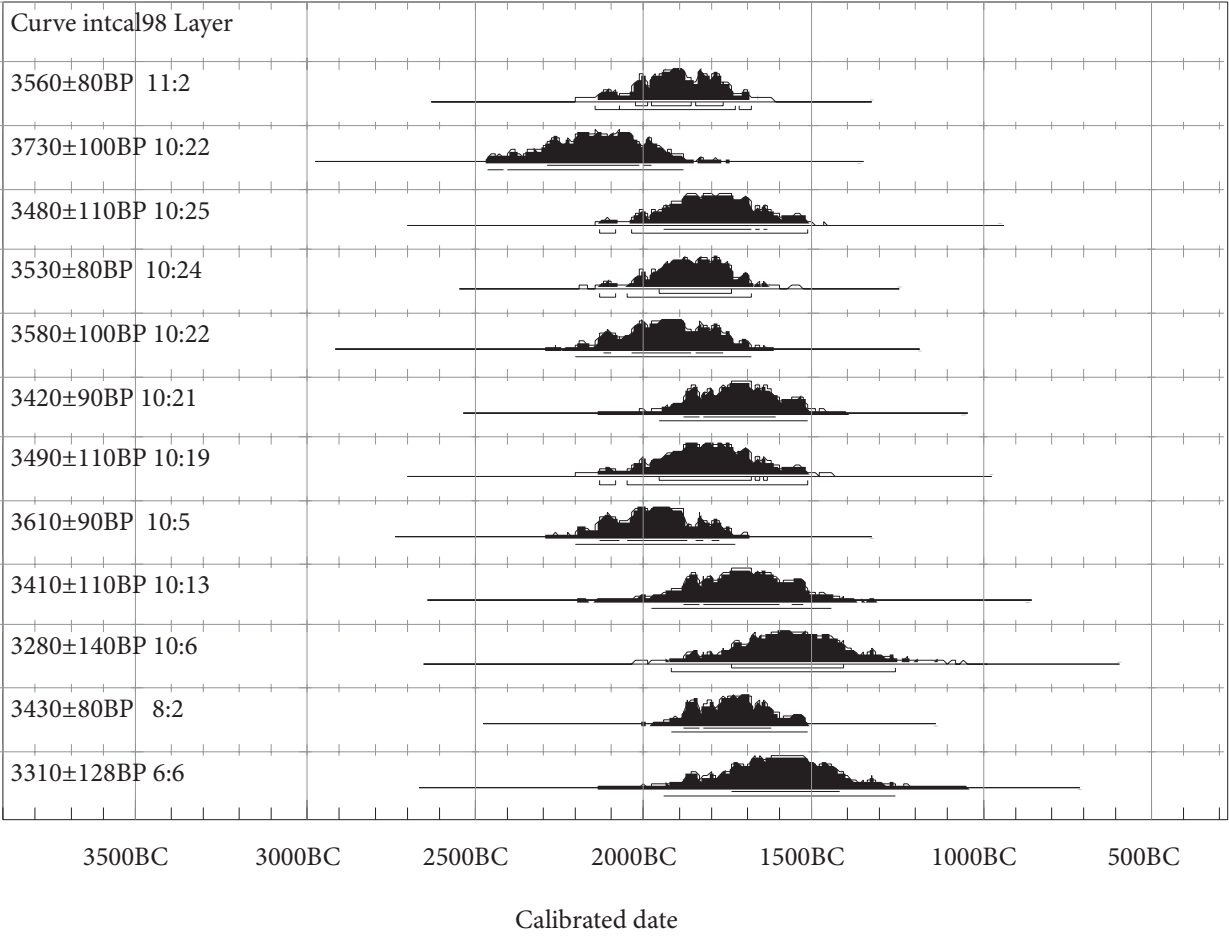


FIG. 10. The set of radiocarbon dates from the Australian National University

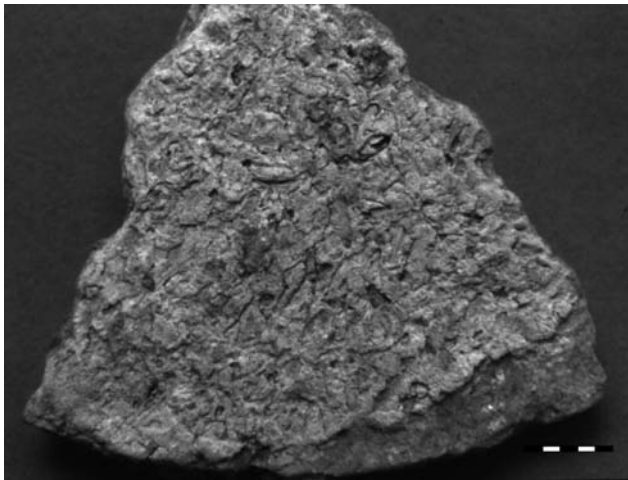


FIG. 11. Rice remains were seen as impressions on clay, adhering to pottery sherds. Scale 5 mm

of decline. A similar pattern is seen for those from clean marine sand, except that the decline was much sharper at the transition from layer 10 to 9. The clean coralline habitat is better represented in layers 9 and 10. Again, layer 10 has provided most species adapted to seaward-facing mangrove before numbers declined. The contrary pattern, earlier rarity and increasing prevalence from the end of layer 10, is seen for species adapted to landward mangrove and fresh water conditions. From layer 7, there was a further change with the advent of dry land species. Many of the small gastropods are thought to have reached the site in fish guts. They are thus likely to represent where people fished. Again, we see a transition from estuarine to freshwater spe-

cies, followed by an increase in terrestrial species which presumably colonised the settlement.

Mason (1991) has concluded that the site was initially located on or near the estuary of a large river, possibly the ancestral Bang Pakong. The inhabitants had access to clean marine conditions, but increased turbidity and sedimentation, which might have been induced by forest clearance in the catchment of the river, saw a reduction in the availability of filter feeding shellfish which rely upon clean water. As sedimentation increased, and the site was progressively distanced from



FIG. 12. The lowest layers at the site incorporated many ash spreads, thought to have resulted from firing pottery vessels



FIG. 13. A row of postholes from the layer 11 reflect the probable presence of structures

adapted to an open salt marsh environment, while the latter inhabits fresh to brackish swamps, or the margins of seasonal pools and streams. *Suaeda maritima* seeds dominate numerically from the initial occupation until layer 10:19, after which they became rare. However, a number were found in layers 6 and 5. Cyperaceae achenes, by contrast, are relatively infrequent in layers 11 and 10, and have their apogee during layer 8 and 7 before declining in layers 6 and 5.

The frequencies of crab remains suggest a change from a mangrove to a drier habitat with clear streams, followed by a return to more marine

the open sea, so landward replaced seaward mangrove species. The advent of land snails and reduction in freshwater shellfish, which indicates non-estuarine and possibly even non-riverine conditions, has been placed by Mason between lower layer 8 and upper layer 7. This change, he has suggested, might have involved a major relocation of the river bed, or the cutting of an oxbow in the vicinity of the settlement and corresponds to the mortuary phase (MP) 4. It was, however, short lived. In layer six (mortuary phase 5), there was a resurgence of landward mangal and mudflat shellfish, which indicate a return to more saline conditions deleterious to rice cultivation.

In her analysis of the charcoal from cultural contexts, Thompson (1996) has found that Rhizophoraceae dominates in layers 10 and 11. She has identified *Bruguiera* and *Ceriops* as the most likely genera, both of which are found in drier parts of the mangrove above the high water mark. This charcoal form continues to dominate, with over 90 per cent of the assemblage, until the top of layer 8. She has suggested that there was a significant change in the trees selected for burning on the site during layer 8, when mangrove species declined. However, at least one sample from layer 5 comprised 100 per cent charcoal from mangrove sources.

Most seeds recovered through flotation come from *Suaeda maritima* and Cyperaceae. The former are



FIG. 14. A cache of potter's anvils (A), adzes (B) and burnishing stones (C) from layer 11:2, the basal context at the site. Scale 5 cm

conditions. *Portunus pelagicus* is adapted to a sandy or sandy/mud habitat, and is restricted to layers 8-11. *Scylla serrata* prefers muddy-bottomed estuaries, and is particularly abundant during layers 8-10, but they were still frequently found up to and including layer 4. Potamid crabs, on the other hand, live in clear streams. Rare in layers 9-10, they increased in relative frequency from layer 8 but become rare again in layers 5 and 6. A move to freshwater species is also seen in the remains of fish. *Plotosus canius*, for example, are currently found in the estuary and lower reaches of the Bang Pakong River. Abundant in layers 9 and 10, they declined in layer 8. This distribution is the opposite of that seen for *Clarias*, which is adapted to rivers, canals, lakes and swamps and therefore also rice fields. Rare or absent in layers 10 and 11, they increased in relative frequency from layer 9.

Few mammals are represented in layers 11-9, the most numerous being the macaque (*Macaca*) and pig (*Sus scrofa*). Both are found in mangrove forests. Bovids are rare, none being found in layers 10 or 11. Where speciation is possible, they are usually water buffalo (*Bubalus bubalis*) which fall within the size range for wild animals. Apart from the dog (*Canis familiaris*), which is exotic to tropical South-East Asia, there is no evidence for the domestication of animals. Deer of various species are the dominant ungulate, and their numbers increased from layer 6. Among the smaller mammals, it is notable that all the rats identified are *Rattus rattus*, the roof rat. West (1991) has noted that this is the only species which Lekagul and McNeely (1977) were able to trap in mangrove forest. Otters were rare until layer 5. She has stressed that by layer 3, a new range of animals adapted to a riverine and non-mangrove forest became more numerous, a range which included otters, civets and cats.

West's research on the avifauna reveals a similar pattern. In layers 9-11, we find the Sarus crane, stork, Oriental darter, duck and godwit, all adapted to estuarine mangroves and marshland. By layer 5, all these species had disappeared, to be replaced by birds which prefer open fields, grassland and forest fringes, such as the dusky broadbill and crow.

The environment of Khok Phanom Di underwent a series of major changes over the five centuries or more of its occupation. It is possible to identify these changes on the basis of data from many sources: the fish, shellfish, forams, ostracodes, charcoal, birds and seeds. They provide a consistent picture. The initial occupation took place on a mangrove-fringed estuary with salt flats in the vicinity. There was then a trend towards freshwater conditions, perhaps related to sedimentation or a slight lowering of the sea level. This situation was then reversed as marine indicators returned in force. However, the final change saw the spread of dry land conditions as the sea level again fell, this time significantly. One of the principal objectives in completing this analysis of prehistoric Khok Phanom Di, is to integrate these changes with patterns of human adaptation.

THE MATERIAL CULTURE

The inhabitants of Khok Phanom Di had access to good potting clay, bone and shell. Stone suited to the manufacture of ornaments, adzes or hoes, however, was unavailable locally. Certain shell species valued in jewellery manufacture, such as cowrie, trochus, tridacna and conus, were also exotic to the estuarine habitat. The biological remains have provided evidence for environmental change during the prehistoric occupation, as the estuarine conditions gave way to an inland habitat which provided more ready access to freshwater resources, followed by a reversion to more saline conditions.

The distribution of the artefacts displays both continuity and change. It is through these implements that we can explore the degree to which people adapted to the changing environment. Fish-hooks, for example, were fashioned from bone. All are one piece, often double-barbed bait hooks. They are found in layers 11 and 10, but thereafter become rare, the latest and smallest example coming from burial (B) 30 in layer 8. This distribution is paralleled by the clay net sinkers, which were found from lower layer 10 until layer 7, with a late return in layer 2. It will be recalled that it was during the period of reduced salinity that freshwater fish and crabs became prominent at the expense of fish suited to marine or estuarine conditions, a change mirrored in the distribution of small gastropods thought to have entered the site in fish guts. Clearly, fishing continued at this juncture, but techniques changed, possibly in the direction of traps which leave no archaeological remains (Higham and Bannanurag 1991).

Taphonomic changes might also account for the disappearance of fishing gear from the archaeological record. Perhaps modifications to the mortuary ritual which excluded the accumulation of profane artefacts in a cemetery area are responsible. Yet this interpretation is not reflected in the distribution of artefacts thought to have been used in decorating pots and the processing of skins. Bone stylus points are found from layers 11 to 2, although there is a hiatus in layers 6, 8 and 9. The same situation obtains for bone awls, which extend from the base of layer 10 to layer 2 while absent from layers 6-8. Particularly small awls appeared from layer 4. Again, artefacts described as bone burnishers appeared from layer 4. These were made, where diagnosis is possible, from deer bones. Deer became relatively abundant at this point in the sequence, and the antler industry as a whole is particularly dominant in these upper contexts.

Stone adzes are found throughout the sequence, but there was a marked reduction in their frequency during layers 5 to 8. Over half the sample of 103 specimens have been ascribed to form 2G, which has an oval elliptical cross section, with examples in every layer. The second most abundant was the shouldered form 8D. Pisnupong has noted that early examples in particular had been subjected to heavy use, and the small size of many reflects resharpening or on occasion, complete reshaping to obtain more use from artefacts fashioned from an exotic raw material. Very few adzes were found as grave goods.

There are two artefacts which could have been used in the cultivation and harvesting of rice. Of these, the implements described by Pisnupong (1993:88) as hoes are made of an exotic leucogranite which outcrops about 50 km from the site. These appear from upper layer 10, and were never abundant. They were usually broken at the midpoint between the functional end and the poll, and had been used in robust work of some sort, possibly turning or tilling the soil. Pisnupong has estimated that they would have been about 30 cm long. The second artefact is a knife formed from the freshwater bivalve *Pseudodon inoscularis*. These are found from upper layer 10 to layer 7. Higham T.F.G. (1993) has undertaken a series of experiments in an attempt to replicate the wear pattern on their cutting edges, and has concluded that their most likely use was cutting grass stalks. Modern equivalents were used to harvest rice in the vicinity of the site, and were found to be satisfactory for the task, although regular resharpening was necessary.

Most personal ornaments were made of shell, and recovered from burials. The most abundant form was the disc bead, over 250,000 of which were found in burials of all phases, and employed as constituents of headdresses, garment ornaments, necklaces, bracelets and anklets (Pilditch 1993). Other shell beads were restricted chronologically: funnel beads to MP1-2, barrel beads to MP2-3, I-shaped beads to MP5 and H-shaped beads to MP6-7. All but one of the shell bangles come from

MP5-7, and the dominant raw material was tridacna shell.

Stone bangles were fashioned from marble, slate, slaty shale, andesite and volcanic sandstone. None was found associated with a burial. Whereas the marble examples were early in the sequence, those from the other sources concentrated in layers 2-5, with a third of the 115 specimens being found in layer 3. This distribution contrasts with that for fish bone bangles. Four burials in MP2 included these ornaments, one from MP3 and one from MP6. Ornaments in the form of a carved turtle carapace are restricted to male graves in MP3 and 5.

Khok Phanom Di was a major ceramic manufacturing centre. The presence of clay potters' anvils and burnishing stones throughout the sequence reveals that the paddle and anvil technique was used in shaping the local clay. Bone stylus points, initially interpreted as being associated with weaving or leather work, are now thought to have been used to incise patterns on the clay before firing (Hall 1993). There are also ceramic stands used for supporting firing platforms, and many lenses of ash that may well reflect the actual location for firing. Prepared clay was commonly found, some in the form of cylinders used as mortuary offerings. Caches of sand temper were also present in the lower layers of the site. Burnishing stones and anvils were regularly found as mortuary offerings with the dead (Moore 1993), and some of the latter bore what may well have been owners' marks (Vincent 2004). When an access road was cut through the edge of the mound, huge quantities of ash and pot sherds, probably wasters, were revealed. It is likely that the inhabitants used the periphery of the settlement for firing their wares. The detailed analysis of the ceramic remains has allowed Vincent (2004) to identify four major ceramic manufacturing phases, together with the changing pattern of imported exotic wares.

THE SUBSISTENCE

Hitherto, the biological remains have been used to reconstruct the changing environment. The earlier inhabitants of Khok Phanom Di had access to one of the richest habitats known in terms of self-replenishing food sources, the tropical estuary. Based on the constant mangrove leaf fall, the food chain provides for a wide range of marine species which are not subject to the vagaries of the monsoon climate. As Thompson (1996) has shown, the mangrove belt itself is not devoid of food sources, while fresh water swamps, which played an increasingly significant part of the environment during layers 9-6 as sedimentation distanced the site from the sea and estuary, are also a potential food source.

Marine, brackish and freshwater species were exploited by the inhabitants. We recovered large samples of shellfish, fish, crustacea and a sample of bird bones. The remains of partially-digested food incorporated fish bones and scales. Mammalian bones, however, were rare for most mortuary phases, and were not incorporated as grave goods, a common practice in inland sites.

Rice remains were recovered from all layers except the uppermost. Even at a depth of 6.8 m and on the surface of the natural substrate, fragments of rice husk were encountered. There is no doubt that rice formed part of the diet of people, as well as for dogs, since rice husks were found in canid coprolites. Burial 56 also provided a sample of partially digested food which included fragments of rice husk. That some, at least, of the rice came from a domesticated plant is seen in the lack of awns and the form of the abscission scars. This evidence, however, does not mean that the occupants of the site cultivated rice. As Thompson (1996) has shown, rice is one of many commodities which might have been exchanged between inland and coastal communities. One

of the most telling points, at least for the earlier part of the sequence, is our understanding of the environment. The saline conditions would have made rice cultivation extremely difficult, if not impossible, within easy range of the site. However, environmental change seen in the increasing frequencies of fresh water fish and shellfish would have provided more promising conditions for the cultivation of rice. Two artefacts might have been involved in rice cultivation, the stone hoe and reaping knife. These appeared towards the top of layer 10. It is, therefore, considered possible that the rice found in layers 11 and 10, at least, was obtained through exchange, but that as conditions changed, so local cultivation was adopted. A reversion to more marine conditions in layers 4-6 would have been injurious to the cultivation of rice.

THE PEOPLE OF KHOK PHANOM DI

The excavation has provided the opportunity to examine the interactions between the environment, subsistence, technology and the health of the inhabitants over time. The sequence of interments was initially divided into seven mortuary phases (MP). These were distinguished on the basis of the sequential placement of graves, and changes in the rituals associated with burial. However, after the completion of his analysis of the ceramics, Vincent was able to pinpoint a basic change which witnessed the transition from ceramic period (CP) 2 to CP3, which took place during MP3. Once identified, detailed scrutiny of the graves in question revealed further more subtle changes, such as the reduction in the number of shell beads, the form of a basic pottery vessel that accompanied the dead, and the presence of smashed rather than complete vessels. On the basis of these consistent changes, we have divided MP3 into subphases MP3A and MP3B.



FIG. 15. Postholes at Khok Phanom Di, on occasion, retained the original wooden upright. Scale, 5 cm

Tayles (1999) has analysed the human remains with particular emphasis on health. There were many changes within a community where a rich natural environment was balanced by numerous potential pathogens. This, generally speaking, is reflected in the contrast between good bone development, which is compatible with an adequate diet, and recurrent anaemia. Tayles has documented the age at death, health and diet reflected in the condition of the teeth, stature, sexual dimorphism, fecundity, physical activity, bone degeneration, evidence for anaemia and possible genetic relations judged on the basis of health and proximity, temporal and physical, of each individual. The picture she presents is one of a community

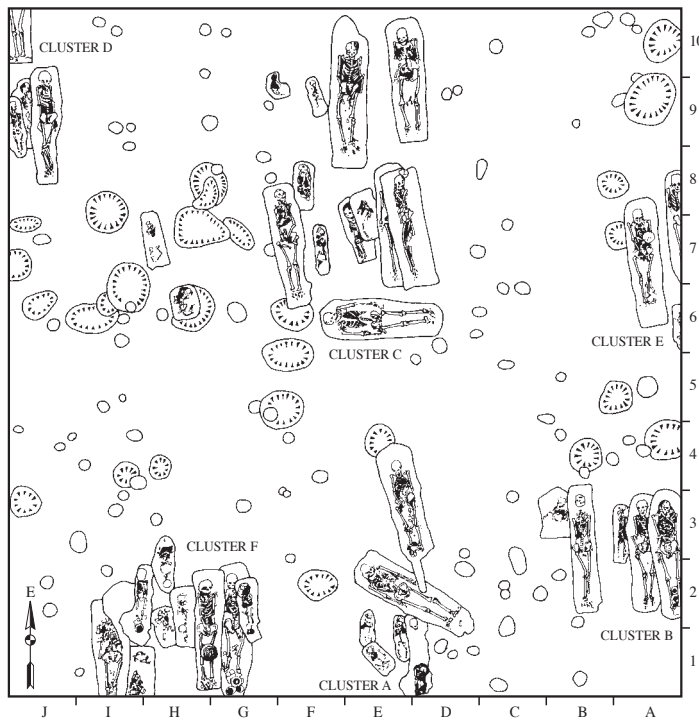


FIG. 16. The distribution of burials during mortuary phase 2. Scale in metres

which survived, adapted, and in many respects prospered, over several centuries, despite some severe health problems. In addition, Bentley (see page 159), has identified through the strontium isotope analysis of teeth, certain individuals who came to the site from a different environment.

The single theme which runs through Tayles's results, is change over time. It is impossible to assert that the people of Khok Phanom Di were relatively tall, or had a particular pattern of tooth wear, because of a kaleidoscopic series of subtle adjustments and changes. The few MP1 burials anticipate a recurrent interplay between the availability of a good diet and genetically inherited anaemia. A haemoglobinopathy, such as thalassaemia, confers some resistance to malaria at the cost of suffering from anaemia. This condition involves changes to bone structure, which Tayles has identified throughout the mortuary

phases. The adults from MP1 had good cortical bone thickness, but also reveal indications of anaemia, while the child burial 150 provides evidence for haemoglobinopathy. The adult male had worn teeth which result, in all probability, from an abrasive diet. Most adults during MP1 came to Khok Phanom Di after living as children in a different environment.

During MP2, two thirds of all individuals died in infancy or childhood. Moreover, the adult teeth and limb bones evidence periods of growth disruption when young. However, the peoples' vigorous and active lives involved a distinction between the sexes. Male upper body strength reflects an activity such as paddling a canoe. Mens' teeth also show more wear which could have been caused by a different diet. Females by contrast have most joint degeneration in the lower back, shoulders, hips and knees compatible with such activities as gathering shellfish or plant foods. They were also fertile, nearly all women showing evidence of pregnancy.

Infant mortality remained high during MP3, and males continued in the same sort of physical activity which saw them taller and more robust than at any other period. Nevertheless, males and females still suffered from anaemia and life expectancy was the same as in the previous phase.

MP 3B and 4 saw a series of changes. Several women came to the site having been raised in a different environment. Infant mortality declined, but that for children increased such that 34 per cent of the sample comes from infants and children combined. Four of the five children had suffered from severe anaemia. Sexual dimorphism was reduced from previous phases, and people had a reduced life expectancy. The men were physically less active, and the limbs of the upper body reveal less joint degeneration. Modifications to the diet may have involved greater tooth

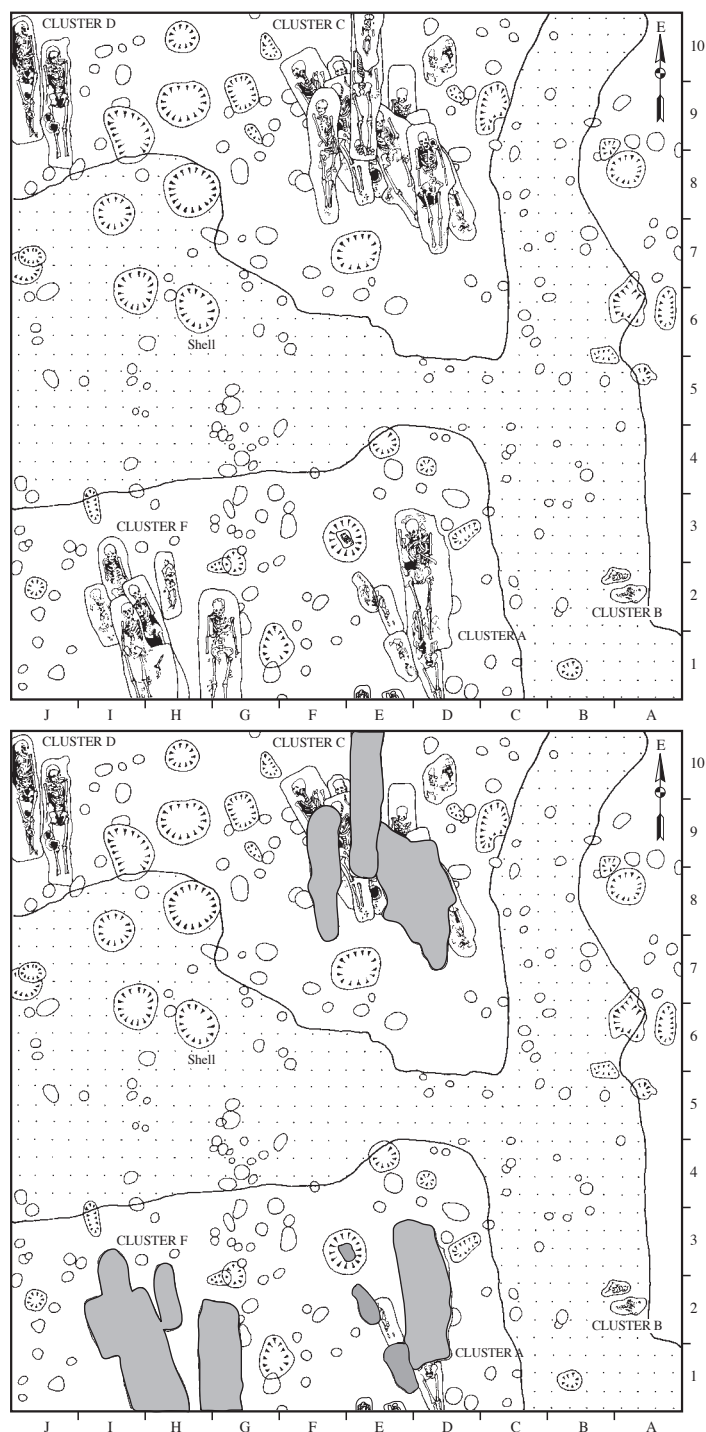


FIG. 17. The distribution of graves during mortuary phase 3, (above), and with MP3B graves highlighted (below). Scale in metres

wear, accompanied by few caries and less periodontal disease.

The samples from the final three phases are small, but the indications are that some trends noted in MP4 continued. People were shorter, and the health of children continued to be poor: half the sample comes from infants or children, with most of the latter revealing evidence for anaemia. A further dietary change saw a reduction in excessive tooth wear and increase in caries. While the males show little evidence for stressful physical activity, women used their arms and hands for exerting pressure, as in working clay for making pottery vessels.

The results of Tayles's analysis stress the interrelatedness of human health, activities and the environment. Natural wealth in terms of food resources was balanced by the many potential pathogens. Haemoglobinopathies were present in the gene pool, the cost of some resistance to malaria being a high incidence of anaemia. Women were fertile, but suffered successively from extremely high infant mortality, and then high child deaths as more infants survived the first few years of life. Relatively few adults lived beyond the age of forty. The diet changed, from one which imposed abrasive wear, particularly on males, to a less harsh range which involved a higher rates of caries. Given the clarity of these changes in human health and activities, it is necessary to relate them, if possible, to the modifications noted in the environment, material culture, subsistence and mortuary ritual.

THE SOCIAL ORGANIZATION

The mortuary evidence for MP2-3B indicates corporate burial in clusters in which some individuals were interred

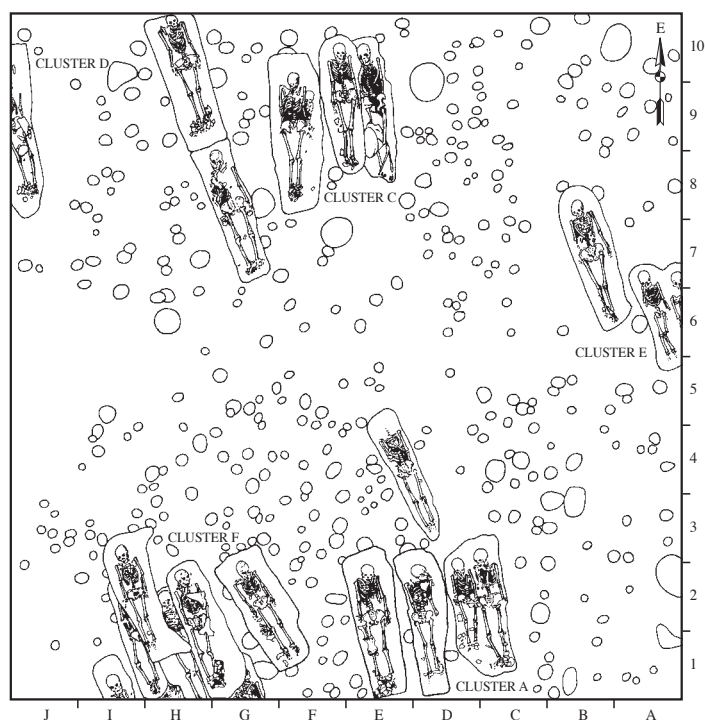


FIG. 18. The distribution of burials during mortuary phase 4.
Scale in metres

in the clay source, the temper used, the means of decorating fine wares and a change in the form of coarseware containers. A man was found buried with a large turtle carapace ornament, a practice that continued into succeeding mortuary phases. This phase saw the first hints of a transition to freshwater conditions, and one MP3B burial, that of a woman, incorporated food remains in the pelvic area that contained rice husks. Faeces in the grave of burial 67 contained husks from cultivated rice. It was during this phase that the shell harvesting knives began to appear in numbers.

During MP4, people were still buried in clusters, but they were provided with individual graves. Men ceased to be so physically robust at a time when fishhooks declined markedly in numbers, and shell jewellery became rare. The teeth reveal a changed diet at the same time that we find numerous shell reaping knives, and a number of stone hoes. Freshwater shellfish and fish increased at this juncture, and Mason has suggested that this reflects an environmental change involving less easy access to the main river channel and the estuary. We consider it likely that rice was now cultivated by the occupants of the site. Infant mortality fell but more children died. Men now wore distinctive turtle carapace ornaments, women were interred with clay potters' anvils. We suggest that some women achieved social prominence as rice cultivation and the manufacture of pottery grew in significance. Men were weaker physically, reflecting less marine or riverine fishing and shellfish collection for jewellery manufacture.

The change in mortuary ritual in MP5, involving as it did the attainment of unprecedented mortuary wealth, coincided with the end of the recovery of shell reaping knives and a surge in

with considerable wealth in terms of shell jewellery. The men were physically robust, and their muscularity is compatible with canoeing. Many fishhooks were found, and shell beads were abundant. Male tooth wear differed from that for women. It is suggested that men were often engaged in riverine or maritime travel which involved fishing and the collection of shells for conversion into ornaments of social value. There is no artefactual evidence for rice cultivation, but rice was present. Exchange of local products for rice may well have taken place. The community struggled with ill health and there was high mortality among infants. Some family groups may have died out through failure to produce the next generation.

With MP3B, we find that people were still interred in the same clusters, but the pottery vessels represent a new ceramic period, involving differences

exotic goods. We find slaty shale, shale, ivory and tridacna shell either arriving at the site for the first time, or increasing in the quantity found. The attention given in the interment of burials 15 and 16 to the accoutrements of the potter, from the raw clay to the anvil and burnishing stones, not to mention the quality and size of the pots themselves, stress the importance of the ceramic industry. It is suggested that high status could be attained through personal skill in pottery making, and that this was signalled through the accumulation of shell ornaments. It is possible that those who made the pots for exchange had preferred access to the ownership or distribution of the new range of exotic ornaments encountered. Vincent (2004) has also suggested that wealth accrued to those who made storage vessels for the export of locally-available items, such as salt or salted fish. This was a period when the output of coarse wares increased considerably.

With MP6, we find one richly-endowed group of three burials interred under a rectangular structure, and a poorer group buried at the same time within a second building. These changes in mortuary ritual took place at a time when the shellfish reflect a reversal to more saline conditions, and the shell reaping knives ceased to be found. Rice cultivation probably became more marginal if not impossible within easy range of the settlement. There was no shortage of shell beads, however, and pottery making continued unabated. The amount of exotic raw materials declined from the levels achieved in the preceding phase.

There are very few burials in MP7, all coming from infants or children. Saline conditions continued, rice cultivation probably remained marginal or impossible, and there were relatively few exotic goods. This was the last phase in a mortuary tradition which had endured for four centuries.

SUMMARY OF THE CULTURAL SEQUENCE

The lowest layer at Khok Phanom Di was identified on the basis of the quantity of ash, which gave it a distinctive grey colour. Designated layer 11, it attained a maximum depth of 26 cm, from 6.55 to 6.81 m below datum. The artefacts relate to fishing, the manufacture of pottery vessels, and probably, forest clearance. Adzes, for example, were plentiful and show evidence for heavy use. The clay anvils and burnishing stones, 21 of which were found

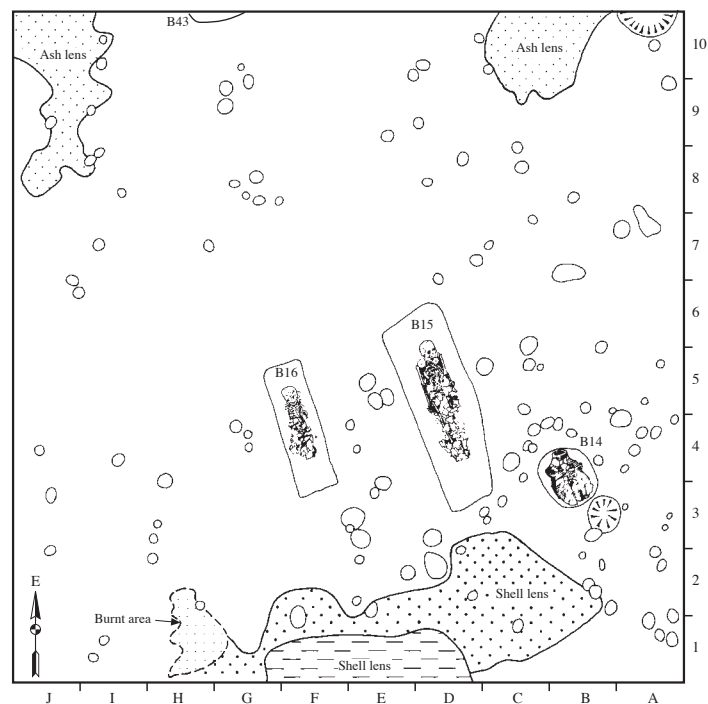


FIG. 19. The distribution of burials during mortuary phase 5. Scale in metres

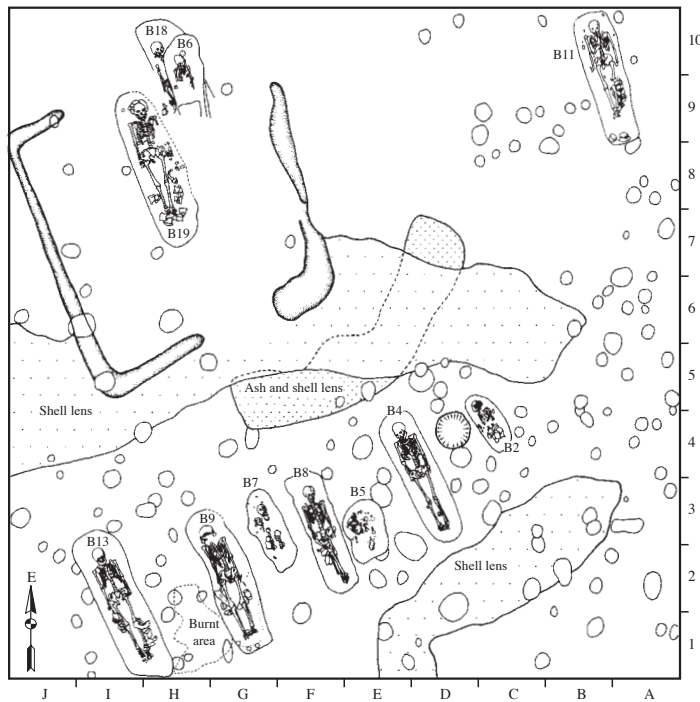


FIG. 20. The distribution of burials during mortuary phase 6. Scale in metres

in charcoal, pits containing organic refuse and areas where redeposition has resulted in thin varve-like lenses probably redeposited through water action. It incorporates graves ascribed to the first three mortuary phases, and will be described beginning with the deposits containing the six graves in MP1 (5.88 to 6.51 m below datum). While some artefacts continue unchanged from layer 11, bone awls and clay net weights appeared for the first time. The principal development in terms of material culture, was the transition at the base of this layer, from CP1 to 2. This involved a new clay source, the preference of a grog rather than a sand temper, some new ceramic forms and novel intricate incised designs against a highly burnished background. Marine and mangrove species predominate in the faunal spectrum, with *Lates calcarifer*, *Anadara granosa*, the pig, macaque and crabs numerically dominant. The first human remains show that a haemoglobinopathy was already present, suggesting that the initial occupants were already adapted to a malarial habitat. As might be expected from a diet rich in shellfish and crabs, adult teeth were well worn. Bone development was robust.

Deposits accumulated to a depth of 29 cm between the latest grave of MP1 and the earliest of MP2. During this period, the nature of the build up remained unchanged. We encounter at least one substantial midden deposit in which *Anadara* valves dominate numerically. There is also a linear row of five hearths and fishhooks, burnishing stones, net weights and clay anvils recur. The abundant evidence for burning might reflect local firing of the pottery vessels. Burials belonging to MP2 were cut from depths of between 4.95 and 5.57 m below datum, and their distribution incorporates clusters with intervening space filled by pits and midden deposits. A thick shell mid-

in a cache dug into the natural substrate along with an anvil and three adzes, evidence a pottery industry. Bone stylus points thought to have been associated with incising designs on pottery vessels, are present from the earliest context. *Lates calcarifer*, a fish which comes into estuaries to spawn, was represented, along with crabs of mangrove and muddy river margins. The midden laid down in layer 11 was dominated by muddy shore and mangrove species. Some hunting is revealed by the presence of bones from species known to inhabit mangroves - the macaque and pig. One deer bone was found, but the dog was absent. Some fragments of rice chaff were found in a layer which might well have accumulated very rapidly. No burials were associated with it.

Layer 10 is a thick accumulation of midden lenses, ash spreads, hearths rich

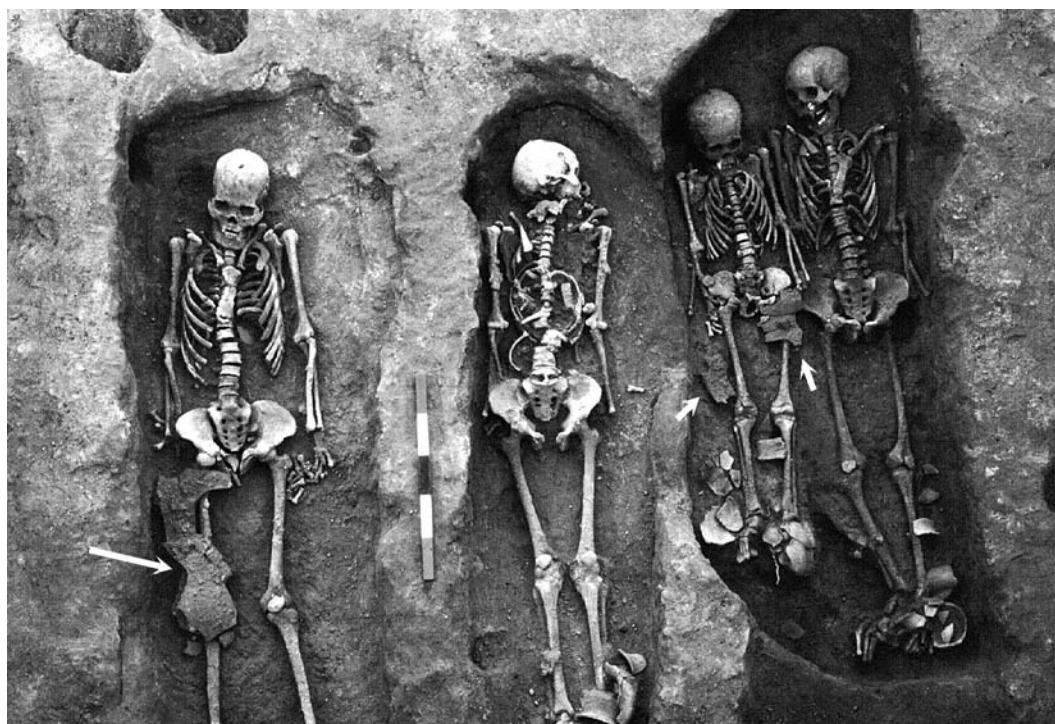


FIG. 21. Burials 30, 28, 32 and 31 (l to r), cluster A of Mortuary Phase 4. The arrows indicate turtle carapace ornaments

den complements the grave clusters, and its linear edges and right-angled turns suggests that it accumulated against rigid structures, such as the wooden walls of collective tombs. This midden contained over 137,000 *Anadara* valves, and was dominated by shellfish adapted to the mangrove and muddy intertidal zone. Apart from this midden, there was a change in the nature of the deposits associated with MP2. In place of ash spreads and hearths, we find many circular pits containing bivalve shellfish many of which were unopened. Postholes indicate the presence of structures in the vicinity of, possibly round, the grave clusters. While the adzes, burnishing stones, anvils and awls continued as before, there were also two innovations. All the bone harpoons came from this part of the site, and a single shell knife, thought to have been used in harvesting a grass, such as rice, were found. There was also an increase in the number of fishhooks and clay netweights.

The faunal remains also reveal continuity in the presence of pig and macaque bones, but we also find the first presence of the otter and the dog. The latter is exotic to South-East Asia, and can only have been introduced in the company of human communities. The pattern of inhuming the dead with the head pointing to the east continued, but we find many more burials, with individuals set out in clusters. In conjunction with a good diet and an active lifestyle among men which particularly involved the use of the upper body, we also find a high incidence of infant mortality, much evidence for anaemia, and virtually universal female fertility. A notable amount of energy was also expended on mortuary ritual. Bodies were wrapped in a fabric shroud, dusted with red ochre and laid on a wooden bier in individual graves. Pottery vessels were expertly made, bril-

liantly burnished and incised with complex designs. One man was found with about 39,000 shell disc beads, and shell beads in barrel and funnel forms were found with many burials. Cowrie shells included in one grave are almost certainly exotic, and bangles were fashioned from fish vertebrae.

Other grave offerings included the teeth of rhinoceros and muntjak, a stone adze, a fishhook and the stones used to burnish pottery vessels. The range of grave goods echoes some of the activities suggested by Tayles as possible correlates of bone degeneration: making pots and paddling canoes. No clear differences have been detected in the mortuary rituals and grave goods found with men and women, although some individuals stand out on the basis of either their complement of barrel beads, or association with shell beads and pottery vessels.

During MP3A, which followed with no evident time lag from MP2, we find that the singular shell midden known as lens 2 first tapered off in size, and then ceased. The stratigraphic sequence included many postholes, pits, and lenses containing ash and charcoal. Artefacts included burnishing stones and clay anvils. Only one fishhook was recovered and net weights became rare. Only two dog bones were found in MP3 contexts, the macaque and pig dominating.

Just over half of all burials contained infants or children. Males continued to develop strong upper bodies, indeed they were taller and more robust than at any other phase. But anaemia still affected health. The grave goods included shell disc beads, pottery vessels some of which were burnished and incised with complex designs, burnishing stones and a fish vertebra bangle. One man was buried with four unique items: a nautilus shell, fish skeleton, shark fin spine and a small stone chisel.

The transition to MP3B saw the first hint of different treatment in death based on sex, a development that might well reflect the arrival in the site of women from a different environment. A man was interred with a turtle carapace ornament, and a woman with a clay anvil. This set a pattern to be followed in later phases. It is also intriguing to note that, as shellfish of the clean intertidal conditions fell away in frequency, so the number of disc beads in burials declined sharply. This phase also saw the transition from CP 2 to 3. While almost certainly belonging to the same regional tradition, pots now exhibited subtle changes in form and decoration, and a new clay source was preferred. Perhaps the most significant change in terms of the economy at this juncture, was the manufacture of large granite hoes and shell reaping knives. Taken in conjunction with the presence

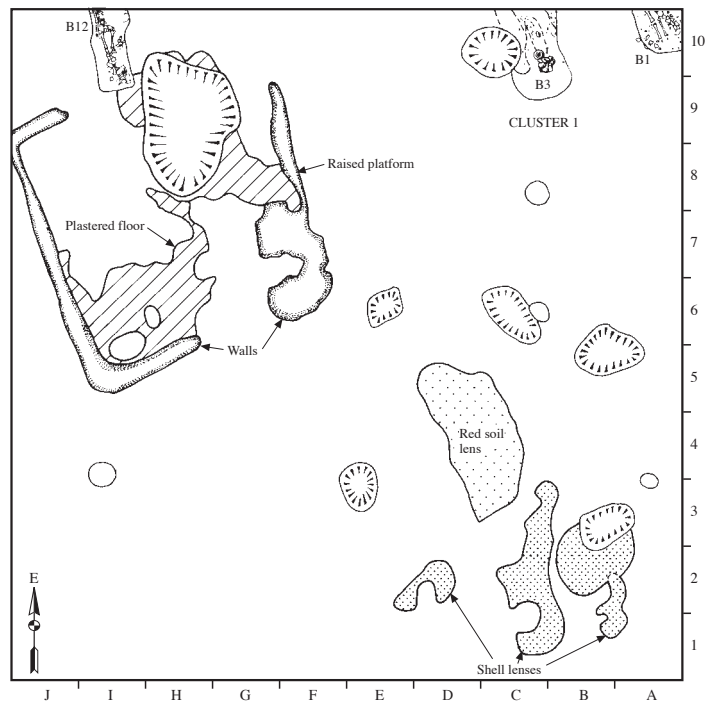


FIG. 22. The distribution of burials during mortuary phase 7. Scale in metres



FIG. 23. The grave cut for burial 1, mortuary phase 7, is clearly seen in the section (see arrows). Scale 5 cm

of demonstrably cultivated rice in the faeces of one individual, and the presence of rice in the stomach contents of another, there is little doubt that rice was now locally grown.

Mortuary activity virtually ceased during the accumulation of layer 9 over a depth of 34 cm. During this period, a series of midden, ash and charcoal lenses were deposited, and their distribution followed that of layer 10 lens 2. This suggests that existing mortuary structures belonging to MP3 remained in place and influenced the location of later deposits. During layer 9, shellfish from clean coralline subtidal and intertidal conditions were no longer present and estuarine species also declined, to be compensated by a rise in shellfish adapted to freshwater habitats. This change is matched by the distribution of fish and crab remains, those adapted to freshwater taking the place of earlier species coming from marine or lower estuarine conditions. We also find the first representation of the water buffalo and small deer. But macaques and pigs continued to predominate. The first pygmy cormorants and pelicans were

found, birds adapted to rivers and marshes. The last crocodile bone was found in lower layer 9. There appears too, to have been a change in fishing strategy, for fishhooks were no longer in evidence and netweights were rare. While adzes, burnishing stones and anvils were still found, shell knives surged in numbers.

Mortuary Phase 4 corresponds with the period identified by Mason as that most likely to have witnessed a major and possibly rapid environmental change. This could have involved a move in the channel of the river thought to have been located adjacent to the site, or the formation of an oxbow lake. At any event, we can pinpoint a number of other changes which might relate to such an event. Shellfish remains show a further decline in the incidence of seaward mangal species, and the rise in freshwater species seen in the preceding hiatus was followed by a decline. Only one fishhook was recovered, and a few netweights. Nevertheless, several stone hoes were found, and numerous shell knives. An ostracode from this context is from a species adapted to fresh water conditions, such as rice field. Freshwater fish and crabs again rose in frequency compared with marine or mangrove species.

It is possible that burning, resulting in a series of ash lenses, preceded the renewal of the tradi-



FIG. 24. The graves of Mortuary Phase 6 looking west. Note the configuration of postholes round the burials, indicating that they were confined within a wooden structure

tion of interring the dead in clusters during MP4, and within the mortuary area, we find a number of postholes, but markedly fewer pits. The burials, while still in their traditional clusters, were now less crowded in on each other, and were provided with individual graves. The trend towards distinguishing between males and females by the provision of turtle carapaces for the former, and anvils for the latter, was strengthened. Other grave goods included pottery vessels, now bearing different ornamentation to that characteristic of MP2-3A, burnishing stones, and a single fishhook. Again, shell disc beads were very rare compared with MP2 and early MP3. The human remains reveal a number of profound changes. Infant mortality fell, but child mortality rose. Four of the five dead children had suffered from severe anaemia. The rise in infants surviving to childhood would have involved a greater investment in child rearing, and probably, a reduction in the number of births through greater spacing between pregnancies. There was a reduction in sexual dimorphism: men were now smaller, lived shorter lives and lacked the powerful upper body musculature of their forebears. Tooth wear declined in both sexes. Whereas tooth wear had caused most dental infection in MP2-3 in males, caries was responsible in MP4. It seems highly likely that the diet involved less abrasive food. Stratigraphically, this mortuary phase includes burial 33, the grave cut for which was recognised at a depth of 3 m. It is possible that the cut was higher, and that this

interment belongs to MP5. The nature of the child interment is much closer culturally to MP5 than to MP4, because it is very rich: There are 7845 disc beads, 108 of the I-shaped beads so distinctive of MP5 burials, four pottery vessels and a small clay anvil.

Only 15 cm of cultural deposit accumulated between the last burial of MP4 and the interment of burial 15, which belongs to MP5. But the mortuary ritual underwent major change. Interment in clusters ceased, and three people, a woman and two infants, were buried in an area not hitherto used for this purpose. These graves were large and the dead were richly endowed with grave goods. Ornaments included thousands of shell disc beads and new forms of jewellery made from tridacna such as discs, bangles and I-shaped beads. Burial 15 was interred with eight complete pots, some of novel form. It is also likely that the woman, who died in her mid thirties, was involved in pottery making. Her hand musculature was well developed, she was interred with an anvil and two burnishing stones, and her body was covered by clay cylinders thought to have been intended for conversion into pottery vessels. The infant buried in an adjacent grave was also interred with a range of novel shell jewellery, fine pots and a miniature clay potter's anvil. A second infant was found within two large, impressively decorated pots. The narrow stratigraphic band associated with MP5 burials saw the advent of land snails, indicating that the site now had access to dryland.

Mason has suggested that this is a delayed impact of an environmental change which occurred earlier in the sequence. This period also lacked any shellfish from the clean coralline habitat to which tridacna is adapted, suggesting that the new range of shell jewellery was exotic. Ivory bangles were found for the first time, although not with burials. The last shell knife was found just before the start of MP5.

The earliest MP6 burials followed with little interval from MP5. There is a consistent body of evidence in favour of environmental instability, seen in an increase in shellfish from estuarine and seaward mangrove habitats. At the same time, sickles fashioned from freshwater shellfish ceased to be found.

After a long interval, a few seeds of *Suaeda maritima*, which is adapted to salt flats, reappeared and Cyperaceae became rare. It is possible that rice cultivation became marginal through the invasion of salt water. The mortuary ritual involved investment in substantial mortuary structures, one containing rich interments, the other a row of burials with far fewer grave goods. A more marine or at least brackish water habitat seems to have continued into the currency of MP7, the final phase which is represented only by a handful of graves.

The wall of the MP6 mortuary structure remained in place while layer 4 sandy deposits accumulated. Several pits were dug within the layer, and they contained faunal remains which included many marine species of fish, shellfish and the mangrove crab. This was a relatively thin layer which represents the last period in which the inhabitants exploited a marine habitat. We cannot demonstrate a period of site abandonment with the end of layer 4, but it is a possibility. With layers 3 and 2, which are undated, the excavated area was used as a pottery workshop. We find many clay anvils and burnishing stones, as well as cylinders of unfired clay thought to represent an early stage in the forming of pots, and a dump of clay. But other activities were also indicated by material remains. A new form of small awl was present in abundance, bone stylus points, much worked antler and numerous slate bangles. Ivory is also relatively abundant. Faunal remains include the first major occurrence of bovid bones, but trapping was also undertaken, with the otter and various civets being identified. Small deer, either muntjak or pig deer, increased in numbers, and at the top of layer

2, net weights reappeared. Potsherds were more abundant than at any other period of occupation. The impression is one of an occupation phase by a community which continued to hunt, trap and fish, within a more forested habitat, continued to obtain exotic raw materials through exchange and manufacture pottery vessels from the local clay.

CULTURAL PHASES AT KHOK PHANOM DI

On the basis of the above synthesis, we suggest the following cultural phases at Khok Phanom Di.

Phase 1. Layers 10:25 to 11:2, date, *c* 2000-1900 BC. The low-lying site was located near salt flats and the inner margin of the mangrove, but the latter half saw an increase in shellfish found just above the reach of high spring tides and a drop in the incidence of seeds representing saline salt flats. Subsistence included much fishing, shellfish collecting, and exploiting mangrove crabs. Rice was found, but there is no artefactual evidence for local cultivation. The dog was absent. Close parallels are found between this phase and the occupation of Nong Nor during phase 1.

Phase 2. Layer 10:24-10:2, *c* 1900-1750 BC, mortuary phases 1, 2 and 3A. This period saw ceramic period 2. During MP1, both men and women were born and raised in an environment different from Khok Phanom Di. The inhabitants made pottery vessels and decorated them with a lustrous burnish and complex incised designs. They suffered from anaemia, and there was very high infant mortality. Men had strong upper bodies, and their dental wear differed from that seen in women. Dead were interred in clusters probably within wooden structures. A few individuals were buried with rich and varied grave goods, but there is no evidence for one burial cluster being consistently more wealthy than another. Reliance on a marine diet obtained through hunting, fishing and collecting continued.

Phase 3. Layers 7:2 -10:1. Mortuary Phases 3B and 4, date *c* 1750-1650 BC. During the early part of this phase, several women came to Khok Phanom Di from a different environment. There were a series of significant changes in both the environment and the material culture. Hoes and rice harvesting knives were in use, while freshwater shellfish became more abundant than those of the landward mangrove swamps. It is likely that rice agriculture was undertaken. Fishhooks ceased to be found, net weights became rare, and men ceased to be so physically robust in their upper bodies. Infant mortality was reduced, but more child burials were found. Tooth wear reflects a less abrasive diet. Burials were markedly poorer, with little evidence for shell jewellery. As MP4 progressed, so we find no further evidence for the arrival of immigrants from a different habitat.

Phase 4, Layers 6:6 to 7:1, Mortuary Phase 5, date *c* 1650-1600 BC. This brief phase saw the interment of four exceptionally rich graves. The burial goods included the first major infusion of exotic shell ornaments, fashioned in the main from tridacna. Ivory, slate and slaty shale were also found with some frequency. Shell harvesting knives, however, ceased to be encountered and mangal, became more abundant at the expense of those adapted to freshwater.

Phase 5, Layer 6, Mortuary Phase 6, date *c* 1600-1500 BC. This phase saw a reduction in the number of freshwater shellfish and a surge in the frequency of species adapted to mangal. No more shell harvesting knives nor stone hoes were found. *Suaeda maritima*, a plant of salt flats, re-established itself. The burials reveal two groups, a rich one within a square mortuary structure, and a poorer one in which graves were set out in a row contained, probably, within a wooden building. A child burial in the former group was found with a large shell disc by the head. Exotic

slate and tridacna items continued to be found. Pottery making implements continued to be associated with women.

Phase 6. Layer 5, Mortuary phase 7. date, *c* 1500 BC. During this phase, there was a decline in the frequency of mangrove species of shell, but they were still present in significant numbers. No harvesting knives were found, but one hoe was present. Slate, tridacna shell and ivory were obtained, probably through exchange. There were few burials.

Phase 7. Layer 4, date, post 1500 BC. There may have been a period of abandonment between phases 6 and 7, but there is no stratigraphic evidence for this. The area excavated was no longer used as a cemetery. The inhabitants still had access to marine resources, made pottery vessels and obtained exotic goods. We see an increase in the quantity of shale and ivory, but a reduction in the amount of tridacna. The faunal spectrum includes the bones of some small mammals and bovids which are compatible with a drier, more forested habitat.

Phase 8. Layers 2-3, date, post 1500 BC. The area excavated was used to manufacture pottery vessels, and there is evidence of working ivory and antler. Net weights were again common, and woodland fauna increased. Marine species of shellfish were no longer found or became very rare. No more tridacna was recovered, but shale was abundant.

FIG. 25. The cultural sequence of Khok Phanom Di

III. THE ANALYSIS OF THE MORTUARY REMAINS

In considering the human burials from Khok Phanom Di, it has already been observed that individuals were laid out in clusters, some of which were added to over about 400 years. Discontinuities in mortuary behaviour are recognised in the ascription of burials to one of seven successive mortuary phases. The transition from mortuary phase (MP) 1-2 was signalled by the commencement of clustering graves together (Fig. 26), for during the former, the few burials encountered were interred with no apparent spatial relationship between them. MP2 and 3A are separated only because of either an apparent hiatus in interments, or a particularly rapid period of deposition giving the impression that burial activity in this part of the site ceased. MP3B witnessed a major change, seen in a new ceramic phase, and many other changes involving the environment and economy. MP4, 5, 6 and 7 are distinguished from each other by changes in behaviour. Thus, MP5 comprises four outstandingly rich burials. MP6 sees two groups of burials, one rich and the other poor in terms of artefacts buried with the dead. MP7 followed MP6 after an interval, and graves were found in another part of the site when compared with those preceding it. The superposition of graves within a stratigraphic sequence 5.3 m deep has enabled burials within a mortuary phase to be designated a particular stage.

Despite these differences in where and how the dead were buried with the passage of time, there remains a marked underlying continuity in their treatment. In nearly all cases, a grave was



FIG. 26. The layout of graves in cluster F, Mortuary Phase 3. Left to right, burial 63, 56, 58, 62 and 60



FIG. 27. Cluster A during mortuary phase 2 comprised a man, a woman, and five infants. The man, burial 100 above, was placed at an unusual angle between burial 110, above, and burials 143 and 144, newly born infants, below

excavated, of a size sufficient to receive the corpse, and orientated such that the head faced in an approximately easterly direction (Fig. 28). There are exceptions, but these are few. Burial 131, for example, faced due north and B100 was placed with the head 25° to the east of north. There may well be simple cultural reasons for these aberrations. Thus B100 just fitted between Bs. 143 and 110 when placed sideways (Fig. 27).

Within its grave, the body lay on the back with the hands usually by the side and the legs straight. The legs were crossed at the ankles rarely, as in B147. In some cases, a wooden bier has survived. It is evident that in the majority of cases, the body was prepared first by covering it with red ochre. Some people at this stage wore items of shell jewellery, but bangles were also placed

over the chest, or in the case of B16, over rather than on the wrist. In some cases, the survival of asbestos sheeting or beaten bark fabric discloses that the body, with its accompanying pottery vessels, were wrapped together in cloth to form a package before interment.

There is recurrent evidence that grave-side ritual included an activity which resulted in thin ash spreads. These may be the result of feasting, or of cleansing the ground prior to the digging of a grave. It is also considered likely that the digging of pits, some of which are almost circular and contain food remains, was part of the mortuary procedure. In the case of cluster C during MP2-4, for example, there are about as many pits as there are graves. The distribution of middens, in particular that known as lens 2 in layer 10, skirts the mortuary clusters in such a way as to suggest strongly that there was a form of structure over or round the graves. This likelihood is further supported for the earlier mortuary phases by the disposition of postholes, although no clear plan of such a structure has been identified. Some rows of postholes, however, apparently follow the same east to west alignment of the graves. The presence of structures in MP6 is beyond doubt (Fig. 31). The foundations of a raised structure have been found, while for cluster H, the posthole distribution is strongly suggestive of a mortuary building. Throughout the mortuary sequence, graves were found in the vicinity of discrete midden lenses containing food remains. In virtually all cases, these middens present a complementary distribution to the grave clusters.

It is not, at present, possible to be sure of the circumstances under which these middens accumulated, although the matching size of *Anadara* valves in some strongly suggests a single and brief phase of deposition. They could represent a normal accumulation of food remains built up during domestic activities. Quite how routine activities



FIG. 28. Burial 152, mortuary phase 1.
Scale 20 cm



FIG. 29. Beads at Khok Phanom Di reveal many changes over time. The funnel and barrel beads are early in the sequence, I beads concentrate in mortuary phase 5, H beads in mortuary phase 6, while disc beads are found throughout. Left to right, barrel beads, disc beads, H beads, I-beads and funnel bead



FIG. 30. Burial 4, mortuary phase 6. A clay anvil for fashioning pottery vessels was placed between the legs. A burnishing stone was located beside the right knee

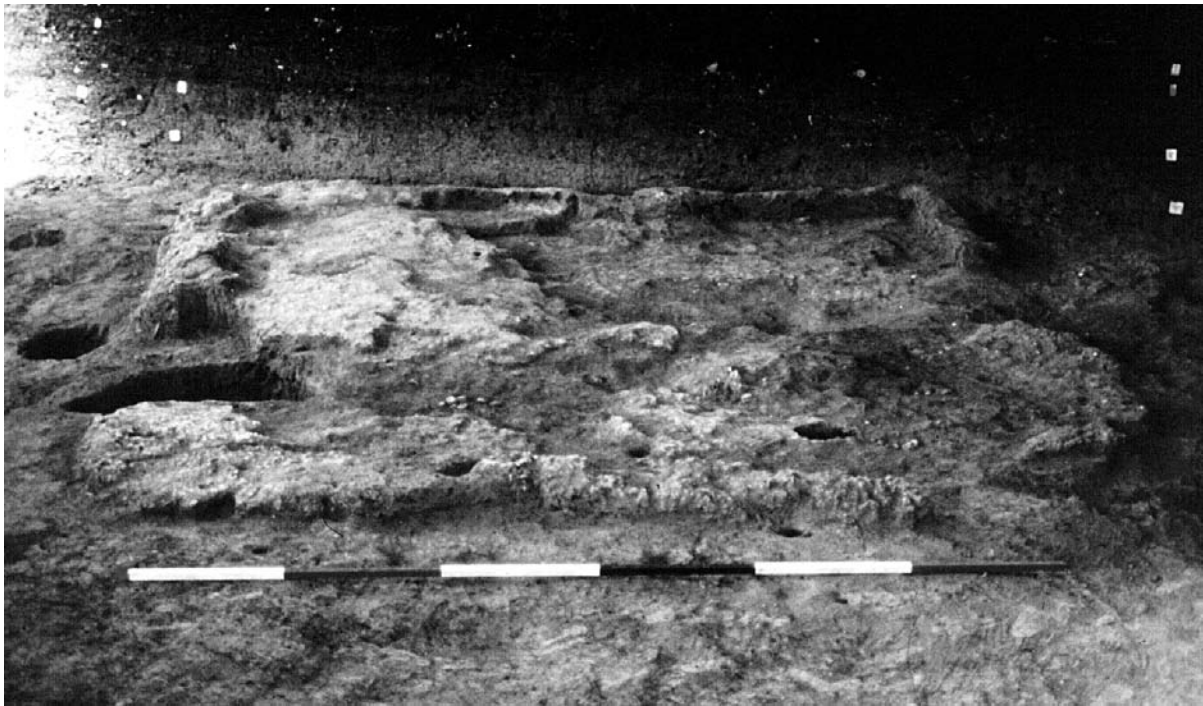


FIG. 31. The mortuary building that contained burials 6, 18 and 19 of Mortuary Phase 6

took place in the narrow spaces between mortuary clusters is hard to identify. It is also possible that the food remains represent mortuary feasting in commemoration of the dead ancestors. If this were the case, then the preparation of food close to the ancestral graves would be easier to explain. Neither alternative presents a consistently plausible explanation, because what might be regarded as implements used in day-to-day activities, such as fishhooks, net weights, shell knives and adzes, are found in these deposits.

There is no uniformity to the quantity of grave goods interred with the dead. Patterning between grave goods and individuals of the same age, sex, cluster and mortuary phase will be considered below. From the earliest to the latest burials, shell disc beads were present. Other grave goods include pierced animal canines, shell beads of the disc, I, H, barrel, short barrel and funnel varieties, fish-bone and shell bangles, bone ornaments, perforated shells, modified fish vertebrae, turtle carapace ornaments, fish bone bangles, adze heads, burnishing stones, clay anvils, pottery vessels, cylinders of clay representing an early stage in the forming of pots and the remains of animals. The analyses to be described also considered the pattern of adult tooth evulsion, the presence of asbestos or bark cloth shrouds and the use of red ochre.

THE RANGE AND CLASSIFICATION OF GRAVE GOODS

Grave goods are artefacts that have been found directly in association with the corpse. They may have been utilitarian, ornaments, parts of a costume, or symbolic items. Not all burials at Khok Phanom Di yielded grave goods. About 61 individuals were interred without any

offering apart from traces of red ochre which have not been included as grave goods but rather as part of the ritual. These incorporate 48 infants, four children, three males and six females. Considering the age at death of the infants, 46 are younger than six months. Adult males and females without grave goods died at an age ranging from 20 to 40 years.

Grave furniture varies. The earliest item, found with a male interment, B152 of MP1, is a necklace of disc and funnel-shaped shell beads. Later, more items were put in human graves. In the main, pottery vessels and shell beads of various types appeared in several graves. There are 33 burials accompanied by pots, 19 by beads, and 33 by pots and beads. Next to pots and beads are items including burnishing stones, clay anvils, bangles, and turtle carapace ornaments. Clay net sinkers, clay pellets, bone fishhooks and polished stone adzes appeared less than three times and some special items appear only once: a shell blade with B102, a modified Nautilus shell, a pendant fashioned from a shark's dorsal fin spine and a shaped pig tusk with B72, and shell discs with Bs. 43, 15, and 6 (Fig. 36).



FIG. 32. Burial 15, Mortuary Phase 6. The shell discs, I-shaped beads and shell bangle are easily visible

ORNAMENTS

This class includes necklaces, belts, bracelets, anklets, pendants, parts of a costume or garment, ear ornaments and a headdress. The commonest raw material is marine shell which was shaped into several types of bead some of which were in favour at certain mortuary phases. Disc-shaped shell beads with diameters ranging from 2-5 mm, and up to 9 mm on some occasions, are maintained from the earliest to the latest mortuary phases. Funnel-shaped shell beads appeared in MP1 and 2, barrel beads in MP2 and 3, I-shaped beads in MP4 and 5, and H-shaped in MP6 and 7. Necklaces, belts, anklets, and garments were fashioned from these shell beads.

Pendants were usually made from mammalian canines. Canine pendants of a small carnivorous species are normally found in association with rich burials, for example, Bs. 132, 43, 33, and 15. In the case of B102, that of a female, 16 canines of *Muntiacus muntjak* were arranged in one row from the right shoulder down to left hip. Fish vertebra bangles from mortuary contexts were found in association with infants during MP2-3 and 6. Shell bangles first appeared in adult graves in MP5, after which they recur in either adult or child graves until the final phase of the mortuary sequence. Anklets fashioned from disc and I-shaped shell beads appeared in Bs. 33, 16, and 15.



FIG. 33. Burials 32 (left) and 31, cluster A, mortuary phase 4. During this mortuary phase, most males were interred with broken turtle carapace ornaments. The eleven-year old on the left of this picture had the broken parts of his ornament placed over the left thigh and beside the left knee (A). Note that the pottery vessels with him and the 25-year-old woman beside him had also been smashed

TABLE 1. *Multiple regression report for disc beads. The dependent variable is $\log_{10}$ (disc beads + 1)*

Independent Variable	Parameter Estimate	Standardized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
MP1	-0.716	-0.108	0.489	-1.46	0.1458	0.0077	0.0077
MP3*	-0.482	-0.169	0.231	-2.08	0.0390	0.0369	0.0251
MP4*	-0.585	-0.179	0.261	-2.24	0.0265	0.0934	0.0261
MP5***	3.191	0.397	0.589	5.41	0.0000	0.2403	0.1836
MP6	0.334	0.070	0.362	0.92	0.3576	0.2443	0.0126
MP7	0.258	0.032	0.589	0.44	0.6613	0.2453	0.0028
Cl A	-0.480	-0.134	0.297	-1.62	0.1077	0.0137	0.0137
Cl B	-0.548	-0.095	0.440	-1.24	0.2156	0.0217	0.0060
Cl D	-0.409	-0.089	0.362	-1.13	0.2606	0.0300	0.0046
Cl E	-0.141	-0.024	0.440	-0.32	0.7480	0.0309	0.0000
Cl F	-0.119	-0.038	0.264	-0.45	0.6518	0.0353	0.0000
Cl G	-0.862	-0.076	0.825	-1.04	0.2979	0.0429	0.0044
Cl H	-0.587	-0.102	0.440	-1.33	0.1849	0.0617	0.0072
Cl I	0.283	0.039	0.540	0.53	0.5999	0.0618	0.0034
Male	5.296	0.017	0.293	0.18	0.8572	0.0141	0.0141
Child	3.050	0.010	0.289	0.11	0.9162	0.0377	0.0129
Infant**	-0.830	-0.299	0.269	-3.08	0.0024	0.0954	0.0952

***: significant $P \geq 0.001$; **: significant $P \geq 0.01$; *: significant $P \geq 0.05$; MP: mortuary phase; Cl: cluster

UTILITARIAN ITEMS

Grave offerings in this category include items that have their primary functions in the technological sphere or in daily use. Examples are anvils, burnishing pebbles, fishhooks, stone adze heads and net sinkers. The adzes, anvils and burnishing pebbles revealed use-wear marks indicating use before being interred with the dead.

SYMBOLIC ITEMS

Symbolic offerings consist of items which probably did not serve the former two functions. Characteristically, they may appear as ornaments or utilitarian items. The two kinds of object most frequently found in this manner are pottery vessels and turtle carapace ornaments. During the course of Vincent's ceramic period 3, they were often smashed or mutilated as part of the mortuary ritual. There are two different ways of "killing" pots. One is smashing them into large pieces and the other is by the removal of the rim. The turtle carapace ornaments were broken into two or more sections. They are probably symbolic

TABLE 2. *Multiple regression report for pottery vessels and overall mortuary wealth.*
The dependent variable is $\log_{10}$ (artefacts summed +1)

Independent Variable	Parameter Estimate	Standardized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Pottery vessels							
MP1	-0.105	-0.083	9.499	-1.11	0.269	0.026	0.026
MP3*	9.662	0.178	4.498	2.15	0.033	0.026	0.000
MP4**	0.156	0.251	5.070	3.09	0.002	0.041	0.017
MP5***	0.557	0.365	0.114	4.88	0.000	0.149	0.098
MP6*	0.182	0.201	7.040	2.60	0.010	0.178	0.012
MP7***	0.307	0.201	0.114	2.69	0.007	0.217	0.021
Cl A	-6.530	-0.095	5.645	-1.16	0.249	0.027	0.027
Cl B	-6.730	-0.061	8.375	-0.80	0.422	0.039	0.008
Cl D	14.400	0.001	6.897	0.02	0.983	0.044	0.001
Cl E	-0.104	-0.095	8.375	-1.25	0.212	0.070	0.017
Cl F	9.586	0.163	5.026	1.91	0.058	0.073	0.020
Cl G	0.224	0.104	0.156	1.43	0.154	0.078	0.008
Cl H	0.105	0.096	8.375	1.26	0.211	0.081	0.005
Cl I**	0.286	0.208	0.102	2.79	0.006	0.114	0.037
Male	5.102	0.086	5.079	1.00	0.316	0.062	0.062
Child	-21.500	-0.003	5.000	-0.04	0.965	0.112	0.020
Infant***	-0.247	-0.468	0.046	-5.32	0.000	0.254	0.247
Overall wealth							
MP1	-1.341	-0.119	0.790	-1.70	0.091	0.012	0.012
MP3*	-0.770	-0.159	0.374	-2.06	0.041	0.054	0.035
MP4	-0.687	-0.123	0.421	-1.63	0.105	0.100	0.016
MP5***	6.460	0.472	0.952	6.79	0.000	0.301	0.244
MP6	1.034	0.127	0.585	1.77	0.079	0.313	0.023
MP7	1.229	0.090	0.952	1.29	0.198	0.321	0.010
Cl A	-0.773	-0.126	0.477	-1.62	0.107	0.026	0.026
Cl B	8.707	0.008	0.708	0.12	0.902	0.026	0.000
Cl D	-0.182	-0.023	0.583	-0.31	0.755	0.029	0.001
Cl E	2.651	0.002	0.708	0.04	0.970	0.030	0.000
Cl F	2.844	0.005	0.425	0.07	0.946	0.035	0.000
Cl G	-0.998	-0.052	1.326	-0.75	0.452	0.041	0.003
Cl H	-0.403	-0.041	0.708	-0.57	0.569	0.050	0.002
Cl I	1.609	0.131	0.868	1.85	0.065	0.058	0.016
Male	0.142	0.026	0.483	0.30	0.768	0.021	0.021
Child	0.155	0.030	0.476	0.33	0.744	0.065	0.024
Infant***	-1.752	-0.370	0.443	-3.95	0.000	0.153	0.153

***: significant $P \geq 0.001$; **: significant $P \geq 0.01$; *: significant $P \geq 0.05$; MP: mortuary phase; Cl: cluster

items of masculinity since they have been found exclusively with males. Particularly rare grave goods include shell horned discs, a modified Nautilus shell, a shark's dorsal fin spine pendant, and a cut pig tusk. Because of their rarity and association with rich burials, they may have been status symbols.

THE DISTRIBUTION OF GRAVE GOODS: MULTIPLE REGRESSION ANALYSIS

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Mortuary patterning is first illustrated on the basis of each artefact associated with the graves and then for overall mortuary wealth. Given the variation in the quantity of individual artefacts (from 0 to 120,787 in the case of the shell disc beads), numbers have been transformed by taking the logarithm of the number of items and adding one. In the review of these distributions which follows, artefacts are illustrated in terms of presence by mortuary phase, cluster, the estimated age of the deceased and the sex. In the case of the sex, we also include interments of infants and children (Figs. 36-39). Operationally, there have been modifications to the inclusion of some burials in groupings in the interests of rational analysis. In the case of infants and children, the former includes only individuals deemed to have died at birth. The latter includes those who survived birth, even by a few months. This was undertaken because consideration of the graves suggested that grave goods were not, or at least were rarely interred, with infants who died at birth. Burials 6, 18 and 19 have been included with cluster C, because it will be argued that they belong to it. Logically, burials 14-16 should have been included with cluster F on the same grounds, but it was decided to give them separate status due to their considerable and obvious wealth. In a later section of this report, it will be argued that the cluster H individuals belong to the

TABLE 3. *The sex distribution in the successive stages of clusters A, C and F*

Cluster and stage	n males	n females	Mortuary Phase	Cluster and stage	n males	n females	Mortuary Phase
A1	1	1	MP2	C1	—	1	MP2
A2	—	1	MP3A	C2	1	1	MP2
A3	1	—	MP3B	C3	—	1	MP2
A4	2	1	MP4	C11	1	1	MP2
F1	—	2	MP2	C4	2	1	MP3A
F2	1	—	MP2	C5	1	1	MP3A
F3	1	—	MP3B	C6	1	1	MP3B
F4	—	3	MP3B	C7	—	2	MP3
F5	1	1	MP4	C9	—	2	MP4
F6	1	1	MP4	C10	—	2	MP4
F7	1	2	MP4				
F8	1	—	MP4				



FIG. 34. Burial 47 contained the remains of a young woman, cradling a newly born infant (arrowed) in her left arm

(Table 1). There are significantly more such beads in MP5-7 than in MP2 and MP3A, but during MP3B-4, the quantity fell significantly. No cluster has significantly more or fewer shell disc beads than any other. Infants have significantly fewer disc beads than do the females, but there is no statistically significant distinction as between the males, females or children.

Barrel-shaped shell beads are found only in graves ascribed to MP2 and 3A. Within those mortuary phases, they occur regularly in cluster B, C, D and F contexts. While there are relatively few graves in clusters B and D, the beads are

genealogy of cluster F, but they retain their separate status for the purposes of this part of the analysis. Where appropriate, the results of multiple regression analyses on these data are presented. Hierarchic cluster, principal component and multidimensional scaling analyses will follow.

Disc beads, the commonest artefacts, are represented in all mortuary phases (Fig. 36). Only eleven were identified among the six graves of MP1. They are regularly found in MP2 and 3, but became rare in MP4. The few MP5 burials were richly endowed with disc beads, numbers reverting to the levels encountered in MP2 during the last two mortuary phases. Distribution by cluster is clouded by the rarity of graves in some of these groups, but visual inspection suggests that clusters C and F, those with the largest sample numbers, have rather more of these beads than does cluster A. There is no visual trend in the relation in the number of these beads with the age of the deceased, nor between males, females and children, although infants appear to have been excluded from a regular association. Regression analyses on these distributions employs MP2, cluster C and females as the bases for comparison with all other groups in their category



FIG. 35. Burial 39, that of a woman aged about 25 at death, was associated with burial 41, an infant, (arrowed) on her left arm (head arrowed). Cluster F, mortuary phase 4

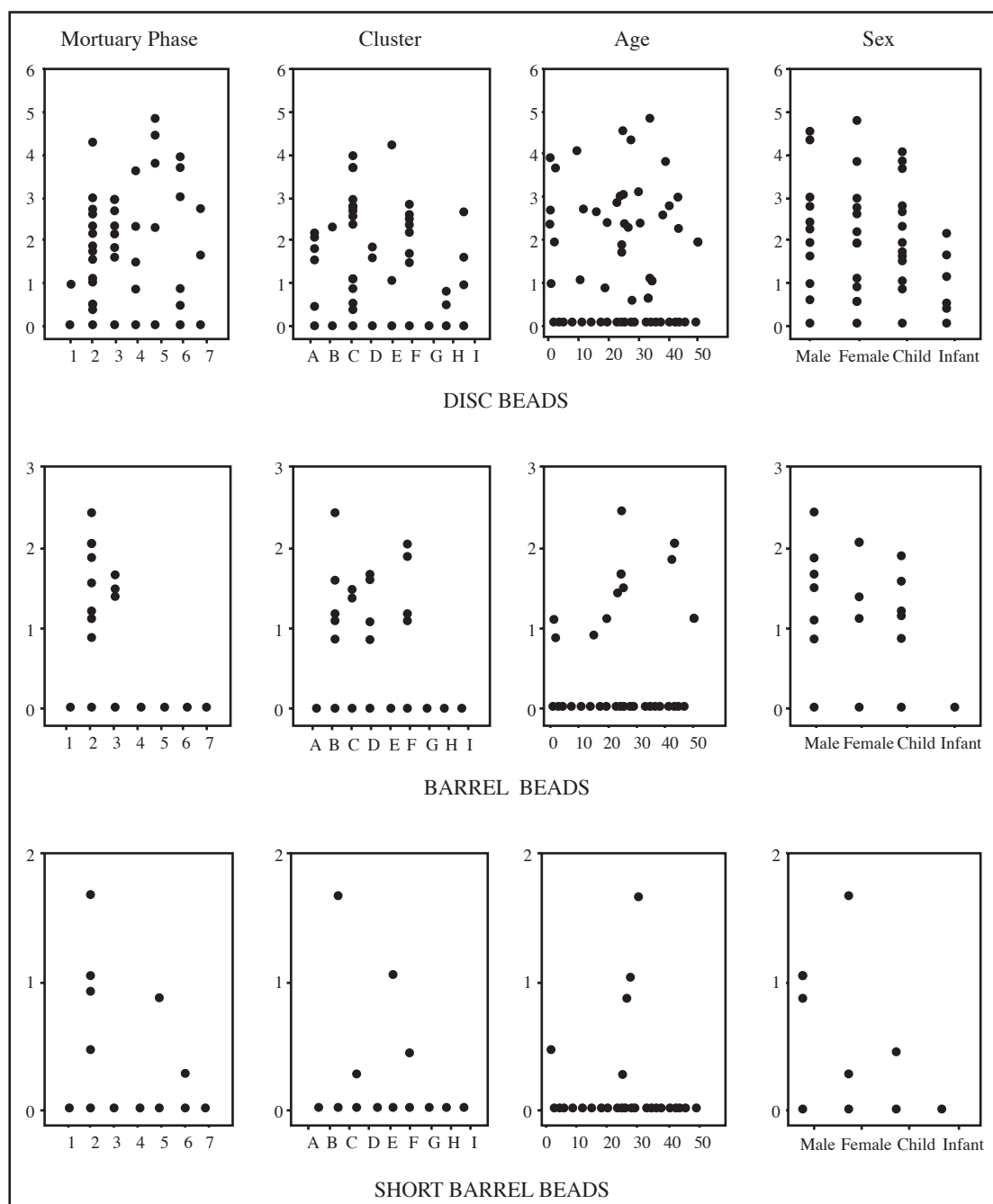


FIG. 36. The distribution of shell disc beads, barrel beads and short barrel beads in graves against the mortuary phase, cluster, age and sex. The numbers of artefacts are expressed as $\log_{10}(\text{count}+1)$

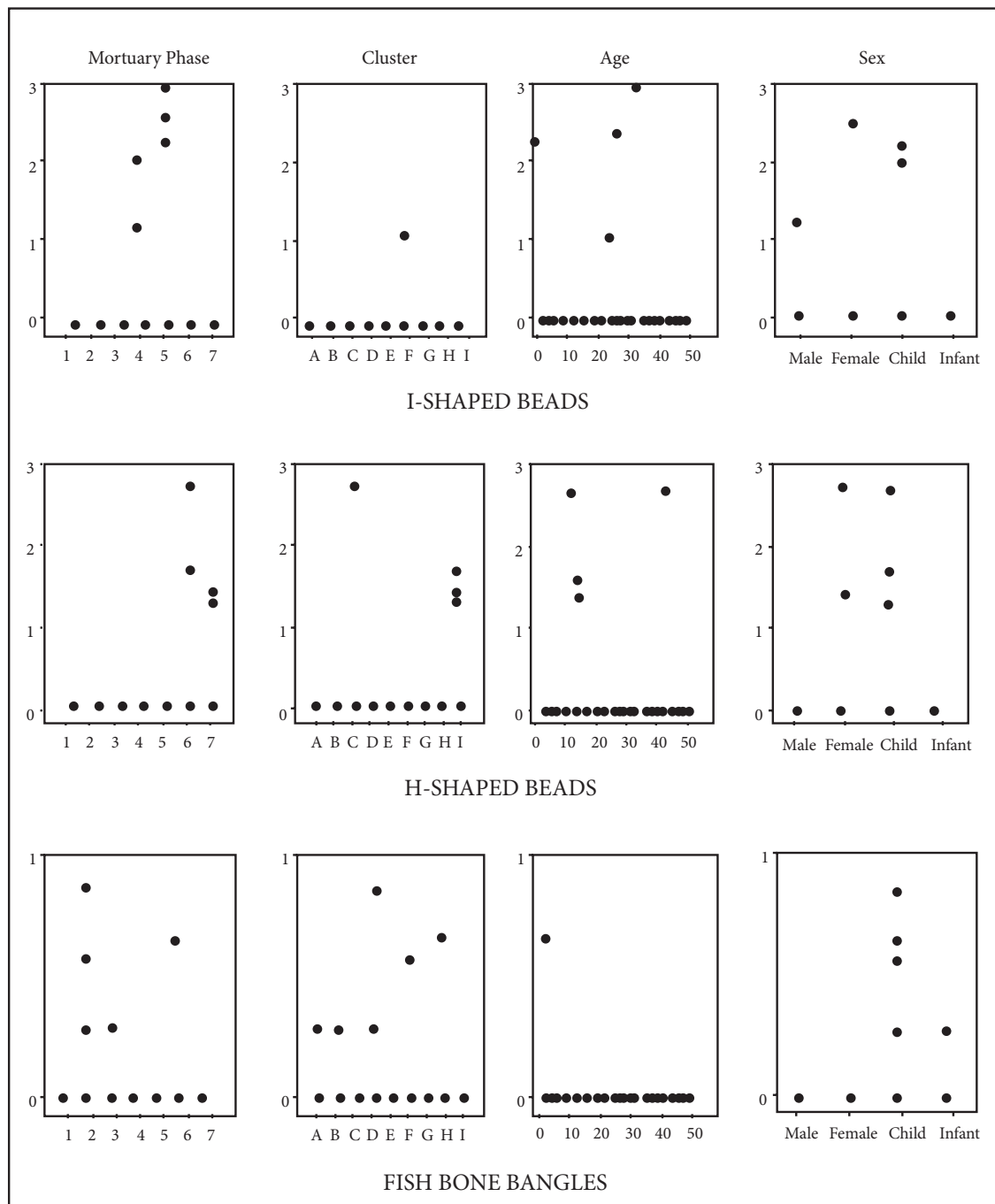


FIG. 37. The distribution of I-shaped beads, H-shaped beads and fish bone bangles against the mortuary phase, cluster, age and sex. The numbers of artefacts are expressed as $\log_{10}(\text{count}+1)$

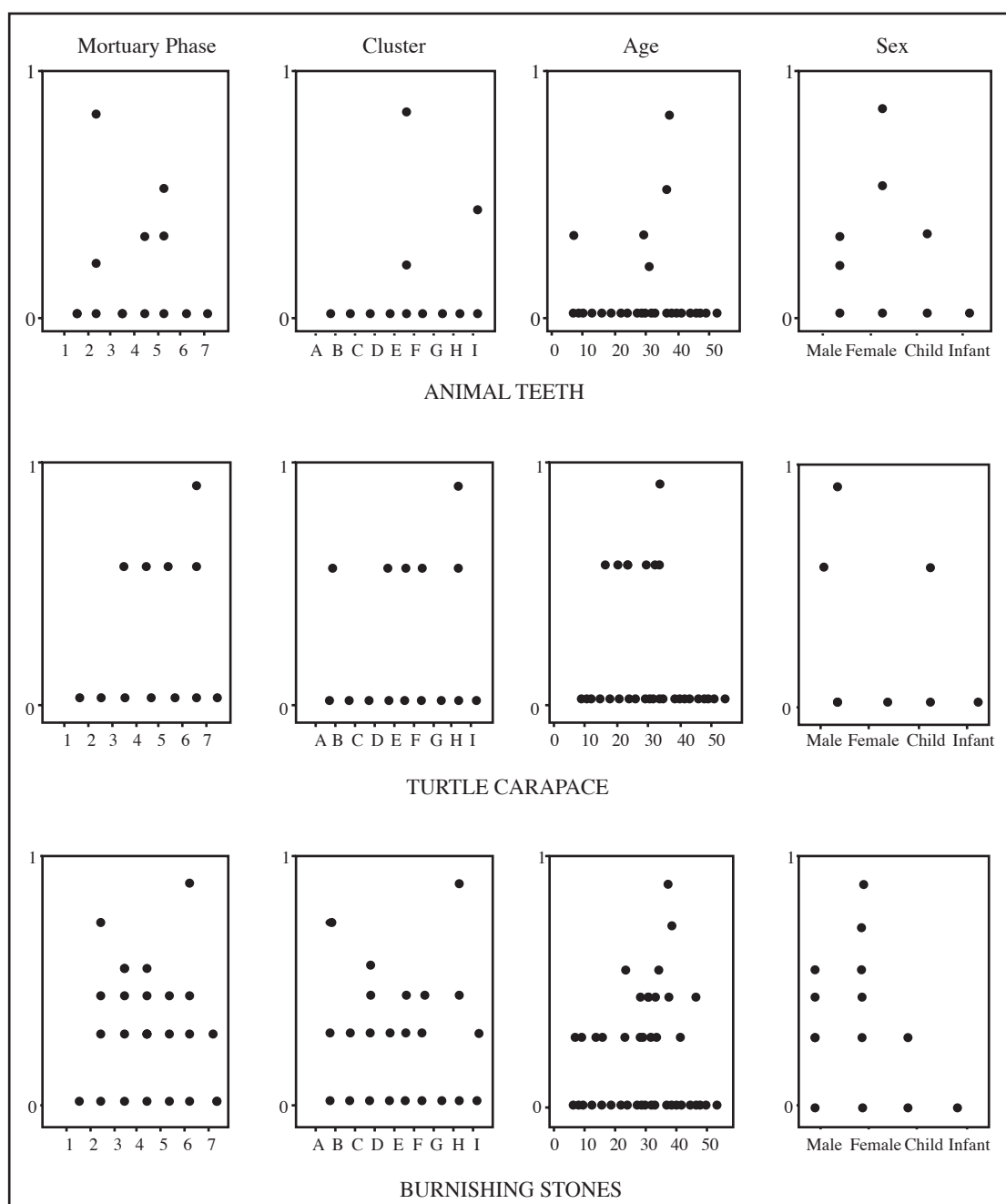


FIG. 38. The distribution of pierced animal teeth, turtle carapace ornaments and burnishing stones against the mortuary phase, cluster, age and sex. The numbers of artefacts are expressed as $\log_{10}(\text{count}+1)$

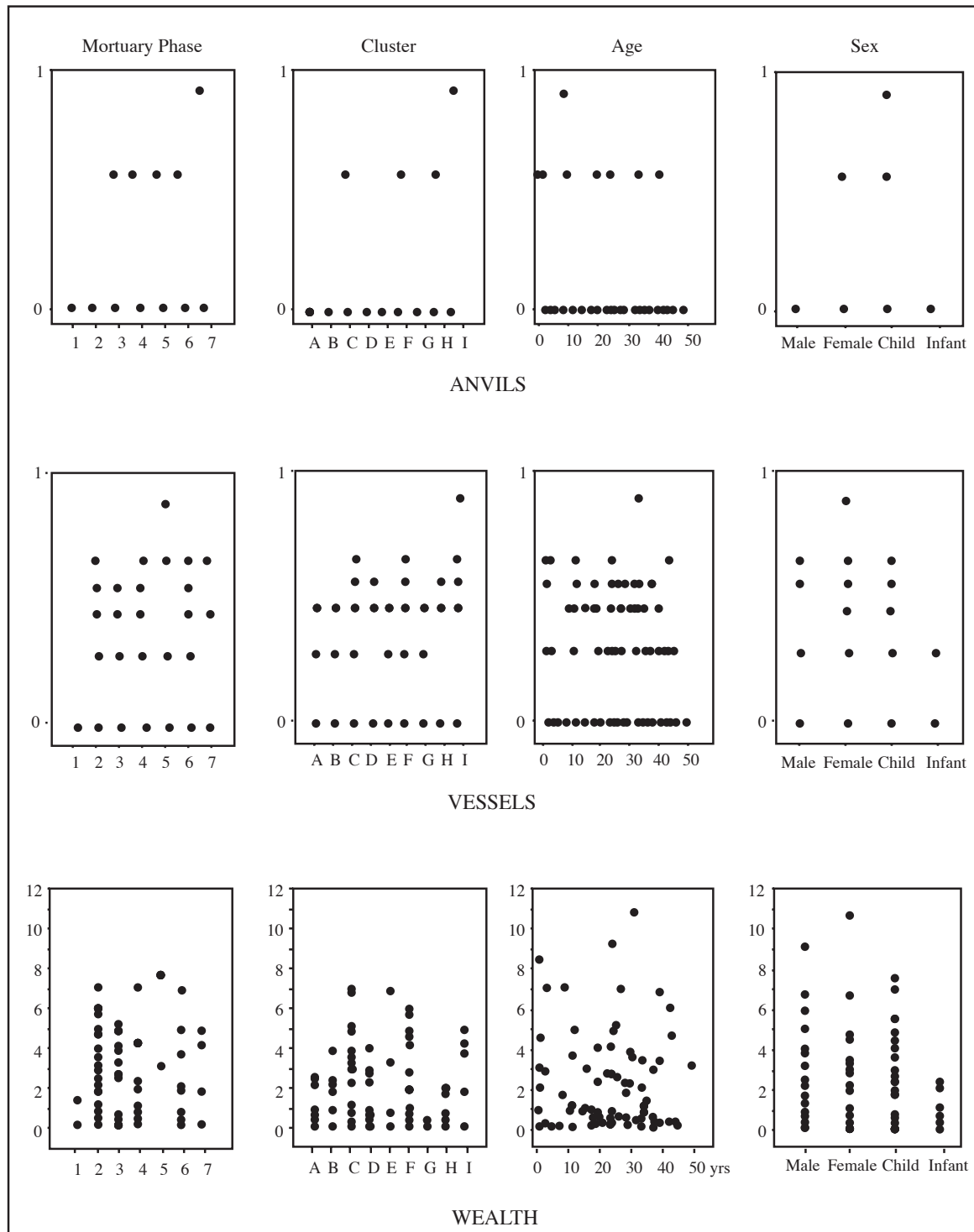


FIG. 39. The distribution of anavils, pottery vessels and overall wealth in graves against the mortuary phase, cluster, age and sex. The numbers of artefacts are expressed as $\log_{10}(\text{count}+1)$

found in four and three cases respectively. Yet none has been found in cluster A graves. These beads are found with males, females and some young children, but never with infants. Six graves contained short barrel beads, four from MP2 and one each from MP5 and 6 (Fig. 36). They are widely distributed in terms of cluster, age and sex. Funnel beads are restricted to three graves belonging to MP1-2. Five graves include the large and distinctive I-shaped beads, involving two children, a female and two males (Fig. 37). Only MP4-5 are represented, again suggesting that this bead type has a narrow chronological range. H-shaped beads are restricted to five graves, representing MP6-7 (Fig. 37).

Pierced animal teeth are found in only five graves, four of which are particularly noted for their wealth (Fig. 38). Shell bangles are rare and late in the sequence of burials. One each of a large variety are found with the exceptionally rich male, female and child burials in MP5. Three and four of a smaller variety are found respectively in child burials belonging to MP7. The discs are also rare, and confined to late, rich burials of both sexes and a child.

Fish bone bangles are confined to the graves of children, and span MP2-6 (Fig. 37). Turtle carapace ornaments are restricted to male graves. The earliest was recovered from MP3B, the latest from MP6 (Fig. 38). Stone adze heads were found in three graves, representing a child from MP6, a male from MP3A and a female from MP2. Burnishing pebbles and clay anvils were used in the manufacture of pottery vessels. The former come from graves covering MP2-7. They were also represented in some burials in every cluster. All age groups except infants are represented, females tending to have more than males, and children, fewer (Fig. 38). Anvils have only been found with women and children. Beginning in MP3B, they recur through to the last mortuary phase. Only males and newly-born infants are excluded (Fig. 39).

Pottery vessels are found in a range of graves from MP2 onwards (Fig. 39). A multiple regression analysis reveals that there was a significant rise in the number of vessels with time, the incidence peaking with MP5 (Table 2). Only cluster I stands out as having significantly more vessels than any other cluster. Infants have significantly fewer pottery vessels compared with females.

OVERALL WEALTH

The figures for overall wealth take into account the sum of the logarithm (count+1) for all artefacts in each burial. Visually, there appears to have been a decline in wealth from MP3A to MP3B and 4, followed by a rise in MP5. There followed another decline from the heights reached in MP5 during MP6-7 (Fig. 39). These impressions are sustained and given statistical significance by the multiple regression analysis (Table 2). The distribution of wealth with age



FIG. 40. Burials 136 and 137. The former, an infant, was interred over the body of a child. Mortuary Phase 2

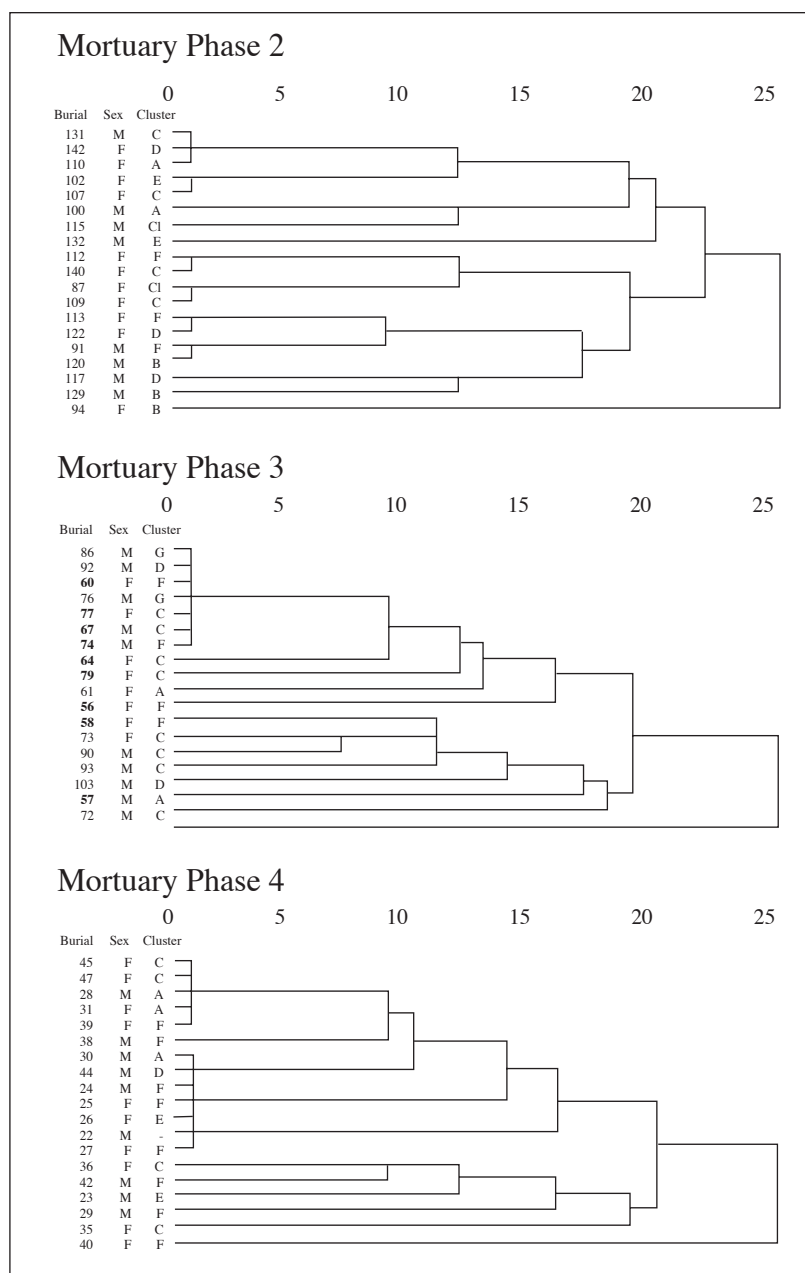


FIG. 41. The results of the cluster analysis for the mortuary wealth of adults from mortuary phases 2, 3 and 4. Mortuary Phase 3B burials are denoted in bold

does not show any particular relationship, but infants are significantly poorer than females. There is no significant difference between the females and males, nor between either sex and children.

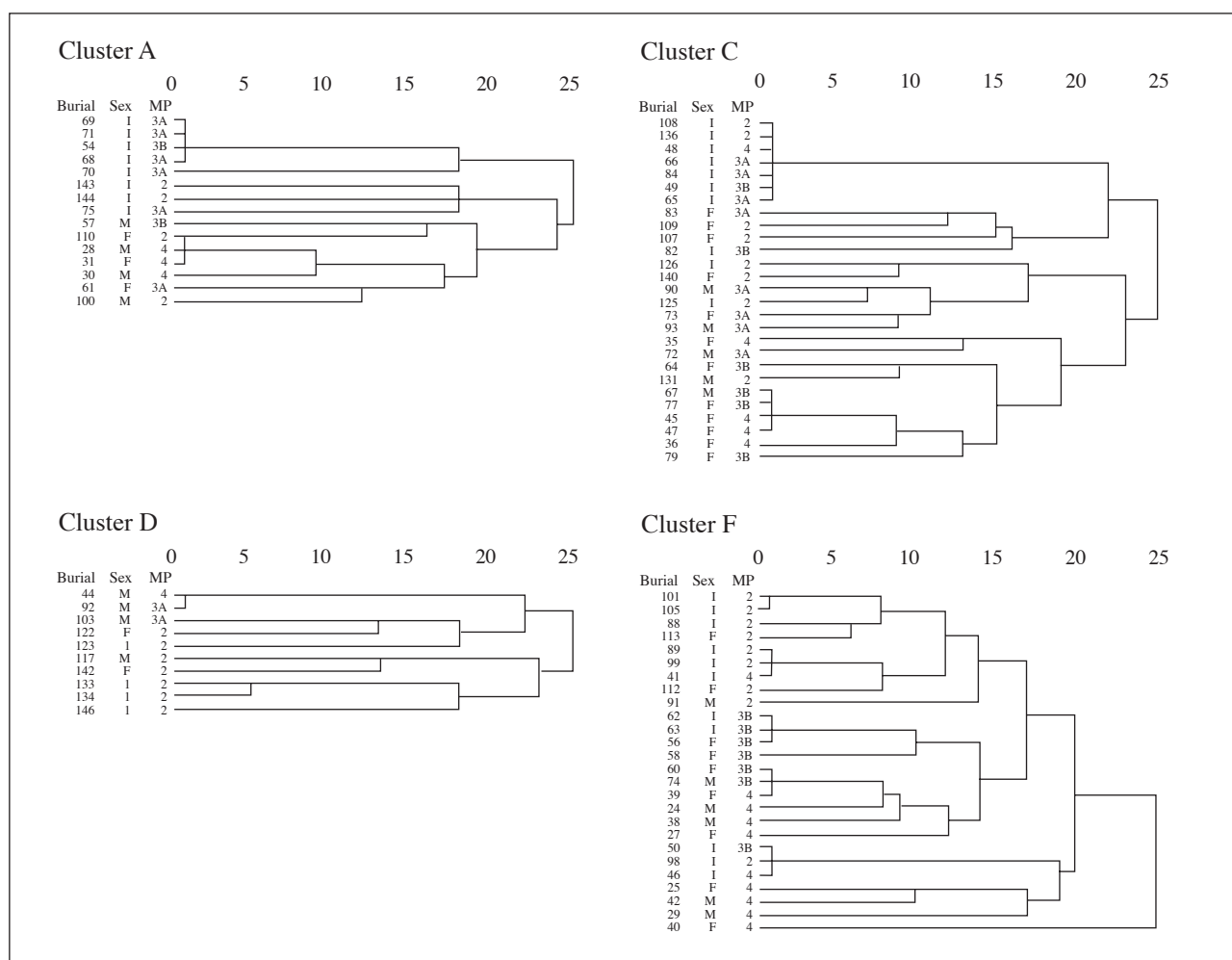


FIG. 42. The results of the cluster analysis for infants and adults from clusters A, C, F. and D

THE COMPOSITION OF SEXES WITHIN CLUSTERS AND STAGES

The establishment of the sex ratio within stages of a given cluster must be considered in conjunction with the 'edge effect' (Table 3). Some clusters were only partially located within the excavation square, particularly cluster C, including sub cluster C1, where there was at least one female present at each of the ten stages with the exception of stage 8, when only a child was represented. Males were absent from five of the ten stages, and for stages 7, 9 and 10, two females were represented, but no males. For cluster F, a single adult male and a female were found together on three occasions. In three cases, males were found alone and in two stages, either two or three females were found together with no accompanying males. For these three clusters during MP2-4, there are 16 males compared with 25 females. There

is a trend in favour of females only during the latter half of cluster C, and a predominance of females at the equivalent stages of cluster F.

INFANTS AND CHILDREN

The distinction between infants and children is to a certain extent arbitrary. In table 17, the oldest infant died when no older than 30 months, and the youngest child is given as about three years of age at death. Where burials are grouped into infants and children in statistical analyses below, the grounds for the grouping on the basis of age will be given. For the first four mortuary phases, there were more infants and children buried than there were adults (Figs. 39-41). This situation was reversed for MP5-7. Infants and children were buried in the same manner as were adults, often in adjacent or even the same grave. Thus, burial 47, a young woman aged about 22 years at death, cradled a newly-born infant in her left arm (Fig. 34). There are some cases in which the order of interment within a particular stage proceeded from north to south. This is seen, for example, in the case of cluster A stage 1, where Bs. 144 and 143 preceded Bs. 110 and 128. It is reflected in cluster C stages 2 and 9,



FIG. 43. Burial 133, mortuary phase 2. The four-month-old infant was interred with 17 cowrie shells and fish vertebra bangles, stone and shell beads. Scale 5 cm

in the case of cluster C1 and as late as MP6 with cluster H. As with virtually every general statement made about this cemetery, however, there are some exceptions. Infants and children were usually interred near adults, but were also found in the same grave as an adult, having been buried at or about the same time. In the case of Bs. 136 and 137, an infant and a five-year old were buried in the same grave. Burials 31 and 32 were likewise interred in a double grave. The former was a 25-29 year old female, and latter a 10-12 year old child.

AVERAGE-LINK HIERARCHIC CLUSTER ANALYSIS

The treatment of the dead under several headings will first be considered through the application of the average-link hierarchical cluster analysis using Jaccard's coefficient of similarity. This expresses the distance between individual interments in terms of mortuary wealth, and is appropriate where there are missing values. It has been used by Rothschild (1979) in her analysis of the burials from the Indian Knoll and Dickson Mounds. It might well be objected that such a method has the limitation of imposing a hierarchy where none exists (MacDonald 1978). This, however, is balanced by the review of individual burials which will follow. The first topic to be considered is whether or not males and females were accorded different treatment in death. This will be reviewed first for MP2-4. It is not necessary to apply statistical analyses for MP5-6 because the results are self-evident.



FIG. 44. Burial 50, a newly-born infant of MP3B with no grave goods

THE RESULTS OF THE CLUSTER ANALYSIS FOR ADULTS FROM MORTUARY PHASES 2, 3 AND 4

During MP2 there is no division into two groups based on sex (Fig. 41). With the exception of B94, which is isolated, the two groups formed at the 25 per cent similarity level comprise males to females in the ratio of 4:4 and 4:6 respectively. If we examine the proximities from the top to the bottom of figure 41, we find that the first five, Bs. 131 to 107 had red ochre and fabric. Burial 132, a male, stands rather apart on account of the range of goods found with it. Burials 112-129 are distinguished by being associated with shell beads and, in some cases, with pottery vessels. There is no evidence for a distinction between adult males and females.

There is no clear division between the sexes for MP3 (Fig. 41). On reviewing the figure from top to bottom, we first encounter a group of seven burials, of which five are male and two, female. These are linked on the basis of having one to three pots. The next four burials, all females, do not form a distinct group. Perhaps the most intriguing grouping is found at the 18 per cent level, where there are five burials of which four were male. These have in common a number of shell disc beads and two or three pottery vessels. Burial 73, however, is a female interred at the same time as Bs. 90 and 93, revealing that females were not excluded from special treatment. However, there is a clear separation between burials belonging to MP3A and MP3B. This reflects the relative paucity of grave goods with the latter group.

During MP4, a trend first noticed in MP3B further manifested itself, in that males were buried with broken turtle carapace ornaments. No indication is provided from placement as to where they might have been worn. One characteristic of this stage is the rarity of shell beads (Fig. 41). From top to bottom, the first six burials have a sex ratio of two males to four females. They are distinguished by the presence of one or two pottery vessels. The next three burials, all male, were interred with a combination of pottery vessels and turtle carapace ornaments. They are closely linked. The two females in Bs. 25 and 26 were buried with no grave goods. Burials 36, 42, 23, 29 and 35 have in common the inclusion of burnishing pebbles, but the sex ratio is two females to three males. The last, B40, was not favoured with any grave goods.

Mortuary Phases 5 and 6 represent a distinct change. In the former, there was one very rich female interment, B15, and part only of a rich male burial, B43. For MP6, two rich females were found beneath a raised mortuary structure. Buried in front of it, and at the same time, there were two females and a male in cluster H. None had a rich endowment of grave goods.



FIG. 45. Burial 125, mortuary phase 2. The arrow points at the fabric shroud

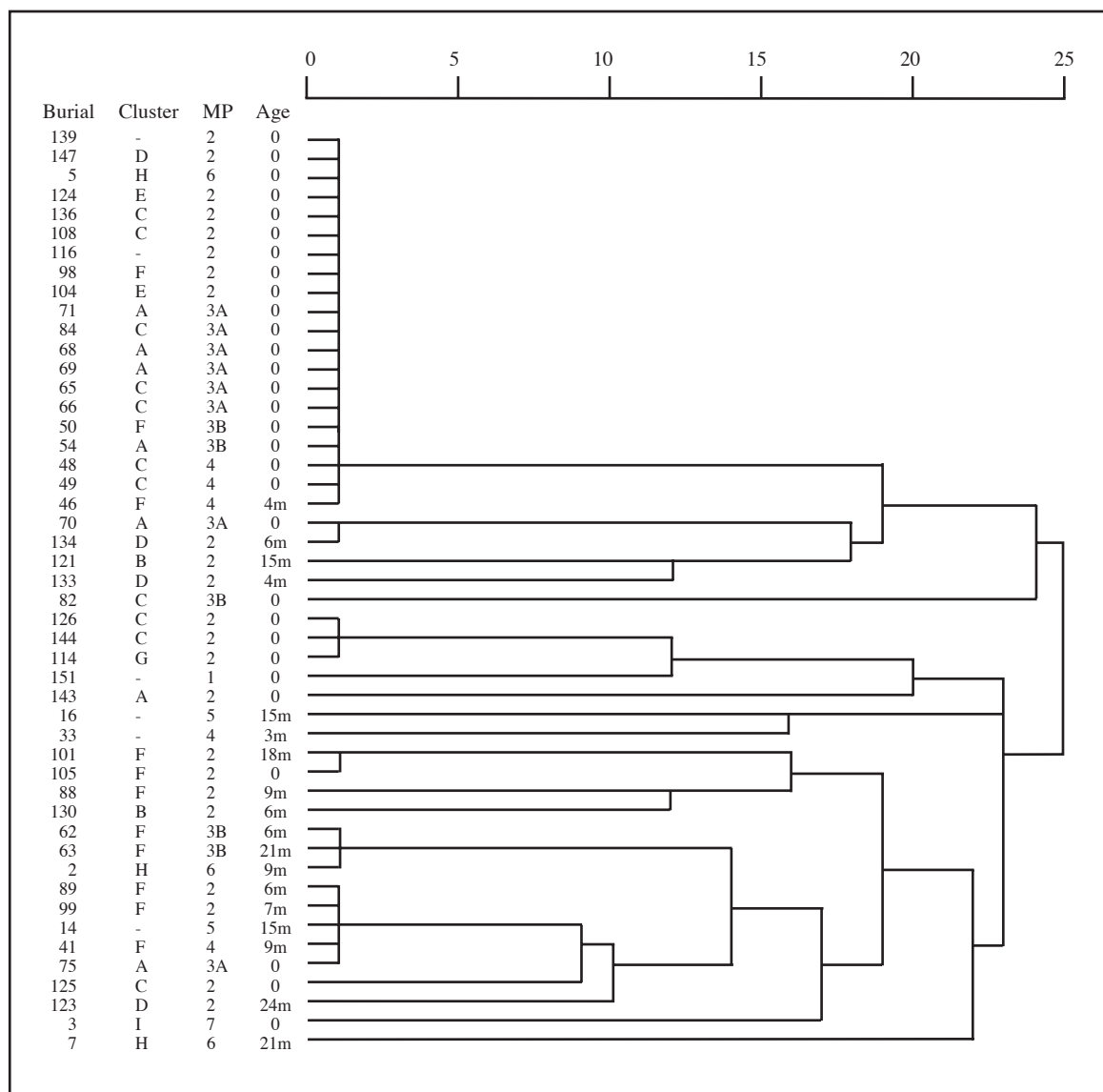


FIG. 46. The results of the cluster analysis of overall grave wealth for infants from all mortuary phases

THE TREATMENT OF INFANTS

The treatment of the young will be considered first by investigating the variation accorded to the infants as a whole. The sample incorporates all individuals who died before attaining the age of about three years. The results disclose considerable variation in their treatment (Fig. 46). We first encounter a series of 20 burials in which there are no grave goods. The next group, distinguished at the 18 per cent level of probability, contains Bs. 70, 121, 133 and 134. The first contained a fish vertebra bangle. Apparently too large to have been worn



FIG. 47 Burial 16, with the clay cylinders in place over the body

over the left wrist, a miniature clay anvil and a burnishing stone. Clay cylinders had been heaped over the body (Fig. 47). Burial 33 of MP4 was accompanied by 7,845 disc and 107 I-shaped shell beads, two pierced animal canine teeth, four pottery vessels and a potter's anvil.

We then encounter a group of four graves distinguished by wealth, but not to the same extent as the two burials just referred to. Three come from cluster F and the other from cluster B, and all date to MP2. Burial 101 had a pottery vessel in addition to a necklace made up of 626 disc, 13 barrel and two short barrel beads. Burial 105, buried in the same group, contained a somewhat richer set of goods: two pots and a necklace comprising 1043 disc, 88 barrel and two short barrel shell beads. Burial 88, somewhat later but in the same cluster, contained two pottery vessels, three fish vertebra bangles, and a necklace comprising 690 disc and 16 shaped shell beads. The last member of this group, B130, comes from cluster B during MP2. It has two pottery vessels, a fish vertebra bangle and a belt of 17 barrel shell beads. There are ten graves in the next group identified at the 18 per cent level of probability, distinguished by the presence of one or more pottery vessels, and in some cases shell beads. Burials 2 and 63 contained a single pot, while B62 contained two. There were pots and shell disc beads with all the rest, while

with ease, the bangle had been placed over the right wrist. Fragments of a fish vertebra bangle over the left wrist were found in association with B134. Seven barrel-shaped shell beads were found in the neck area of B121, while B133 was interred with 45 barrel-shaped and 6 cylinder-shaped beads disposed as a belt and a bracelet, seven fish vertebra bangles placed over the chest, a pierced snail shell and 17 cowrie shells in the chest area. The snail shell, cowrie shells and cylinder-shaped beads were not included in the cluster analysis because of their great rarity.

Burial 82 stands out because the only artefacts associated were a clay anvil and a burnishing stone. These were located in such a manner relative to the human remains that they cannot be confirmed as being in primary association. The 18-20 per cent confidence level also distinguished a group of five burials (nos. 126, 144, 114, 151 and 143). These were not as well endowed with grave goods as the four just described. With the exception of B151, which was associated only with red ochre and fabric, these infants were interred with a small number of shell beads. Burials 16 and 33 are outstandingly rich, and set apart at the 23 per cent confidence level. The former was interred with 12,247 disc beads, 200 I-shaped shell beads, four pottery vessels, a shell bangle placed



FIG. 48. Burial 150, Mortuary Phase 1. Scale 10 cm

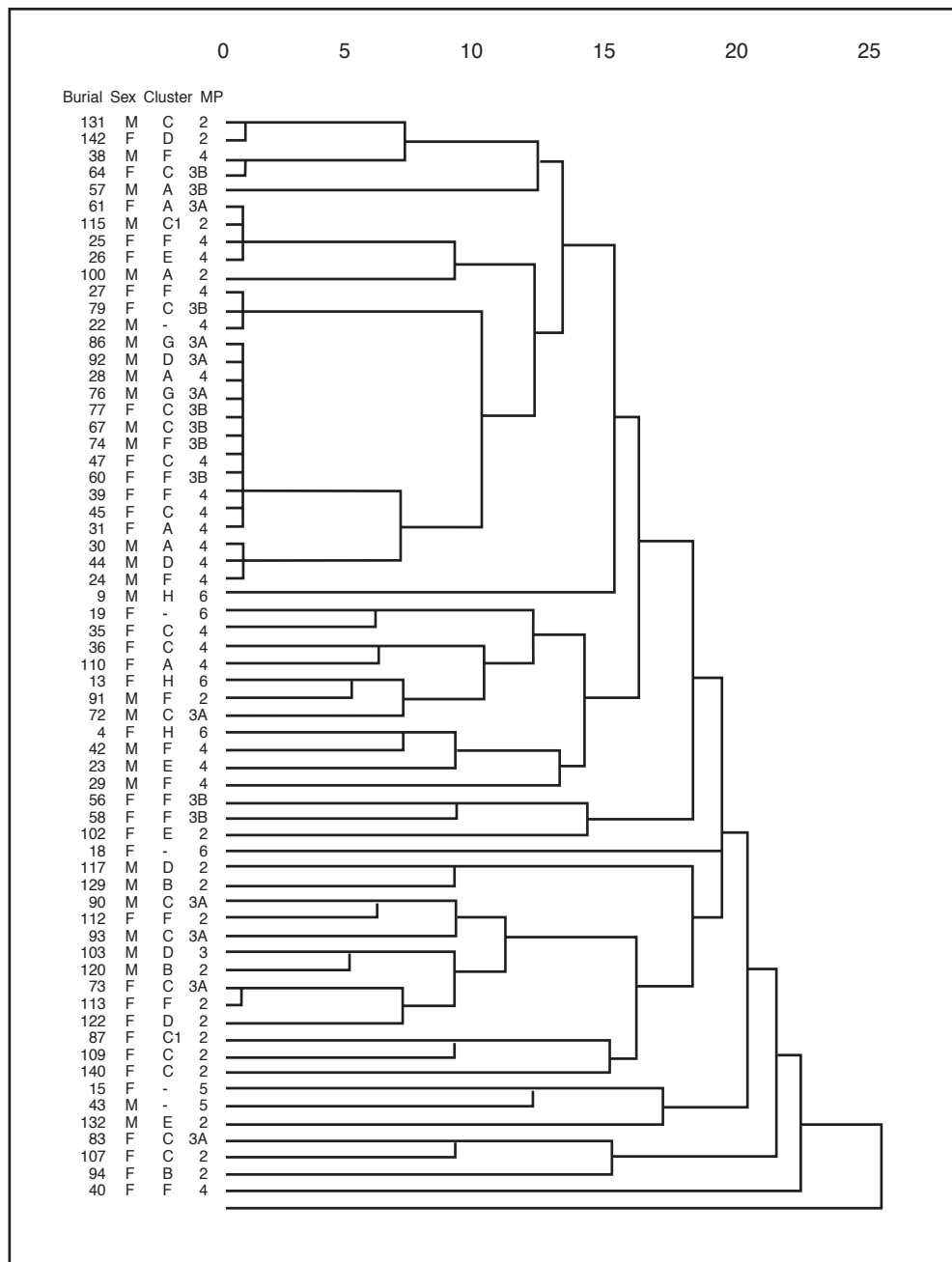


FIG. 49. The results of the cluster analysis for all adults on the basis of grave wealth

B123 was interred with three pots, 120 beads and a burnishing stone. Burials 3 and 7 are set apart at the 20 per cent probability level. They belong to MP7 and 6 respectively. The latter was interred with a set of four fish vertebra bangles in the vicinity of the right wrist, a pottery vessel and nine

TABLE 4. *The child burials from Khok Phanom Di*

Burial No.	Age at death	Probable sex*	Cluster	Mortuary Phase
150	2.5	-	-	1
145	8	-	C	2
137	5	-	C	2
96	4	-	A	2
37	9	male	C	4
33	3	-	-	4
32	11	-	A	4
21	8	-	E	4
20	12	female	F	4
17	12	male	F	4
11	12	-	-	6
8	15	-	H	6
6	9	-	-	6
12	12	female	-	7
1	9	-	I	7

*based on inferences from grave goods



FIG. 50. Burial 145, mortuary phase 2

disc beads. Burial 3 of MP7 was interred with two pottery vessels, four shell bracelets, 56 disc and 22 H-shaped shell beads. In addition to the burials represented in figure 46, there are also 22 burials which are excluded because there were no grave goods, red ochre or fabric. These are found in all mortuary phases, except MP6.

It is apparent that there are four major groupings of infant burials. The first has only the grave and its link with other members of a cluster. There is no further evidence for ritual. The second includes the sprinkling of some red ochre over the body. The third major group includes a set of grave goods found in many adult graves: shell beads and pots. Then there is a rich group which divides itself chronologically. Four come from MP2 and a further four of outstanding wealth were found from MP4, 5, 6, and 7. There is no apparent relationship between the two poor groups with the passage of time, or with a particular cluster. On the contrary, they are found throughout the sequence and in virtually all clusters. There is, however, one variable which distinguishes between the poor and the other infants in nearly all cases: it is that of age. Figure 46 includes the estimated age of death for each infant. Where an infant which probably died at or just after birth is involved, the age range is given as 0-2 months. They were buried in the appropriate mortuary area, but were only rarely provided with grave goods. As is always the case, we find one or two exceptions. The late burial 3, for example, was buried with a rich endowment.



FIG. 51. Burials 19 (to right), 18 and 6 (with the shell disc), located within the mortuary chamber, mortuary phase 6

Burial 46, a 4-month old, was interred with no grave goods apart from some red ochre. In nearly all other instances, however, infants which survived parturition were treated no differently from adults. The treatment of infants in each cluster will now be considered, to identify more precisely this relationship between the treatment of the young relative to the adult members of society. The hierarchic cluster analyses have been applied only to clusters A, C, D and F because no other has provided sufficient numbers.

In an analysis applied to all infant and adult burials found in cluster A during MP2-4, a separation was encountered at the 20 per cent level (Fig. 42). Four of the infants, all from MP3, are set apart because they have no grave goods. Although the remaining four infants were under two months of age at death, they were buried with some grave goods. Beads were found in MP2 and a bangle, pot and necklace in MP3. In the case of stage 2 MP3, the infants were richer than the adult female with which they were associated. For stage 1, MP2, two infants buried alongside the adult male (B100) shared the presence of shell disc beads as grave goods.

This situation raises a particularly interesting variable, that of similar treatment of adults and the infants with whom they were interred. Is it, for example, found that rich infants tend to be buried

together with rich adults? This issue will now be reviewed in the context of cluster F, which has an unusually high proportion of infants who survived the first two months of life (Fig. 46). The pattern differs from that seen for cluster A, because the infants and adults are distributed together rather than grouped separately. At the 17 per cent probability level, the analysis reveals a group comprising nine burials, all but one belonging to MP2. All members of stage 1 are present in this group, with the exception of B135, which was disturbed in prehistory. All were buried with pots and a large number of shell disc beads irrespective of age. Three also wore barrel beads. We can go a stage further in this enquiry. Burials 99 and 113 were found adjacent to each other. Their pottery vessels were placed complete and upside down over the knees. Burials 101 and 105 also

TABLE 5. *Multiple varimax rotated factor matrix for all mortuary phases*

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Communality
Disc beads	0.1543	-0.2711	-0.5407	0.3554	0.5234	0.7900
Barrel beads	-0.0820	-0.8283	-0.0192	0.1300	0.1047	0.7210
Short barrel beads	0.0425	0.0252	-0.0971	0.8774	0.0054	0.7817
I-beads	0.2055	0.0687	-0.7850	0.1716	-0.0584	0.6960
H-beads	0.0550	0.1010	0.0500	-0.0461	0.9207	0.8656
Pierced animal teeth	0.0874	0.0448	-0.6215	0.2852	-0.1399	0.4968
Modified fish bone	-0.0038	-0.6938	0.0125	-0.1403	-0.1456	0.5224
Shell bangle	0.4596	0.0991	-0.4783	-0.1314	0.1842	0.5011
Turtle carapace ornament	-0.5451	0.2325	-0.5116	-0.0472	-0.0248	0.6158
Burnishing stone	0.6396	0.0612	-0.1134	0.2566	-0.0134	0.4917
Clay anvil	0.7384	0.0905	-0.3770	-0.1807	0.0973	0.7377
Pottery vessel	0.1028	-0.2335	-0.6447	-0.1743	0.1938	0.5487

contained complete vessels placed over the knees and in the ankle area.

The same situation is found in stage 3. Indeed, Bs. 88, 89 and 91 were grouped with the stage 2 burials just described. Each contained pottery vessels, shell disc and barrel beads. Burials 88 and 91, a year-old infant and an adult male, were buried together. The complete pots were placed over the ankles, that with the infant being a miniature. The next group, distinguished at the 17 per cent level, begins with five burials. There are two infants, three females and a male. The infants and the females all belong to stage 4, the male to stage 3. They are linked because they were all buried with one to three pots. No shell beads were found. Preference was given to placing the pots in the ankle area. There are then four graves, Bs. 39, 24, 38 and 27. All come from MP4, and comprise two males and two females. The last group of three infants were poorly endowed (Bs. 46, 50 and 98). Two died soon after birth. Four burials remain: B25 had no offerings, B42 two burnishing stones, B 29 having a range of goods and B40, neither ochre nor a fabric shroud.

With cluster C, we again encounter a situation where most of the infants died when newly born, and are grouped together (Fig. 42). Burial 82, that of an infant which died when about 6 months old, is linked with adult burials 83, 107 and 109. All four have in common the presence of a burnishing pebble, although the pebble and anvil with burial 82 were found in the grave fill. At the 18 per cent probability level, there is a group of six burials which include two infants, two males and two females. The two infants were interred with two and three disc beads respectively, the former, B125, also having one pottery vessel. The adults buried in this, stage 2, were poorly endowed with artefacts, the female having a burnishing stone and the male, nothing. The balance of the cluster C burials were all adult. During stage 1 of cluster B (MP2), an adult male (B129) was interred in conjunction with a 6-month-old infant (B130). Both wore barrel beads, and the infant also had a bracelet and a pottery vessel. The same variety of bead was also shared between the adult female B94 and the infant buried alongside her, B121. This infant survived to about 15 months.

Figure 42 shows the result of the Jaccard test for all members of cluster D. Reading from top to bottom of this figure, the two burials comprising the first group distinguished at the 20 per

TABLE 6. *Multiple varimax rotated factor matrix for mortuary phases 2–4*

Variable	Factor 1	Factor 2	Factor 3	Communality
Mortuary phase 2				
Disc beads	0.4380	-0.2541	0.6116	0.6305
Barrel beads	0.0423	-0.8162	0.2404	0.7257
Short barrel beads	0.7723	0.0684	-0.0328	0.6022
Pierced animal teeth	-0.1641	0.3846	0.7237	0.6987
Fish bone disc bangle	-0.1827	-0.7030	-0.0685	0.5323
Burnishing stone	0.7647	0.0768	0.1425	0.6109
Pottery vessel	0.1440	-0.3696	0.7787	0.7638
Mortuary phase 3				
Disc beads	0.8713	0.0868	0.2359	0.8223
Barrel beads	0.8569	-0.0634	-0.2118	0.7832
Short barrel beads	-0.0863	-0.1218	-0.3351	0.1346
Turtle carapace ornament	0.0252	-0.1226	0.9020	0.8293
Burnishing stone	0.1002	0.8276	0.0918	0.7034
Clay anvil	-0.1261	0.7962	-0.0152	0.6501
Pottery vessel	0.7141	-0.0511	0.3238	0.6174
Mortuary phase 4				
Disc beads	0.9122	-0.1184	0.1090	0.8579
I-beads	0.9398	-0.0062	0.1508	0.9060
Pierced animal teeth	0.9412	0.0580	-0.1488	0.9114
Turtle carapace ornament	0.0300	-0.0252	0.9686	0.9397
Burnishing stone	-0.0365	-0.9421	0.1171	0.9027
Clay anvil	0.5792	-0.6591	-0.2934	0.8559
Pottery vessel	0.4194	-0.1751	-0.0611	0.2103

cent level of probability, both males, had respectively three pottery vessels and a turtle carapace ornament and two pottery vessels. The next three, a male, female and an infant, are relatively well endowed with shell beads and, in the cases of Bs. 103 and 123, with pottery vessels. Burial 117, linked in the analysis with B142, is an adult male with eight barrel shell beads. The latter, a female, was interred with red ochre and fabric, but no other grave goods. The last three graves to be combined at the 20 per cent level are all MP2 infants. Burials 133 and 134 had in common the presence of fish bone bangles. There were also 45 barrel-shaped beads associated with B133, that of a five-month-old infant.

The only relevant data from cluster E come from the first stage, MP2, which includes two neonates interred only with a dusting of red ochre. The adult male is rich, as is the female.

Perhaps the most dramatic example of both concordance between an adult and an associated infant burial and of special attention being given to infants comes from MP5. Here, we find that the burial ritual of B15, that of an adult female, was almost precisely matched by that of a 15-

month-old infant interred alongside her in B16. Both were favoured with a grave much larger than was required to contain the body. They were covered with a particularly large amount of red ochre, and no sign of fabric was noted. Grave goods for each included thousands of shell disc beads, hundreds of the large and rare I-shaped shell beads, a shell bangle and eight pots for the adult against four for the infant. The woman's bangle was worn on the left wrist, the infant's was placed over the left wrist. In both cases, the pots had been smashed and placed over the legs. A shell container holding burnishing pebbles and a clay potter's anvil lay beside the right ankle. A miniature anvil and a burnishing pebble were placed in the equivalent position with B16. While the adult was exclusively endowed with a shell headdress, pierced animal canines and shell discs,

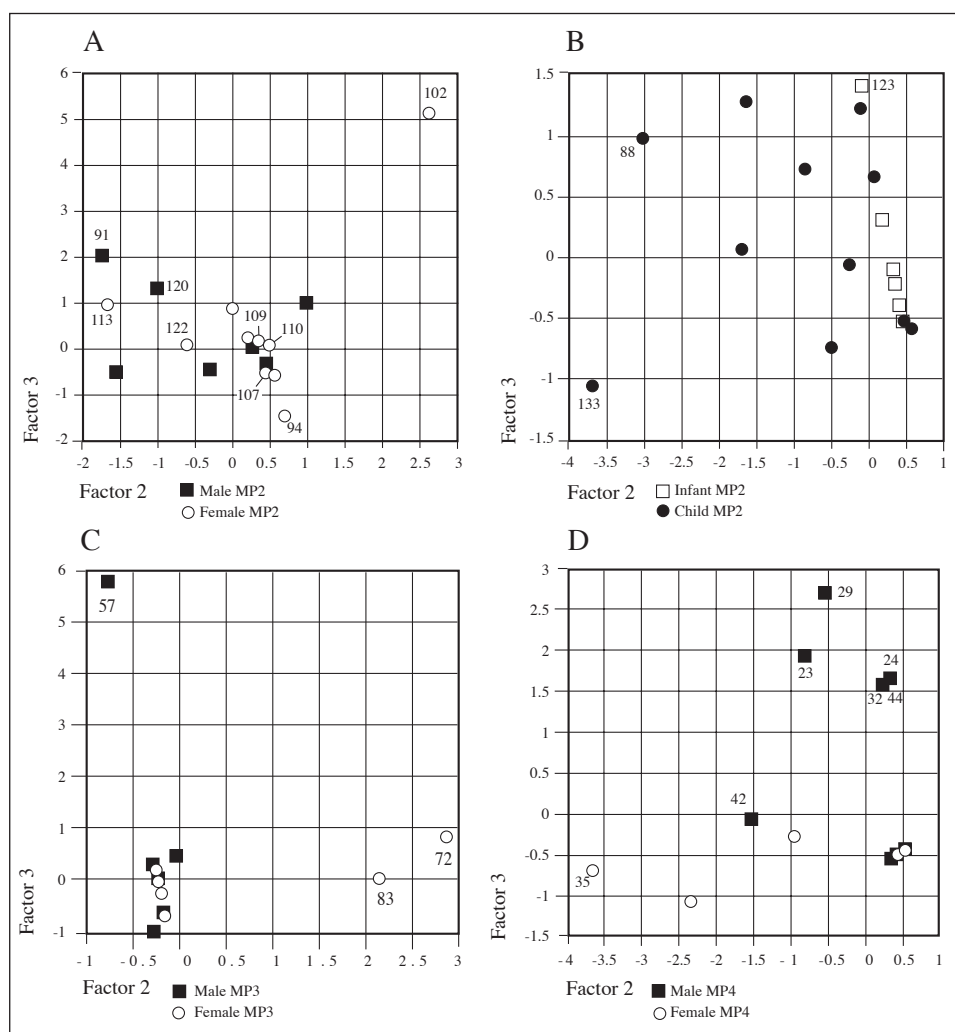


FIG. 52. Results of factor analyses for burials from mortuary phases 2-4. A: mortuary phase 2, males and females. B: infants and children, mortuary phase 2, C: mortuary phase 3, males and females. D: mortuary phase 4, males and females

both bodies had been covered with unfired clay cylinders before the grave was filled. A second rich and unusual infant burial was found less than a metre to the south of the foot of B15, the 15-month-old infant in this case being buried in an oval grave within two magnificent pots, and accompanied by 269 shell disc beads and two further pots.

We encounter two sets of graves during MP6. The first, and by far the richest, incorporates two females interred under a raised structure, each being accompanied by many shell disc beads and a clay potter's anvil (Figs. 31, 51). Unfortunately, B18 was seriously disturbed by a later pit and the lower part of the body is missing. We do not, therefore, know the full extent of her offerings, but B19 also included five pots, two burnishing stones, an anvil, shell beads and a shell bangle. Burial 6 had been interred over B18 and suffered the same disturbance when the pit was dug into the grave. This nine-year-old child was richly endowed, for despite the disturbance and destruction, there still remained a heavy shell disc behind the head, 17,786 disc beads, 656 H-shaped beads and a burnishing stone. This opulence contrasts with the interments which belong to cluster H. Buried at the same time as the three just described, the female in B4 was accompanied by two burnishing stones and a clay anvil. Burial 13, a second female, had eight burnishing stones and three pots and a male in B9 was provided with two pots, two turtle plastron objects, and an enigmatic item of shaped bone. Burial 7, that of a 21-month-old infant, included nine shell disc beads, four fish vertebra bangles and a pottery vessel. A second infant of the same age, B2, was found with a single pot, and there were also two neonates in the same grave, Bs. 5a and 5b, who were not accompanied by any goods, nor ochre.

Little can be said of MP7 in the absence of any adult graves. Cluster I incorporated the interesting interment, B3, of a three to four-month-old infant, provided with two pottery vessels, four shell bangles and 78 shell beads of disc and H-shape.

THE TREATMENT OF CHILDREN

Few graves contain the remains of children (Table 4). The earliest, burial 150, was also the only instance of interment in a crouched position (Fig. 48). Burial 145, containing the remains of an eight-year-old, was interred alongside an adult female. The child was not accompanied by any mortuary ritual, but the adult had 610 disc beads, an adze head and a worked shell. Burial 137, also belonging to cluster C during MP2, was buried in the same grave as an infant, and again, with no grave goods. The adults at this stage was also poorly endowed with grave offerings. The four-year-old in B96, cluster A, was accompanied by a burnishing pebble. These three burials all come from MP2. With MP4, we find a richer array of grave offerings with three of the five child burials encountered. While Bs. 17 (probably male, based on associated grave offerings) and 21 contained no goods, B37 (probably male) was accompanied by two pottery vessels, B32 by a pot, a bone object and a turtle carapace ornament, and B20 (probably female) with a burnishing stone, an anvil and two pots. These last three graves come respectively from clusters C, A and F. It is intriguing that the burial with a burnishing stone and an anvil was probably a young female.

The last set of child graves, all of which come from MP6-7, were accompanied by rich assemblages of grave goods. B6, of which only the upper part of the body survived, was interred with 17,786 disc beads, 656 H-shaped beads, two small cylindrical shell beads, a burnishing stone and a rare shell disc (Fig. 51). This grave was cut through the raised structure into the grave of B18. Burial

8, a contemporary of B5 but found in cluster H, was buried with two pots. Burial 11 was found with 12 disc beads, 57 H-shaped beads, an adze head and 3 pots. The last two child burials come from MP7. Burial 12 (probably female) was found with 730 disc beads, 30 H-shaped beads and four pots, while B1 was accompanied by three shell bangles and two pots, a burnishing stone and two anvils.

Given the small sample size, the apparent rise in the wealth of child graves with time could be illusory. There is, however, a relationship between the wealth of children and adults with whom they were buried. Poor child graves usually accompanied poor adults, and where children were interred with a rich set of goods, so too were the adults alongside them.

DIFFERENCES BETWEEN CLUSTERS

It has already been suggested that clusters might represent groups of some social kind. Let us now consider whether any cluster is distinguished through the hierarchic cluster analysis from any other in terms of grave goods. For this analysis, all adults were included (Fig. 49).

On reviewing this figure from the top to the bottom, we encounter at the 13-14 per cent probability level, a group of five burials distinguished by a paucity of material goods: Bs. 131 and 142 were devoid of offerings, while B38 had three pots, and 64 and 57 had two pot each and, in the case of B57, 23 disc beads. Within this group of five, there are four clusters and three mortuary phases. The next five graves are set apart at the 13 per cent level, and are again notable for the rarity of any grave goods. Four clusters are represented. There follows a grouping of 18 interments distinguished by the inclusion of a small number of pottery vessels. Five of these burials come from cluster C, five from cluster F, two respectively from clusters D and G and three from cluster A. Burial 9 is set apart from all others. It contains a rare bone object, two pots, a burnishing stone, three disc beads and two turtle plastron ornaments. The next 11 graves to be grouped at the 15 per cent probability level have in common the presence of anvils, some with and others without burnishing stones. It seems that this is a group of people concerned with pottery manufacture, and we find that five clusters are represented. Two of the next three burials to be grouped together have in common modified fish vertebrae. Possession of shell beads seems to be the linking variable for the group of 13 burials from Bs. 117-140 which are set apart at the 18 per cent probability level. Four clus-

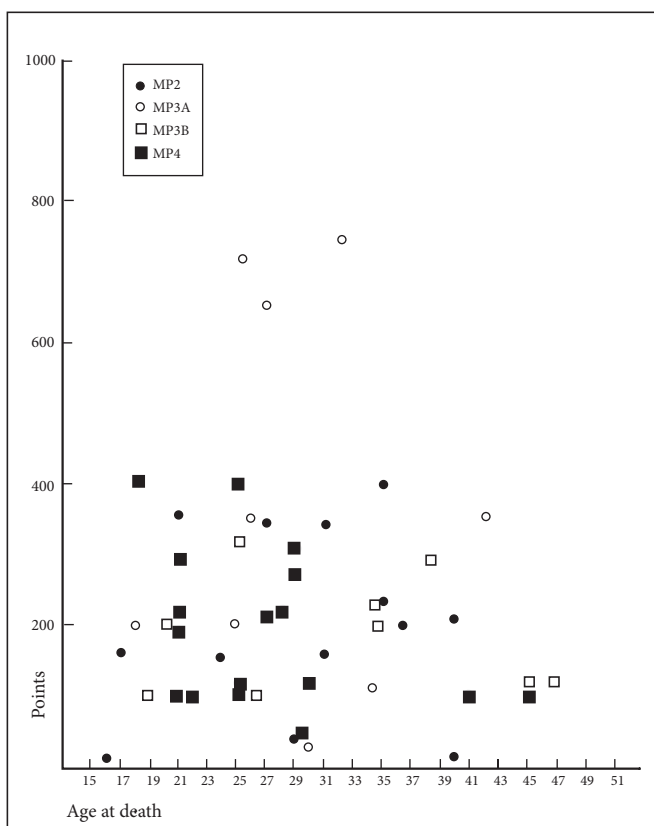
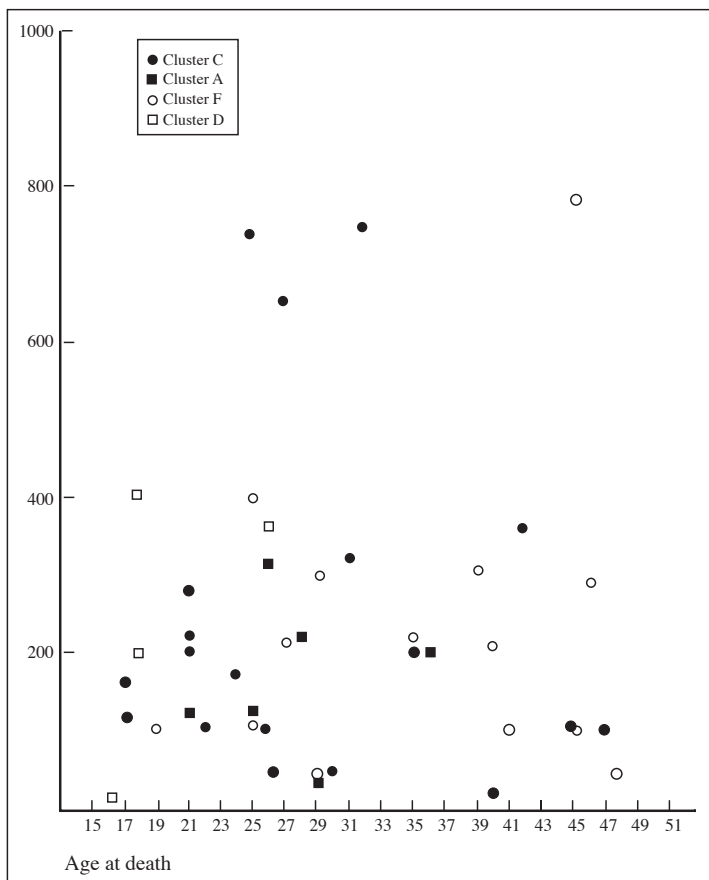


FIG. 53. The degree of wealth associated with graves of Mortuary Phases 2-4



ters are represented. The next group of three, Bs. 15, 43 and 132, comprises the richest adult burials in the site, and no cluster is dominant. Burials 83, 94 and 107, respectively from clusters C, B and C, seem to represent a second group of people associated with pottery decoration, since each included at least one burnishing stone among their grave goods. The last two burials are set apart from the rest, B40 being interred with fabric but no red ochre, and B152 having a distinctively early variety of funnel bead as grave goods.

It is apparent that the Jaccard test has failed to isolate any particular cluster as being outstandingly rich in terms of grave goods or mortuary treatment up to the end of MP4. Thereafter, the situation changed dramatically, a change which will be considered when reviewing the evidence for temporal developments.

PRINCIPAL COMPONENT ANALYSIS OF THE MORTUARY DATA

FIG. 54. The degree of wealth associated with individuals from specified clusters, Left hand scale is the number of points

There was a consistent difference between the treatment of infants who died at birth or soon thereafter, and those who survived beyond a few months of age. In order to consider this variance more precisely, the following analyses divide the young into two groups: those who barely survived parturition (described as infants) and those who survived at least the first few months of life (children).

As is customary in the application of principal component analyses to mortuary data, artefacts with low frequencies were excluded in order to reduce correlations affected by a small sample size (O'Shea 1984). This involved the exclusion of the funnel beads, bone and pierced shell objects, modified fish vertebrae and adze heads. The remaining types and graves underwent a principal component analysis and a varimax rotation was then applied to the five components with an eigenvalue exceeding 1.0. These accounted for 64.7 per cent of the original variance.

Factor 1 highlights the contrast between graves with anvils and burnishing stones, and those without turtle carapace ornaments. This emphasises the distinction observed between females with potting implements and males with turtle carapaces. Factor 2 has a chronological aspect, as it emphasises graves which do not have barrel beads or fish bone bangles. Both these artefact types

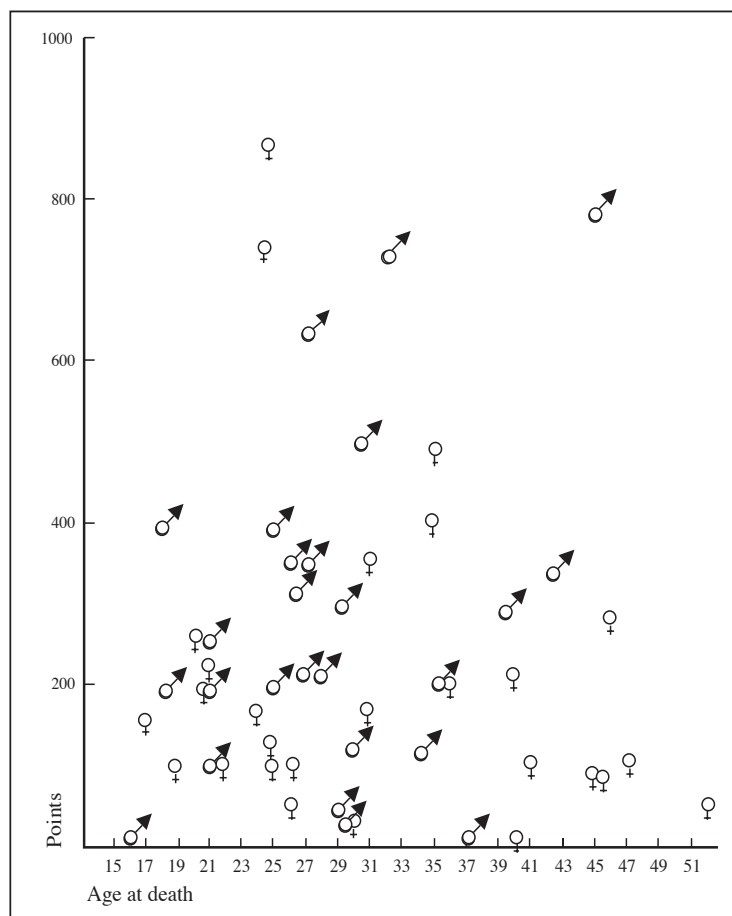


FIG. 55. The wealth of individuals on the basis of sex during Mortuary Phases 2-4

third shows a high value for turtle carapace ornaments (Table 6). The three eigenvalues for MP4 data exceeding 1.00 account for 79.77 per cent of variability. The first factor has generally high positive scores for disc and I-shaped beads and animal teeth. The second reveals high negative values for the burnishing stones and anvils, while the third has a high positive score for the turtle carapace ornaments (Table 6). The results for successive mortuary phases reveal that, with time, less variation is accounted for on the basis of the incidence of shell jewellery and pottery vessels. In the place of these artefacts, we find that a contrast between females or children on the one hand, and males on the other, is revealed by the disposition of anvils, burnishing stones and carapace ornaments. Females and children alone had the former, and only males the latter. This supports the result obtained for the analysis of all graves irrespective of mortuary phase.

Table 7 sets out the factor values for each grave. There is no obvious grouping of males or females on the basis of scores for factors 2 and 3 (Fig. 52). Rather, the plot distinguishes graves on the basis of the inclusion of different types of bead or, when unusual, other artefact types. Thus B102, which has values of 2.63 and 5.15, includes sixteen pierced animal teeth. Burials 91, 120,

are early in the mortuary sequence. The third factor also reflects chronological change, as it scores low values for late items. The fourth factor has a particularly high value for short barrel beads, which are rare and early. Finally, the fifth factor has a particularly high reading for H-beads, which are found only in late graves.

Given the impact of temporal change when the principal component analysis was applied to all graves, further analyses were applied to graves from MP2-4 separately. For MP2 graves, three eigenvalues exceeded a value of 1.0. The first factor shows high positive values for pottery vessels, disc and barrel beads and fish bone bangles. The third contrasted animal teeth with short barrel beads (Table 7).

Three eigenvalues for MP3 data also exceeded 1.0, and account for 64.86 per cent of variability. The first factor reveals positive values for disc beads, pottery vessels and barrel beads. The second highlights positive scores for burnishing stones and clay anvils and a low score for barrel beads and turtle carapace ornaments. The

Table 7. *The factor values for the principal component analysis of Mortuary Phases 2–4*

MP 2									
Burial	Status	Factor 1	Factor 2	Factor 3	Burial	Status	Factor 1	Factor 2	Factor 3
87	female	0.088	0.212	0.203	88	child	-0.373	-3.018	0.981
89	child	-0.128	0.063	0.666	91	male	1.622	-1.734	2.009
94	female	4.035	0.689	-1.468	96	child	0.562	0.544	-0.565
97	child	-0.418	0.445	-0.523	98	infant	-0.418	0.445	-0.523
99	child	-0.056	-0.115	1.223	100	male	-0.013	0.259	0.056
101	child	0.994	-0.869	0.732	102	female	-2.111	2.631	5.151
104	infant	-0.418	0.445	-0.523	105	child	1.023	-1.653	1.270
106	child	-0.418	0.445	-0.523	107	female	0.562	0.544	-0.565
108	infant	-0.418	0.445	-0.523	109	female	1.689	0.348	0.201
110	female	2.083	0.467	0.093	111	infant	-0.418	0.445	-0.523
112	female	0.020	-0.005	0.880	113	female	-0.017	-1.666	0.941
114	infant	-0.206	0.347	-0.218	115	male	-0.418	0.445	-0.523
116	infant	-0.418	0.445	-0.523	117	male	-0.406	-0.302	-0.454
118	infant	-0.418	0.445	-0.523	119	infant	-0.418	0.445	-0.523
120	male	-0.021	-1.023	1.334	121	child	-0.406	-0.262	-0.458
122	female	-0.053	-0.613	0.060	123	infant	0.856	-0.088	1.404
124	infant	-0.418	0.445	-0.523	125	infant	-0.369	0.173	0.321
126	infant	-0.314	0.397	-0.374	127	infant	-0.418	0.445	-0.523
128	infant	-0.418	0.445	-0.523	129	male	-0.385	-1.552	-0.340
130	child	-0.639	-1.723	0.074	131	male	-0.418	0.445	-0.523
132	male	3.622	0.976	1.023	133	child	-1.010	-3.712	-1.061
134	child	-0.623	-0.506	-0.742	135	child	-0.418	0.445	-0.523
136	infant	-0.418	0.445	-0.523	137	child	-0.418	0.445	-0.523
138	infant	-0.418	0.445	-0.523	139	infant	-0.418	0.445	-0.523
140	female	0.062	0.224	0.166	141	infant	-0.418	0.445	-0.523
142	female	-0.418	0.445	-0.523	143	infant	-0.123	0.310	-0.100
144	infant	-0.336	0.407	-0.405	145	child	-0.418	0.445	-0.523
146	infant	-0.418	0.445	-0.523					

MP 3A									
51	infant	-0.568	-0.210	-0.220	52	infant	-0.568	-0.210	-0.220
61	female	-0.568	-0.210	-0.220	65	infant	-0.568	-0.210	-0.220
66	infant	-0.568	-0.210	-0.220	68	infant	-0.568	-0.210	-0.220
69	infant	-0.568	-0.210	-0.220	70	infant	-0.552	-0.779	-2.146
71	infant	-0.568	-0.210	-0.220	72	female	1.569	2.857	0.823
73	female	3.075	-0.177	-0.646	75	infant	0.820	-0.088	0.246
76	male	-0.152	-0.253	0.034	78	infant	-0.568	-0.210	-0.220
83	female	-0.386	2.144	0.017	84	infant	-0.568	-0.210	-0.220
85	infant	-0.568	-0.210	-0.220	86	male	0.090	-0.279	0.182
90	male	3.413	-0.200	-0.624	92	male	0.090	-0.279	0.182

MP 3A (cont.)									
Burial	Status	Factor 1	Factor 2	Factor 3	Burial	Status	Factor 1	Factor 2	Factor 3
93	male	1.343	-0.065	0.456	95	infant	-0.568	-0.210	-0.220
103	male	2.843	-0.299	0.995					
MP 3B									
49	infant	-0.568	-0.210	-0.220	50	infant	-0.568	-0.210	-0.220
53	infant	-0.568	-0.210	-0.220	54	infant	-0.568	-0.210	-0.220
55	infant	-0.568	-0.210	-0.220	56	female	-0.152	-0.253	0.034
57	male	0.161	-0.785	5.777	58	female	0.090	-0.279	0.182
59	female	-0.568	-0.210	-0.220	60	female	-0.152	-0.253	0.034
62	child	0.090	-0.279	0.182	63	child	-0.152	-0.253	0.034
64	female	0.090	-0.279	0.182	67	male	0.090	-0.279	0.182
74	male	0.263	-0.297	0.288	77	female	-0.152	-0.253	0.034
79	female	-0.152	-0.253	0.034	80	infant	-0.568	-0.210	-0.220
81	infant	-0.568	-0.210	-0.220	82	child	-0.807	5.099	-0.097
MP 4									
17	male	-0.373	0.545	-0.433	20	female	0.017	-2.352	-1.067
21	child	-0.373	0.545	-0.433	22	male	-0.128	0.374	-0.524
23	male	-0.538	-0.883	1.948	24	male	-0.007	0.231	1.598
25	female	-0.373	0.545	-0.433	26	female	-0.373	0.545	-0.433
27	female	-0.218	0.437	-0.490	28	male	-0.218	0.437	-0.490
29	male	1.224	-0.548	2.721	30	male	-0.162	0.339	1.655
31	female	-0.218	0.437	-0.490	32	child	-0.162	0.339	1.655
33	child	4.893	0.301	-0.773	34	infant	-0.373	0.545	-0.433
35	female	0.114	-3.668	-0.705	36	female	-0.349	-0.956	-0.288
37	male	-0.128	0.374	-0.524	38	male	-0.063	0.329	-0.547
39	female	-0.218	0.437	-0.490	40	female	-0.373	0.545	-0.433
41	child	0.322	0.463	-0.276	42	male	-0.724	-1.564	-0.059
44	male	-0.007	0.231	1.598	45	female	-0.218	0.437	-0.490
46	child	-0.373	0.545	-0.433	47	female	-0.218	0.437	-0.490
48	infant	-0.373	0.545	-0.433					

113 and 122, which have positive values for factor 3, contain shell barrel beads. On the other hand B94 is distinguished by having short barrel beads. A small group comprising Bs. 107, 109 and 110 is characterized by burnishing stones. The contrast between the treatment of new-born infants and those which survived even for a few months, is clearly illustrated in figure 52. There is a dense concentration of infant graves with no mortuary goods. Childrens' graves are much more widely scattered. Burial 133 contains shell barrel beads, and B88, occupying an extreme position with a negative value for factor 2, included many beads and two pottery vessels. Burial 123, which scores

TABLE 8. *Coordinates of the burial data obtained from a four-dimensional non-metric multidimensional scaling*

Burial	Dimension				Burial	Dimension			
	1	2	3	4		1	2	3	4
1	1.0395	-0.2965	-0.0469	-0.4778	2	0.9940	-0.0819	-0.0436	-0.0121
3	-1.5029	-0.4898	1.5535	-0.6761	4	1.0426	-0.1924	-0.0352	-0.0147
5	1.0221	-0.0979	-0.0086	0.0020	6	-4.8600	-0.7702	3.2572	-0.9340
7	-0.2721	-0.1158	0.1324	0.4095	8	1.0004	-0.1199	-0.0405	0.0417
9	0.2234	-0.1528	-0.1015	0.1747	10	1.0219	-0.0982	-0.0066	0.0007
11	-0.6765	-0.4765	1.8873	-0.9926	12	-2.9391	-0.4722	1.6677	-0.3145
13	0.2051	-0.2930	-0.1351	0.9516	14	-2.1823	-0.2001	0.0832	0.5594
15	-6.4432	-1.7130	-2.3520	-1.2125	16	-4.8655	-1.3770	-1.6834	-0.9337
17	1.0221	-0.0980	-0.0081	0.0006	18	-4.5532	-0.7455	3.2032	-1.1678
19	-3.2355	-0.2822	0.0746	0.8375	20	1.0016	-0.1529	-0.0458	0.0370
21	1.0221	-0.0980	-0.0074	-0.0005	22	0.9946	-0.0880	-0.0390	-0.0092
23	1.0283	-0.1272	-0.0175	-0.0030	24	1.0033	-0.1360	-0.0397	0.0724
25	1.0221	-0.0982	-0.0074	-0.0006	26	1.0221	-0.0982	-0.0074	-0.0006
27	0.9940	-0.0820	-0.0428	-0.0142	28	0.9940	-0.0820	-0.0428	-0.0142
29	-2.5425	-0.7839	-0.9021	-0.3867	30	1.0003	-0.1032	-0.0394	-0.0118
31	0.9940	-0.0821	-0.0429	-0.0142	32	1.0003	-0.1032	-0.0394	-0.0118
33	-4.6174	-1.1645	-1.5247	-0.7544	34	1.0221	-0.0983	-0.0077	-0.0008
35	-0.2572	-0.2412	-0.0533	0.3928	36	0.9984	-0.1184	-0.0302	0.0608
37	0.9944	-0.0882	-0.0392	-0.0092	38	1.0030	-0.1150	-0.0226	0.0785
39	0.9939	-0.0824	-0.0430	-0.0142	40	1.0220	-0.0983	-0.0077	-0.0010
41	-1.0196	-0.1147	0.0792	0.2196	42	1.0280	-0.1256	-0.0322	0.0015
43	-5.7863	-1.5870	-2.0506	-1.2634	44	1.0025	-0.1377	-0.0421	0.0698
45	0.9930	-0.0836	-0.0450	-0.0161	46	1.0213	-0.0996	-0.0098	-0.0029
47	0.9930	-0.0836	-0.0450	-0.0161	48	1.0213	-0.0996	-0.0098	-0.0029
49	1.0213	-0.0996	-0.0098	-0.0029	50	1.0213	-0.0996	-0.0098	-0.0029
51	1.0213	-0.0996	-0.0098	-0.0029	52	1.0213	-0.0996	-0.0098	-0.0029
53	1.0213	-0.0996	-0.0098	-0.0029	54	1.0213	-0.0996	-0.0098	-0.0029
55	1.0213	-0.0996	-0.0098	-0.0029	56	0.9930	-0.0836	-0.0450	-0.0161
57	-1.5425	-0.1756	0.0802	0.4034	58	0.9937	-0.0895	-0.0414	-0.0111
59	1.0213	-0.0996	-0.0098	-0.0031	60	0.9932	-0.0836	-0.0450	-0.0163
61	1.0213	-0.0996	-0.0098	-0.0031	62	0.9937	-0.0895	-0.0414	-0.0111
63	0.9932	-0.0836	-0.0450	-0.0163	64	0.9937	-0.0895	-0.0414	-0.0111
65	1.0213	-0.0996	-0.0098	-0.0031	66	1.0213	-0.0996	-0.0098	-0.0031
67	0.9937	-0.0895	-0.0414	-0.0111	68	1.0213	-0.0996	-0.0098	-0.0031
69	1.0213	-0.0996	-0.0098	-0.0031	70	1.0248	-0.0653	-0.0181	-0.0388
71	1.0213	-0.0996	-0.0098	-0.0031	72	-2.3101	-0.2304	0.1076	0.7192
73	-3.2351	1.5403	-0.0195	0.1817	74	1.0026	-0.1172	-0.0250	0.0750

Table 8 (cont.) *Coordinates of the burial data obtained from a four-dimensional non-metric multidimensional scaling*

Burial	Dimension				Burial	Dimension			
	1	2	3	4		1	2	3	4
75	-1.9560	-0.1422	0.1203	0.4535	76	0.9936	-0.0841	-0.0451	-0.0177
77	0.9936	-0.0841	-0.0451	-0.0177	78	1.0219	-0.1001	-0.0099	-0.0048
79	0.9936	-0.0841	-0.0451	-0.0177	80	1.0219	-0.1001	-0.0099	-0.0048
81	1.0219	-0.1001	-0.0099	-0.0048	82	1.0281	-0.1322	-0.0255	-0.0280
83	1.0278	-0.1277	-0.0350	-0.0038	84	1.0219	-0.1001	-0.0099	-0.0048
85	1.0219	-0.1001	-0.0099	-0.0048	86	0.9941	-0.0902	-0.0414	-0.0126
87	-2.8137	-0.1993	0.2018	0.6837	88	-2.8947	1.3840	-0.0619	0.2178
89	-1.3566	-0.1257	0.0984	0.2948	90	-3.3787	1.6900	-0.0588	0.2213
91	-3.3594	2.2240	-0.1785	-0.0291	92	0.9944	-0.0908	-0.0414	-0.0135
93	-2.8299	-0.1801	0.1456	0.6553	94	1.0820	-0.4557	-0.4867	-1.8856
95	1.0224	-0.1010	-0.0107	-0.0126	96	1.0210	-0.1129	-0.0243	-0.0104
97	1.0224	-0.1010	-0.0107	-0.0126	98	1.0224	-0.1010	-0.0107	-0.0126
99	-2.1119	-0.1600	0.1049	0.4553	100	-2.0037	-0.1919	0.1765	0.4995
101	-2.8038	1.1920	-0.0698	0.1333	102	-0.5162	-0.4598	-0.3750	1.1514
103	-1.5542	1.9440	-0.1855	-0.1970	104	1.0225	-0.1026	-0.0114	-0.0093
105	-3.2344	2.1805	-0.2153	-0.1057	106	1.0224	-0.1018	-0.0115	-0.0096
107	1.0210	-0.1137	-0.0252	-0.0073	108	1.0224	-0.1018	-0.0115	-0.0096
109	-3.1868	-0.2224	0.2354	0.8355	110	1.0542	-0.2669	-0.0894	-0.0044
111	1.0224	-0.1018	-0.0115	-0.0094	112	-2.5580	-0.1546	0.1574	0.6018
113	-2.3717	2.4468	-0.1745	-0.2370	114	-0.5120	-0.1164	0.0313	0.1097
115	1.0226	-0.1022	-0.0115	-0.0102	116	1.0226	-0.1022	-0.0115	-0.0102
117	0.8902	1.0357	-0.1080	-0.3418	118	1.0226	-0.1022	-0.0115	-0.0100
119	1.0226	-0.1022	-0.0115	-0.0100	120	-2.4338	1.1471	-0.0421	0.1474
121	0.9203	0.8906	-0.1002	-0.2653	122	-1.7604	1.1837	-0.0353	0.0469
123	-1.7120	-0.1474	0.0511	0.4474	124	1.0227	-0.1027	-0.0115	-0.0105
125	0.3761	-0.0838	0.0137	0.0790	126	0.2518	-0.1053	-0.0037	0.0560
127	1.0227	-0.1027	-0.0115	-0.0105	128	1.0227	-0.1027	-0.0115	-0.0105
129	0.7006	3.0880	-0.3371	-0.9307	130	0.8518	1.3883	-0.2777	-0.4316
131	1.0227	-0.1032	-0.0115	-0.0100	132	-5.0738	-0.4887	0.1736	1.5362
133	0.8698	2.1675	-0.3012	-0.6740	134	1.0255	-0.0687	-0.0198	-0.0394
135	1.0219	-0.1032	-0.0115	-0.0055	136	1.0219	-0.1032	-0.0115	-0.0055
137	1.0219	-0.1032	-0.0115	-0.0055	138	1.0219	-0.1032	-0.0115	-0.0055
139	1.0219	-0.1032	-0.0115	-0.0055	140	-2.6020	-0.1694	0.1957	0.6658
141	1.0221	-0.1031	-0.0115	-0.0063	142	1.0221	-0.1031	-0.0115	-0.0063
143	-1.0484	-0.1494	0.0886	0.2035	144	0.3982	-0.0744	0.0163	0.0383
145	1.0219	-0.1032	-0.0114	-0.0057	146	1.0219	-0.1032	-0.0114	-0.0057
147	1.0219	-0.1032	-0.0114	-0.0057	148	1.0219	-0.1032	-0.0114	-0.0057
149	1.0219	-0.1032	-0.0114	-0.0057	150	-0.3556	-0.1039	0.0951	0.1675
151	1.0219	-0.1032	-0.0114	-0.0057	152	1.0219	-0.1032	-0.0114	-0.0057

highly for factor 3, included a burnishing stone, three pottery vessels and 120 shell disc beads.

In the case of MP3, the distribution for factors 2 and 3 reveals a large concentration of burials with few or no grave goods, but also highlights B57, a male, and Bs. 72 and 83, both females (Fig. 52). Burial 57 is the earliest male, and the only one in MP3, to be interred with a turtle carapace ornament, and it is possession of this which sets him apart. The two females have in common the presence of burnishing pebbles. Thus, there are hints that the earliest clear distinction in the treatment of males and females occurred during MP3. This trend crystallised during MP4, where we encounter a clear demarcation in factors 2 and 3 between males and females, a concentration of the former all having the turtle carapace ornaments, while the latter have anvils. Burial 42, that of a male located near the group of females, was equipped with two burnishing stones. Burial 32, an eleven-year-old child interred with a turtle carapace ornament, was probably a young male.

MULTIDIMENSIONAL SCALING

Multidimensional scaling has been applied to the data in order to identify possible patterning. As Manly (1986) has shown, this statistic produces a map which may have two or more dimensions, showing distance between objects. Figure 56 shows the results for all data, the bases being the logarithm of the counts for each artefact +1. Viewed in two dimensions, there is a large concentration with values of 1.02 for dimension 1 and -0.10 for dimension 2 (Table 8). These graves contain no artefacts. Proceeding towards a value of -6.44 for dimension 1 (B15), graves become progressively richer. There is also a temporal dimension, for graves score high values of dimension 2 if they contain barrel beads. The highest score for this dimension was obtained by B129, a grave which included most of these artefacts. Graves with positive values for dimension 2 and slightly positive values for dimension 1 all come from MP2, and have either only barrel beads or barrel beads and little else as grave goods. The grave with high positive values for dimension 2 and negative values for dimension 1 all contain barrel beads and high scores for other grave goods as well. All but three belong to MP2, the remainder to MP3. Figure 57 also shows a three dimensional plot of the burials, and again, the rich burials stand out for their high negative scores in all three values. The cloud of interments with no or few goods is also visible and once again, the early group of burials distinguished by the presence of barrel beads is seen with their high values for dimension 2. High positive values for the third dimension are confined to burials with H-shaped beads, again confirming that the variation is strongly influenced by changing styles of shell beads.

In order to avoid chronological distinctions, multidimensional scaling was applied to successive mortuary phases. The results for MP2 suggests three configurations (Fig. 56). The first, where values for dimension 2 are all negative, reveals burials rising in terms of mortuary wealth as dimension 1 increases in value. The second has positive scores for dimension 2 and negative ones for dimension 1. This grouping contains five burials, three from cluster B and two from cluster D. Two are male and the rest, children, and all possess barrel beads. The same proximity and contemporaneity is found for Bs. 117 and 133.

The third group includes five burials belonging to cluster F. These are richer than the cluster B and D graves in that they include disc and barrel beads and pottery vessels. Once again, the graves in question are virtually contemporaneous and contiguous, suggesting that there was a relationship

TABLE 9. *Coordinates of the burial data obtained from a four-dimensional non-metric multidimensional scaling for mortuary phase 2, 3 and 4 burials. The mortuary phase 2 data and the mortuary phase 3-4 data were subjected to the analysis separately*

Burial	Dimension				Burial	Dimension			
	1	2	3	4		1	2	3	4
Mortuary Phase 2									
87	2.588	-0.968	0.221	-0.324	88	2.851	0.771	0.377	-0.300
89	1.198	-0.654	0.207	-0.043	91	3.449	1.654	0.176	0.342
94	-1.160	-0.326	-2.321	-0.039	96	-1.282	-0.229	-0.031	-0.022
97	-1.287	-0.196	0.048	-0.013	98	-1.287	-0.196	0.048	-0.013
99	1.931	-0.791	0.304	0.039	100	1.795	-0.807	0.229	-0.243
101	2.774	0.569	-0.345	-0.154	102	0.351	-0.510	0.192	1.597
104	-1.288	-0.196	0.048	-0.007	105	3.304	1.578	-0.409	0.058
106	-1.288	-0.196	0.048	-0.007	107	-1.282	-0.229	-0.030	-0.015
108	-1.288	-0.196	0.048	-0.007	109	2.959	-1.112	0.214	-0.224
110	-1.264	-0.246	-0.189	0.754	111	-1.287	-0.196	0.048	-0.005
112	2.339	-0.903	0.270	-0.040	113	2.403	2.044	0.124	-0.101
114	0.330	-0.503	0.117	-0.115	115	-1.288	-0.196	0.047	-0.005
116	-1.288	-0.196	0.047	-0.005	117	-1.032	1.021	-0.028	-0.055
118	-1.288	-0.197	0.048	-0.005	119	-1.288	-0.197	0.048	-0.005
120	2.399	0.668	0.195	0.085	121	-1.043	0.958	-0.058	0.015
122	1.698	0.767	0.059	-0.200	123	1.547	-0.735	0.290	0.348
124	-1.288	-0.197	0.048	-0.004	125	-0.608	-0.324	0.019	0.053
126	-0.473	-0.354	-0.005	-0.051	127	-1.288	-0.197	0.048	-0.004
128	-1.288	-0.197	0.048	-0.004	129	-0.632	3.155	-0.154	0.013
130	-0.921	1.497	0.016	0.101	131	-1.288	-0.197	0.048	-0.005
132	4.892	-1.512	-1.154	-0.074	133	-0.930	2.119	0.159	-0.546
134	-1.292	-0.182	0.059	-0.139	135	-1.288	-0.197	0.047	-0.007
136	-1.288	-0.197	0.047	-0.007	137	-1.288	-0.197	0.047	-0.007
138	-1.288	-0.197	0.047	-0.007	139	-1.288	-0.197	0.047	-0.007
140	2.396	-0.934	0.217	-0.325	141	-1.288	-0.197	0.047	-0.007
142	-1.288	-0.197	0.047	-0.007	143	0.969	-0.614	0.164	-0.163
144	-0.626	-0.336	0.007	-0.069	145	-1.288	-0.197	0.047	-0.007
146	-1.288	-0.197	0.047	-0.007					
Mortuary Phases 3–4									
17	0.769	-0.038	-0.017	0.267	20	0.668	-0.019	0.093	-0.646
21	0.769	-0.038	-0.017	0.268	22	0.682	0.040	0.199	-0.407
23	0.762	-0.105	-0.288	0.351	24	0.660	0.047	0.230	-0.722
25	0.768	-0.038	-0.018	0.270	26	0.768	-0.038	-0.018	0.270
27	0.705	0.010	0.076	-0.159	28	0.705	0.010	0.076	-0.159

Table 9 (cont.) *Coordinates of burial data from multidimensional scaling*

Dimension					Dimension				
Burial	1	2	3	4	Burial	1	2	3	4
Mortuary Phases 3–4 (<i>cont.</i>)									
29	-4.266	-1.782	0.493	0.886	30	0.713	-0.007	0.149	-0.142
31	0.705	0.010	0.075	-0.159	32	0.713	-0.007	0.149	-0.143
33	-7.199	-2.719	1.565	-0.020	34	0.768	-0.038	-0.018	0.271
35	-1.092	-0.205	-0.518	-0.546	36	0.683	0.000	0.069	-0.464
37	0.682	0.041	0.200	-0.408	38	0.664	0.069	0.232	-0.639
39	0.705	0.010	0.076	-0.159	40	0.768	-0.038	-0.017	0.273
41	-2.291	-0.069	-0.640	-0.083	42	0.750	-0.088	-0.540	0.360
44	0.660	0.047	0.228	-0.722	45	0.705	0.010	0.076	-0.158
46	0.768	-0.038	-0.017	0.274	47	0.705	0.010	0.076	-0.159
48	0.768	-0.038	-0.018	0.274	49	0.768	-0.038	-0.018	0.274
50	0.768	-0.038	-0.018	0.274	51	0.768	-0.038	-0.018	0.274
52	0.768	-0.038	-0.018	0.274	53	0.768	-0.038	-0.018	0.274
54	0.768	-0.038	-0.018	0.274	55	0.768	-0.038	-0.018	0.274
56	0.705	0.010	0.077	-0.162	57	-2.983	-0.202	-0.674	-0.382
58	0.682	0.041	0.199	-0.414	59	-0.038	-0.038	-0.017	0.277
60	0.705	0.010	0.077	-0.163	61	0.768	-0.038	-0.017	0.277
62	0.682	0.041	0.200	-0.415	63	0.705	0.010	0.077	-0.163
64	0.682	0.041	0.199	-0.415	65	0.768	-0.038	-0.019	0.280
66	0.768	-0.038	-0.019	0.280	67	0.682	0.041	0.200	-0.417
68	0.768	-0.038	-0.019	0.282	69	0.768	-0.038	-0.019	0.282
70	0.771	-0.032	-0.066	0.345	71	0.768	-0.038	-0.019	0.282
72	-4.024	-0.288	-1.201	-0.634	73	-5.557	1.900	0.086	0.324
74	0.662	0.069	0.230	-0.649	75	-3.508	-0.182	-0.919	-0.008
76	0.705	0.010	0.077	-0.165	77	0.705	0.010	0.077	-0.165
78	0.768	-0.038	-0.020	0.284	79	0.705	0.010	0.077	-0.165
80	0.768	-0.038	-0.020	0.285	81	0.768	-0.038	-0.020	0.285
82	0.754	-0.121	-0.292	0.407	83	0.749	-0.087	-0.536	0.382
84	0.768	-0.039	-0.020	0.285	85	0.768	-0.039	-0.020	0.285
86	0.681	0.041	0.200	-0.423	90	-5.753	2.121	0.265	0.161
92	0.681	0.041	0.200	-0.423	93	-4.765	-0.241	-1.061	-0.335
95	0.768	-0.039	-0.022	0.288	103	-3.217	2.530	0.949	0.420

between location and mortuary treatment of the dead. Burials 101, 105 and 113 were interred in a group, and burials 88 and 91 were found together. The sample sizes for MP3 and MP4 are not large enough on their own, so they are pooled. There is a concentration of interments with one or two pottery vessels. The distribution sets apart the MP3 graves with barrel beads three of which,

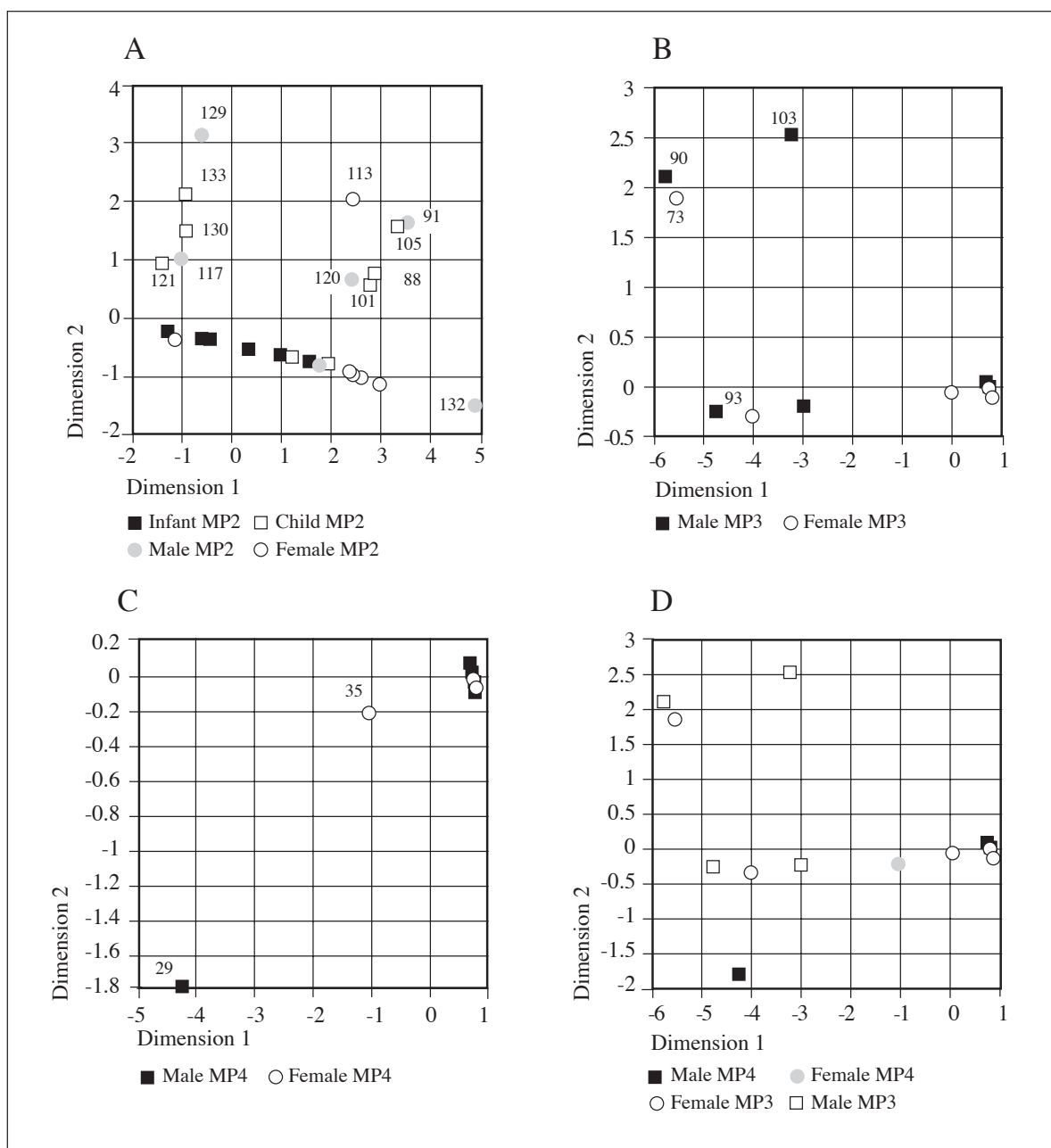


FIG. 56. The results of multidimensional scaling. A: Mortuary phase 2, adults, infants and children, B: Mortuary phase 3, adults, C: Mortuary phase 4, adults, D: Mortuary phases 3 and 4 combined

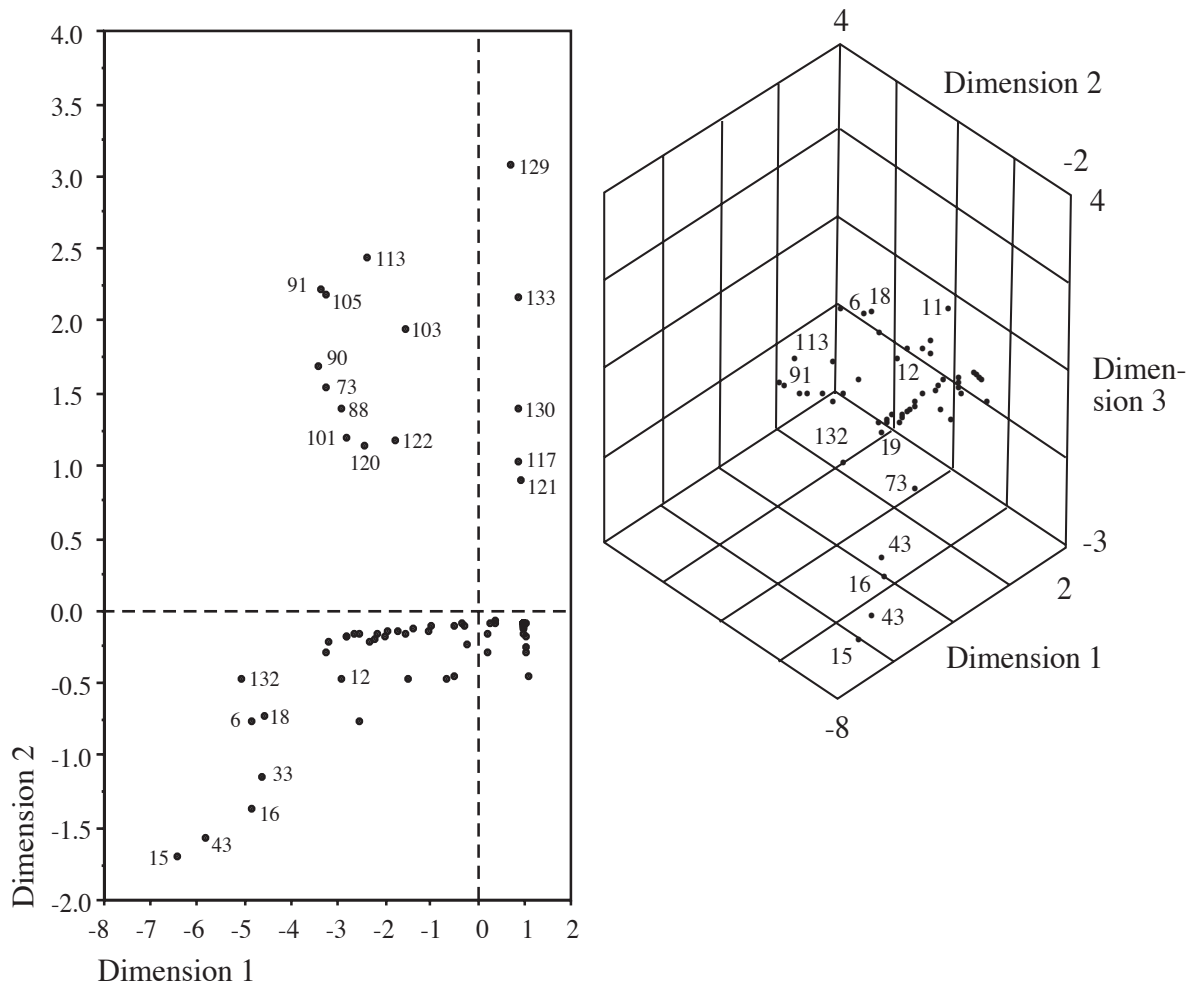


FIG. 57. The distribution of graves against the first two dimensions of the configuration produced by three-dimensional non-metric multidimensional scaling (left) and the first three dimensions (right)

Bs. 73, 90 and 93, lie adjacent to each other, and these were interred virtually contemporaneously. One is a female, the other two are males. Burial 103 stands out, probably because in addition to disc and barrel beads, it was associated with an unusual perforated shell. Burial 29 is also set apart as it is the earliest to contain I-beads (Fig. 56C). When the chronological factor, as far as possible, is removed from the samples subjected to multidimensional scaling, we find that the technique tends to group together individuals buried near each other within the same cluster.

TABLE 10. *The numbers of pottery vessels in Mortuary Phase 2–4 burials*

N pots/burial	Total no.	Burial								M	F	C	I	
MP2														
1	7	89	101	110	112	113	125	130	–	3	–	4		
2	5	88	99	102	105	120			1	1	–	3		
3	1				123				–	–	–	1		
4	1				91				1	–	–	–		
MP3A														
1	3				75	79			1	1	–	1		
2	5	73	76	92	93	103			4	1	–	–		
3	2				72	86	90		2	–	–	–		
MP3B														
1	4	56	60	63	74	77			–	3	–	1		
2	5	57	58	62	64	67			2	2	1	–		
MP4														
1	9	27	28	30	31	32	39	41	45	47	2	5	1	1
2	5	20	22	35	36	37			1	2	2	–		
3	3				24	38	44		3	–	–	–		
4	1				33				–	–	–	1		

M: male, F: female, C: child, I: infant

THE PLACEMENT OF GRAVE GOODS: POTTERY VESSELS

Pottery vessels, shell beads and other grave goods will now be examined on the basis of their location in each burial. This enables us to ask whether there is any trend in the placement of a particular item at a certain location from the initial to the final mortuary phase. Is the location of grave goods related to the age and sex of the interment? Are there any differences in the distribution of grave goods between clusters of burials? This analysis seeks evidence for or against minor but consistent differences in mortuary rites within each cluster.

The appearance of pottery vessels in graves was first recorded in MP2 with B130, which contained the remains of a six-month-old infant. Broken pieces of one vessel clustered beyond the infant's head. Not long after or at about the same time, another vessel was found in the grave of a 36-year-old female, B110. It was almost complete and was located between the ankles. The third and fourth vessels appeared together in a young adult male grave, B120, and were disposed on their bases between the calves. Thereafter, more vessels, some broken and others intact, were found in association with interments of all ages and both sexes. They were usually located at the lower part of the body or in the region of legs. Burials with several pots were also accompanied

by other grave goods, mainly ornaments.

During MP2, fourteen burials were accompanied by between one and four pottery vessels (Table 10). These comprise two males, four females and eight infants. The age at death of these interments is 21 and 45 years for males, 35 to 46 for females, over five months for six infants, and less than five months for two infants. The quantity of vessels ranges from one to four pots.

In general, pottery vessels were placed over or close to the body, most often in the region of the legs. There are three occasions when the vessels were seen at other parts of the body, for example, beyond the head in B130 and over the torso in Bs. 102 and 112. Burial 102 also contained one more vessel which was placed over the left shin. Vessels from other burials were located over the legs, over/between the ankles, over the knees, or between the calves. In the case of burials with more than one pot, the vessels were placed next to each other, except for B102.

With regard to the shape of vessels, there is a wider range than during later periods. There are at least eight different forms from 24 vessels. The commonest is a carinated, round-bottomed vessel which was either plain or decorated. There are eight such vessels from six graves. Sometimes, they appeared in an identical pair or together with vessels of different shapes. Other forms include ring-footed jars, shallow bowls with or without ring-feet and deep bowls with or without ring-feet. It seems that there is no evidence for any particular shape of the vessel cross-cutting the age and sex of the dead. According to their dispositions, these mortuary vessels were arranged in the following manner:

1 On its base or right side up. 2 Upside-down. 3 On the side. 4 A cluster of broken pot(s). 5 A spread of broken pot(s).

The majority of intact and almost complete vessels, comprising less than one fourth of vessels found, were disposed on their bases. Those placed upside-down or on the side are rare. For broken vessels, the common arrangement is placing sherds from one or more vessels in a cluster. These configurations imply that Khok Phanom Di mortuary vessels did not function as food containers or for storage. It is particularly true for smashed vessels and for those placed upside-down since it is not practical to store food in such a manner or condition. There is one possibility for some vessels being used as containers. This applied to those intact and partially broken vessels which were placed either on their bases or on their sides. However, no food residue has been identified. Instead, a thin layer of red ochre adhering to the interior surface of the vessel was recognized in several cases, suggesting that they were used specifically in the funerary ritual rather than as food containers for the dead.

Pottery vessels appear in 20 MP3 burials from the total of 43 graves. With the exception of two females, Bs. 61 and 83, all are adult interments, 10 males and 7 females, were buried with vessels, but they were associated with only three infants. The arrangement of pottery vessels, both in location and disposition, follows the same trends as the preceding phase. Either broken or, in some cases, intact vessels are normally located at the region of lower limbs such as over or near the ankles, at the knees, over or between the calves, over or between the thighs, and alongside one leg. In the case of Bs. 57 and 64, they were placed beyond the left shoulder. The idea of "killing" vessels was widely adopted in MP3B and after. More vessels were deliberately smashed and were arranged in such a manner, indicating that they were not caused by the natural decomposition or by chance. However, some *in situ* vessels may have broken naturally. This can be recognized by the disposition of the vessel on its base or side, which is normally correlated with intact pots. It is found that for MP3A, all but one pottery vessel remained intact. With MP3B, however, all vessels

had been broken, almost certainly in antiquity. The quantity of vessels in MP3A and B graves varies from one to three (Table 10).

Among vessel forms, the classic shape with a carination and round-bottom predominated. Pots of other forms, about five different styles all of which are highly decorated, appear only once in graves of MP3A (Bs. 72, 75, 86, 90, and 103: one infant and four males). During MP3B, however, mortuary vessels became plainer and there was less variation in form. It is likely that there is no differentiation between MP2 and 3A mortuary vessels. With MP3B, there were marked changes both in vessel form, and in the number of forms. Shell beads became rare with MP3B. Phase 3A graves yielded 3138 disc beads, but only 23 were found with one MP3B interment, B 57. With the same burial, there is the first appearance of a male symbolic item: an ornament shaped from a turtle carapace.

Eighteen out of 29 burials were accompanied by pottery vessels in MP4: six males, seven females, three children, and two infants. Altogether, there are 36 vessels, most of which were smashed in prehistory. The majority are disposed in the region of the legs, mainly in the ankle area. Vessels belonging to MP4 still included carinated round-bottomed vessels. The diameter of the rim, ranging from 12-20 cm, is greater than that of the body. The ratio of the diameter between the rim and the body is approximately 1:0.75. These vessels are plain and burnished, sometimes interrupted vertically or diagonally by short, impressed lines at the carinated point or at the rim. On some occasions, two parallel incised lines were applied horizontally at the upper portion of the vessel. Only one vessel with a ring foot that had been detached in prehistory was found, interred with a child in B37. This child was also accompanied by another complete but not intact vessel (cat. 1270) with cord-marked impressions and an unusual bowl-like shape. The number of vessels in each grave is set out in table 10.

THE DISTRIBUTION OF POTTERY VESSELS BETWEEN CLUSTERS

A further study concerning the distribution of mortuary vessels is a closer examination within each cluster of burials. It is interesting to ascertain whether there is any variation in the placement of vessels among interments from different clusters. The comparative study will be applied in particular to those burials from clusters C and F, which comprise an appropriate number of interments accompanied by vessels.

In cluster C, the earliest grave yielding a mortuary vessel is that of an infant, B125. An intact, small and plain pot was placed on its base over the ankles. The second and third graves containing vessels are Bs. 90 and 93. Both involved adult males and were accompanied by a pair of carinated round-bottomed vessels. In B90, they were disposed on their bases in an intact condition near both knees. The third vessel with a ring-foot, similar to those seen in two female graves of cluster E and F (Bs. 102 and 113), was broken and the pieces were located over the ankles and the lower legs. In B93, one vessel was nearly intact and was located on its base over the ankles, while a broken vessel was found near the right knee. Burial 73, an adult female, was interred with two almost intact globular vessels. One was placed between her knees and the other between her thighs. The next male burial in cluster C, B72, revealed a similar distribution of pots relative to the body, but all three vessels were broken.

With MP3B, there was a marked change in vessel placement. All pots were found in a broken condition, and, as is seen for B64, an adult female, the two pots were placed some distance apart,

one on the left shoulder and the other beside and to the left of the left shin. In the case of B67, an adult male, the two broken vessels were found alongside the left leg, and for B79, one vessel was smashed and placed over the left thigh, with the second under the right thigh. Finally, B77 had a smashed pot in the vicinity of the ankles. This pattern, with the exception of B37, was to be repeated during all other interments of MP4 in cluster C: pots were invariably found broken and located near the ankles (Bs. 47, 45, 36 and 35).

The same variables will now be considered for cluster F. During MP2, the dead were usually accompanied by complete pots placed between the ankles and knees. Only in the case of B112 was a broken pot placed above the right shoulder. There are, however, instances where similar pots were placed in the same position relative to the body of contemporary burials. Thus, Bs. 113 and 99, an adult female and an adjacent infant, had complete vessels placed one over the knees and the other over the ankles. One of the vessels (cat. 1649), however, had had its rim removed in



FIG. 58. The four burials comprising cluster A during mortuary phase 4 reveal how the turtle carapace ornaments had been smashed and placed with the dead males. From left to right, burial 30 is a man who died when about 34 years of age, and his turtle carapace ornament is placed over his right thigh. He also has a fishhook beside his right shoulder. Burial 28, in the centre, is a man who died aged about 21 years. The young male and woman in the grave to the right had pottery vessels smashed over the feet, and the turtle carapace ornament with the former individual had been smashed and placed over and beside the thighs

prehistory. Burials 91 and 88, an adult male and an adjacent infant, saw at least two complete and two broken vessels (but probably buried intact) in the ankle area of the former, while the infant was interred with two complete pots over the ankles. These vessels were found face upwards in each case. There was a consistent change with MP3B, when broken vessels were placed in the vicinity of the lower leg. It is also found that infants and adults interred as part of a group at about the same time, shared the same treatment. Burials 60 and 63, the former an adult female and the latter an infant, had broken vessels placed near the right knee. Two adult females, Bs. 58 and 56, had broken pots placed in the vicinity of the lower left leg. Little can be said of MP4, because the lower limbs were located outside the excavated area. Yet three burials reveal rather more variation in placement than hitherto. Burial 27, an adult female, had one broken vessel over the left elbow. B24, an adult male, had three broken pots in the region of the left shin and B20, a child, was interred with two broken pots alongside the right leg.

There are fewer burials associated with the remaining cluster from MP2-4. In the case of cluster A, we find that the only MP2 burial with a pottery vessel had a complete pot placed between the ankles (B110, an adult female). For MP3A, there are two burials with pottery vessels. Burial 75 (an infant) had one complete pot in the ankle area. With MP3B, the adult male in burial 57 had two broken pots scattered in the vicinity of the lower legs and the left shoulder. All four MP4 burials comprising cluster A had broken pots placed in the ankle area.

Only two burials from cluster B have relevant data. Both belong to MP2. The adult male in B120 had two complete pots between the shins. One of these had had its rim removed in prehistory. The infant, B130, had broken pieces of a pot over its head. Cluster D has furnished a sample of four graves. One belongs to MP2. It is a two-year-old infant, B123, accompanied by three complete miniature pots over the legs. During MP3A, there are two male burials. The first, B103, had two complete pots: one placed face up between the thighs, and the other over the shins. Burial 92 had two complete pots adjacent to each other lying face up against the right thigh. During MP4, B44, a young adult male was found with a partially complete pot placed face down between the thighs, and a second, broken vessel over the ankles. A large sherd, possibly from another mortuary offering, was found beside the face. The only relevant grave from cluster E is an adult female (B102). One vessel was found upside down over the left abdomen. It survived with only a single fracture, and was probably buried intact. The second vessel, which had been broken in antiquity, was found over the left shin.

There is no consistent difference between any two clusters on the basis of the placement and treatment of pottery vessels as part of the mortuary ritual during MP2-3A. On the other hand, there is a clear, overall pattern of change with time. During MP2 to MP3A, it was customary to place complete pots in the leg region. With MP3B, there was a change in favour of broken vessels being placed in the region of the legs. A further change took place with MP4, when broken vessels were found in the ankle area. There are always some exceptions to the above, but the general trend is clear. The only hint of specific treatment within a given cluster has been detected for cluster F during MP4, when burials displayed greater variation in vessel placement than did contemporary burials in any other cluster. This could, of course, be a result of small sample size, but the possibility that the cluster F people had their own preference is also apparent.

PLACEMENT OF ORNAMENTS BETWEEN CLUSTERS DURING MORTUARY PHASES 2, 3 AND 4

In order to consider the possibility that people comprising each cluster adopted differences in mortuary ritual, we will now turn to the variety of personal ornaments in each cluster, and how items were placed. In this context, it is possible to consider the shell beads and bone bangles. Unique or rare items are not relevant to this review and will not be considered further.

Shell beads of different types were placed relative to the body in such ways as to suggest the presence of necklaces, bracelets, belts and as stitched decoration on garments. Shell jewellery was commonly found in MP2 burials. Three of the nine cluster A burials were found with shell ornaments, two being infants and one an adult male. Of the former, B144 had only two disc beads. Burial 143 possessed a necklace of 50 disc and two funnel beads. Burial 100, an adult male, was buried with a necklace of 220 disc beads. During MP3A and B, shell jewellery continued to be worn. Burial 75, an infant, was found with a belt or bracelet made up 189 disc beads, while B57, that of an adult male, had only 23 disc beads. Their context is unknown, because they were found while preparing the material from the grave in the laboratory. No shell jewellery was found with any of the four MP4 burials.

There are six burials belonging to cluster B during MP2. Five were found with shell beads: two infants, two males and a female. One infant, B130, was found with a belt comprising 17 barrel beads. The other infant, B121, had a necklace of seven barrel beads. Turning to the adults, we find that B129 had a necklace of 353 barrel beads, B120 had a necklace comprising 327 disc and 13 barrel beads and, finally, B94 also wore a necklace made of 55 short barrel beads. The cluster C burials, including cluster C1, during MP2 were richly endowed with shell jewellery. There are 17 burials, of which six included shell beads: three adult females and three infants. It is therefore notable that neither of the adult males was interred with any shell jewellery. Infants had few beads, and their contexts, in terms of the type of artefact they represent, cannot be determined. For the females, Bs. 140 and 87 had necklaces of disc beads but B109 had 1588 disc beads found such as to suggest that they had been stitched onto the back of a garment. The ensuing phase is represented by 14 burials, of which only four have shell beads. These comprise three males and a female. The disposition of the beads suggests that the former wore a similar garment to that described for B109. Burial 93 had 859, B90 had 1500 and B72 was found with 330 such disc beads. In addition, B90 also wore a bracelet of 37 barrel beads. Burial 73, the female, had 1260 disc and 285 barrel beads strung as necklaces. During MP4, only one female, B35, was interred with beads, there being only eight of the disc variety.

Cluster D comprises 11 burials, of which nine belong to MP2. These include six infants, one male and two females. One infant, B133, had a belt and a bracelet. The former was made of barrel beads, while the latter comprised alternating barrel and bird-bone beads. The other infant and both adults all possessed necklaces made of shell beads. Burial 123 had 120 disc beads, B122, the oldest adult in the site and a female, had 105 disc and 13 barrel beads and B117, the male, had only eight barrel beads. During MP3, there are two adult males but only one, B103 was found in association with beads, there being 59 disc and 56 barrel beads worn as a necklace.

Cluster E had four burials during MP2. Only one, an adult male (B132) was found with shell jewellery. He wore about 39,000 disc beads, 11 short barrel and five funnel beads disposed as a

set of necklaces.

Cluster F is, with cluster C, the longest-lived. Twelve burials belong to MP2. Four are infants with no grave goods. Of the remainder, the single adult male wore necklaces of 1294 disc and 93 barrel beads (B91). The two adult females also wore necklaces, B112 having 542 disc beads, and B113 having 224 disc and 143 barrel beads. She also had a headband of disc beads. Of the remaining five infant burials, B105 was interred with a necklace made of 1043 disc beads and 88 barrel beads. Burial 99 had a necklace comprising 250 disc beads, while B89 also had a necklace, with 73 disc beads. Finally, B88 wore a necklace with 690 disc and 16 barrel beads. This wealth of shell jewellery during MP2 and MP3A contrasts with its rarity during MP3B. In MP4, however, two of the 12 burials wore shell jewellery. A nine-month-old infant (B41) had 41 disc beads in the form of a bracelet, while B29, an adult male, was accompanied by a necklace of 330 disc beads and 17 I-shaped beads.

There is one further burial from MP4 which does not clearly belong to any cluster. Burial 33, that of a three-year-old child, was found at the northern edge of the excavated area. It was particularly richly endowed with shell jewellery: there were 7845 disc beads and 107 I-shaped beads worn as multiple necklaces and anklets. It also had a necklace made of *Nassarius* shells.

During MP2-3A, all bangles identified were made from fish vertebrae. No bangles were found during MP3B-4. Only five infant burials possessed such bangles, four from MP2, and the other from MP3A. The former came from clusters B (B130), D (Bs. 133 and 134) and cluster F (B88). In the case of B130, there was one broken bracelet, one fragment being found beside the right of the cranium, and the second half in the area of the right wrist. Burial 134 had one fragment near the left wrist, and for B133, there were seven complete bangles, which had been placed over the chest. One of these bore traces of manufacturing, and was interred when incomplete. Burial 88 (cluster F), had three bangles. One was complete, and had been placed either on or over the right

wrist. A fragment was found at the left elbow, and another near the left wrist. These came from different bangles. Burial 70, which belongs to cluster A during MP3A possessed a complete bangle over the left arm. Of these four burials, only B70 was younger than five months at death.

In terms of the placement and presence of shell and bone jewellery during MP2-4, only some cluster C adults were interred wearing clothing embroidered with shell disc beads. These individuals were buried near each other over a short time span, and were also, with the exception of B109, buried with a relatively rich assemblage of well-decorated pottery vessels. Apart from this group of rich graves, there is no other evidence in favour of a distinction between clusters



FIG. 59. Burial 14. The only jar burial at the site. Note the decoration on the large vessel to the left



FIG. 60. Burial 140, Mortuary Phase 2. One of the few burials with an adze as a grave good (arrow). Scale 5 cm



FIG. 61. Burial 4 of cluster A, mortuary phase 6, involved a woman aged in her mid twenties, interred with an anvil between her calves, and a burnishing stone beside the right knee. Women were often accompanied by the tools of the potter's trade

on the basis of jewellery. Rather, there is a time trend. We find that MP2 graves were often well endowed with shell jewellery, but that the amount fell during MP3 and 4. Only one adult, a male (B132) in cluster E stands out for its extreme wealth, having 39000 disc beads. Burial 33, a child which is not ascribed to any cluster, stands out as being rich during MP4. In terms of the place-

TABLE 11: *The number of burials with or without disc shell beads for Mortuary Phases 2–4*

MP	Male with	Male without	Female with	Female without	Inf. with	Inf. without	Child with	Child without
2	4	4	6	5	11	23	–	3
3A	4	1	1	2	1	21	–	–
3B	1	4	–	5	–	1	–	1
4	1	8	1	9	2	3	–	5

ment of shell jewellery, it is not possible, therefore, to claim a separation in terms of mortuary ritual between the clusters.

Turtle carapace ornaments are only found with males, the first instance being in MP3B. Six burials contain these artefacts during MP3B–4. They come from cluster A (Bs. 57, 30 and 32). The last is a child aged about 11 years at death and its sex has not been defined with certainty. Burial 44 (cluster D), B23 (cluster E) and B 24 (cluster F) also have these ornaments. A small piece of carapace was also found with B29 in cluster F. Apart from B44, these ornaments were always broken before being placed adjacent to the body. In the case of B57, two large pieces were placed over each other by the right elbow with two other sections near the right hip. Burial 30 revealed two superimposed sections over the right thigh. Burial 32 had one piece over the left femur, another near the right knee and a third between the knees. In the case of B23, pieces were placed over the legs. Burial 24 revealed two sections, one over the left side of the abdomen and the other over the left hip. Burial 44 yielded a single piece of carapace over the left arm. There is no distinction in terms of presence, placement or design of the ornament between the clusters.

TABLE 12. *The number of points ascribed to each type of mortuary artefact*

Artefact	Points	Artefact	Points	Artefact	Points
Fish bone bangle	100	Shell bangle	100	Shell disc	100
Carapace ornament	100	Tusk pendant	100	Bone figurine	100
Shell headdress	100	Pottery vessel	100	Canine pendant	100
Bone point	20	Stone adze	20	Fishhook	20
Shell blade	20	Mod. fish vertebra	20	Burnishing pebble	20
Clay anvil	20	Net sinker	1	Clay pellet	1
Cowrie shell	1	Shell bead	1	<i>Nassarius</i> shell	1
Disc bead	0.2				

TABLE 13. *The number of points for individual burials, based on all grave goods*

Burial	MP	Cluster	Points	Burial	MP	cluster	Points	Burial	MP	Cluster	Points
1	7	I	540	2	7	H	100	3	7	I	633
4	6	H	60	6	6	-	4336	7	6	H	502
8	6	H	300	9	6	H	501	11	6	-	379
12	7	-	576	13	6	H	461	14	5	-	454
15	5	-	26968	16	5	-	3190	18	6	-	2714
19	6	-	861	20	4	F	240	22	4	-	200
23	4	E	120	24	4	F	400	27	4	F	100
28	4	A	100	29	4	F	203	30	4	A	220
31	4	A	120	32	4	A	300	33	4	-	2309
35	4	C	282	36	4	C	220	37	4	C	200
38	4	F	300	39	4	F	100	41	4	F	108
42	4	F	40	43	5	-	12265	44	4	D	400
45	4	C	100	47	4	C	100	56	3B	F	100
57	3B	A	319	58	3B	F	220	60	3B	F	100
62	3B	F	200	63	3B	F	100	64	3B	C	200
67	3A	C	200	70	3A	A	100	72	3A	C	747
73	3A	C	737	74	3B	F	300	75	3A	A	138
76	3A	G	120	77	3B	C	100	79	3A	C	100
82	3B	C	40	83	3A	C	40	86	3A	G	200
87	2	C1	174	88	2	F	654	89	2	F	116
90	3A	C	637	91	2	F	792	92	3A	D	200
93	3A	C	372	94	2	B	175	96	2	A	20
99	2	F	250	100	2	A	44	101	2	F	241
102	2	E	400	103	3A	D	368	105	2	F	499
107	2	C	20	109	2	C	360	110	2	A	200
112	2	C	209	113	2	F	288	114	2	C1	3
117	2	D	8	120	2	B	279	121	2	B	7
122	2	D	34	123	2	D	344	125	2	C	101
126	2	C	1	129	2	B	353	130	2	B	217
132	2	E	7956	133	2	D	868	134	2	D	100
140	2	C	162	143	2	A	12	144	2	A	1
152	1	-	3								



FIG. 62. Burial 6, Mortuary Phase 6

THE PLACEMENT OF UTILITARIAN ARTEFACTS

There are few adze heads ($n=3$), fishhooks ($n=2$) or net sinkers ($n=1$) from burials (Fig. 60). Numerically, the dominant utilitarian artefacts are the burnishing pebbles and the clay anvils for shaping pots. All clusters include burials containing burnishing pebbles. In the case of cluster A, there are two burials, one an adult female and the other a child (Bs. 110 and 96). The former included five specimens, placed in a group by the ankles. The latter was associated with a single pebble, but the placement and association are not clear. There is one example from a cluster B grave, an adult female (B94). Again, the placement is not clear. For cluster C, there are two examples from MP2, two from MP3A, one from MP3B and two from MP4. All but one came from adult female graves and their position varies. In MP2, two were found near the left forearm of B109, and one in B107 was placed near the right shoulder. The three graves in MP3A and B saw pebbles placed by the left hand, beyond the feet, over the abdomen and beyond the right shoulder. Both MP4 graves (Bs. 35 and 36) had pebbles placed near the ankles.

For cluster D one grave, that of an infant (B123), contained a pebble. It was found near the feet. Two graves from cluster E yielded these implements. Both came from adult male burials. The earlier, (B132, MP2), yielded two, one by the right knee and other at the left shoulder. The later, B23, MP4, had one pebble over the stomach. Four of the cluster F graves contain pebbles, one from MP2 and three from MP4. The earliest is a male with two pebbles near the right ankle (B91). During MP4, they were found with two adult males and a child. Burial 42 had two pebbles in the area of the feet, while one of unknown location was associated with B29. The child, B20, had one pebble near the right knee.

All clusters contain burials associated with burnishing stones. There is no distinction between clusters in terms of where they were placed. The only difference noted is that in the case of cluster F, they were found only with males, whereas in cluster C, all but one were found with females.

Anvils were only associated with females, infants and children, the earliest being from a MP3B context. None was found in any cluster A, B, D or E grave. Two only were associated with cluster C graves: B82, that of an infant from MP3B, provided one, a miniature example, although it was not in certain association. Burial 35, MP4, also provided an anvil, placed near the right ankle. In cluster F, only one grave burial 20, was found with an anvil: B20 was that of a child with an anvil near the right knee. Burial 33, which does not belong to any cluster, was associated with an anvil between the ankles.



FIG. 63. Burial 15, mortuary phase 5, involved a remarkably deep grave for a woman interred with an abundance of shell ornaments, pottery vessels, and the clay preforms for manufacturing pots. Her clay anvil and two burnishing stones were found beside the right ankle

THE PLACEMENT AND NATURE OF GRAVE GOODS DURING MORTUARY PHASES 5-7

Pottery vessels have been found with all four MP5 burials which show no sign of disturbance. Graves are outstandingly rich in terms of furniture. Besides, they are much larger and deeper than earlier graves. The grave of B14 is unusual not only because it was dug into an almost circular pit but it also contained an infant buried inside two large vessels, the only example of a human jar burial. The vessel, which contained the whole skeleton of the infant, has an oval shape with a maximum breadth of 43 cm (Fig. 59). The actual height as well as the diameter of this vessel are not known because the whole rim was removed in antiquity. The available height measured from the bottom to the detached point is approximately 45 cm and the diameter of the existing part is 30 cm. The second vessel, found with its mouth facing the first one, is complete. The maximum height is 33.5 cm and the diameter of the rim is 40 cm. The widest part of this vessel is its mouth, which is 41.8 cm across.

Apart from placing the body inside these two jars, the mortuary treatment for B14 is similar to other interments. Both jars were disposed on their sides so that the body could be laid out prone with the head orientated towards the east. Broken pieces from two identical carinated, round-bottomed vessels were arranged over both ankles.

Burials 15 and 16 are identical in various respects, although they died at a different age. First, their graves are larger and deeper than hitherto.

Second, they were located next to each other in a

new area between burial grounds belonging to clusters C and F. Third, they yielded similar types of grave goods as well as their location and disposition. Their bodies, richly covered in red ochre, were laid out prone and were fully decorated with shell jewellery. There was a clay anvil beside each right ankle. Broken pieces of complete vessels were arranged in a sheet spreading over the hip down to the feet of both interments. In B15, there was a set of Vincent's form 2j container vessels arranged over lumps of unfired clay which were piled up over the body.

TABLE 14. *The pattern of tooth evulsion. Ablated refers to those where teeth were removed, but the pattern is unclear*

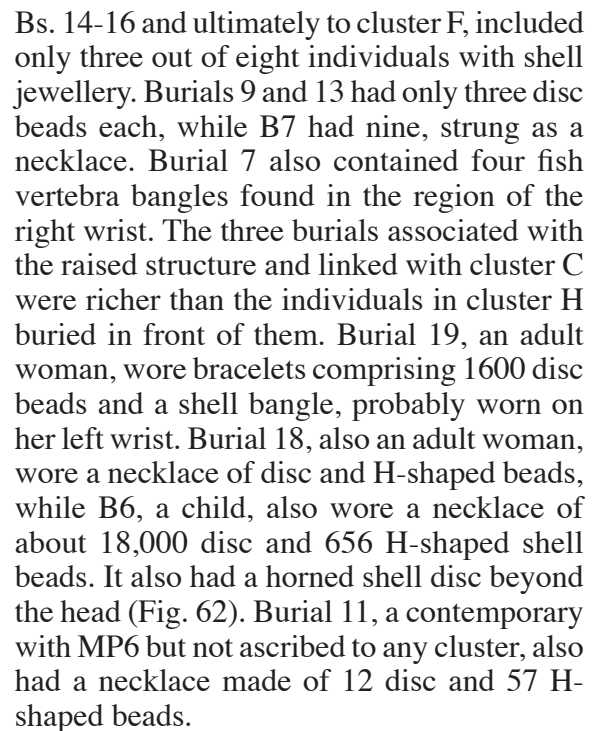
Number	teeth removed	Burials
1	I ² (r)	103
2	I ¹ (r&l)	57, 47, 40, 39, 38, 29
3	I ¹ (r&l)	115, 110
4	I ² (r&l)	142, 131, 120, 100, 92, 86, 77, 76, 74, 72, 64
5	I ¹ I ¹ (r&l)	24
6	I ¹⁻² (r &l)	44, 43, 30, 15
7	I ¹⁻² (r&l)	4
8	I ¹⁻² (r&l)	36, 35, 31, 25, 18
9	I ¹⁻² & I ₁₋₂ (r&l)	45, 42, 26, 13
10	CI ¹ (r&l)	132
11	I ² & CI ¹ (r&l)	60
12	ablated	79, 67, 61, 27, 23, 19, 11, 8
13	unknown	154, 152, 112, 94, 91, 73, 28, 22, 20, 9, 6
14	no removal	147, 140, 129, 122, 117, 113, 109, 107, 102, 93, 90, 87, 83, 58, 56, 37, 32, 17, 12, 1

The quantity and variety of shell jewellery in B15 far exceeded any encountered in earlier or later burials. Many of the disc beads had been stitched onto the front and back of a tunic. There were also two anklets comprising four I-shaped and about 200 disc beads. In addition, this woman was interred with a shell bangle on the left wrist, two horned shell discs on the chest, and components of a head dress made from a conus and a clam shell. The shell jewellery from B16, a 15-month-old infant, was similar, including anklets, a belt and necklace. A shell bangle was found over the left wrist. Burial 14 had a disc bead belt. Burial 43, a male, is also similar to B15, though not as rich in terms of the number of beads. He wore a belt made of disc beads, a tunic embroidered with at least 56,000 disc beads and 435 I-shaped beads. He also possessed a shell bangle either on or over the right wrist, and two discs under the shoulders.

During MP5-6, turtle carapace or plastron ornaments continued in vogue, but they were now of a different form, being smaller and less ornately carved. Again, they were restricted to males (Bs. 43 and 9), or, in the case of B8, with a child.

Mortuary Phase 6 incorporates 12 individuals, pottery vessels being present in seven graves. The placement of vessels followed established practice. One or more were arranged in the vicinity of both legs. Two intact vessels were found in a child grave, B11, disposed upside-down beyond the feet. The third vessel from the same grave was smashed and the broken pieces were laid out along and partially underneath the left leg. Vessels from other burials were all broken into halves or more.

During MP6, the quantity of shell jewellery declined. Cluster H, which is seen as being related to



The final phase of the Khok Phanom Di mortuary sequence yielded two children and two infants. Only the lower part of their graves extended into the square. Pottery vessels were seen in three graves in the region of the legs. Burial 12 yielded one more vessel near the left arm. It is probably another intact vessel but it has been broken through the cutting of a posthole. Some mortuary vessels of MP7 are cruder and simpler than those from the

preceding phases.

Burnishing stones and anvils continued to be associated with MP5-7 burials. Burial 15 had an anvil and two stones in a shell (*Geloina*) container, near the right ankle. Burial 16 had one pebble and a miniature anvil in the same relative position. In the case of cluster H, eight stones were found with B13, an adult female, four near each knee. Burial 4, a second adult female, had two stones beside the right knee. This burial also contained an anvil between the ankles. Burial 19 had two stones and an anvil beside the left knee. Burial 18 also revealed an anvil, placed between the knees. The last interment with a burnishing stone was B6. It was found near the body of the child. During MP7, only B1 included pottery-making artefacts, a stone located beyond the feet and two anvils of dubious provenance relative to the body.

THE PLACEMENT OF GRAVE GOODS: SUMMARY

We cannot identify any clear rule determining that a given artefact should be placed in a specific place relative to the body, apart from such obvious items as necklaces, bangles and anklets. There is no distinction between clusters in terms of the placement of any particular item. In general, vessels were found in the foot or leg region, and anvils were usually placed in the vicinity of the pots. The location of the burnishing stones is more variable: sometimes they were found in a set near the feet, where the vessels lay, but on other occasions they were recovered near the shoulder or over the abdomen.

TABLE 15. *The relationship between tooth evulsion and sex, cluster and mortuary phase*

	Pattern of tooth evulsion													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sex														
Male	1	3	1	8	1	3	0	0	1	1	0	2	5	5
Female	0	3	1	3	0	1	1	5	3	0	1	4	4	10
Uncertain	0	0	0	0	0	0	0	0	0	0	0	2	2	5
Total	1	6	2	11	1	4	1	5	4	1	1	8	11	20
Mortuary phase														
7	0	0	0	0	0	0	0	0	0	0	0	0	0	2
6	0	0	0	0	0	0	1	1	1	0	0	3	2	0
5	0	0	0	0	0	2	0	0	0	0	0	0	0	0
4	0	5	0	0	1	2	0	4	3	0	0	2	3	3
3B	0	1	0	3	0	0	0	0	0	0	1	2	0	2
3A	1	0	0	4	0	0	0	0	0	0	0	1	1	4
2	0	0	2	4	0	0	0	0	0	1	0	0	3	9
1	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Cluster														
A	0	1	1	1	0	1	0	1	0	0	0	1	1	1
B	0	0	0	1	0	0	0	0	0	0	0	0	1	1
C & C1	0	1	1	4	0	0	0	2	1	0	0	2	1	8
D	1	0	0	2	0	1	0	0	0	0	0	1	0	2
E	0	0	0	0	0	0	0	0	1	1	0	1	0	1
F	0	4	0	1	1	0	0	1	1	0	1	1	3	4
G	0	0	0	2	0	0	0	0	0	0	0	0	0	0
H	0	0	0	0	0	0	1	0	1	0	0	1	1	0

TRENDS WITH TIME

TABLE 16. *The burials associated with implements used in pottery manufacture*

Cluster-stage	Burial	Sex	Age	Anvil	Burn. stone	Cylinder
I	1	—	9	2	1	—
H	4	F	26–30	1	2	—
—	6	—	9	—	1	—
H	9	M	30	—	1	—
H	13	F	35	—	8	—
—	15	F	32	1	2	many
—	16	—	15m	1	1	many
—	18	F	42	1	—	—
—	19	F	23	1	1	—
F8	20	—	12	1	1	—
E3	23	M	30	—	1	—
F8	29	M	27	—	1	—
—	33	—	3	1	—	—
C10	35	F	21	1	3	—
C10	36	F	22	—	1	—
F5	42	M	29	—	2	—
C5	72	M	32	—	3	—
C6	82	—	6m	1*	1	—
C5	83	F	30	—	2	—
F2	91	M	45	—	2	—
B1	94	F	31	—	1	—
A1	96	—	4	—	1	—
C2	107	F	40	—	1	—
C2	109	F	31	—	2	1
A1	110	F	36	—	5	—
D3	123	—	2	—	1	—
E1	132	M	28	—	2	—

*uncertain association

During MP1, burials have few grave goods. MP2 saw the inclusion of shell beads and pots, with the number of shell disc beads exceeding 1,000 on four occasions. In the case of B132, 39,000 such beads were counted. Eleven infants were interred with shell beads, and in some cases the number was considerable (Table 11). MP3 saw a reduction in the number of shell disc beads, from a total of 47,651 in MP2 to 4198 in MP3A and 93 in MP3B. In MP4, the number of beads found rose to 8,224 but the number of individuals with them was lower



FIG. 65. The burials of mortuary phase 6 involved a raised mortuary structure and a row of interments, seen above, ringed by a pattern of post holes. The latter group, much the poorer of the two, were accompanied by broken pottery vessels, and a few shell disc beads

than in either of the two preceding phases, there being one male, one female and two infants. 95 per cent of these MP4 beads were found in one enigmatic infant's grave, for which the stratigraphic and cultural relationship to other clusters is arguable. This situation changed with MP5 and 6, when the number of disc beads rose to exceptional levels. Barrel beads were confined to MP2 and MP3A.

It has already been argued that the Jaccard analyses undertaken have failed clearly to identify any cluster during MP2-4 which stood out as being unusually rich. When all the graves in each cluster are grouped for the purpose of the analyses, individuals and their associations with others tend to lose focus within the group. Yet it is argued that one of the more unusual features of the Khok Phanom Di cemetery is the fact that stages in the addition of bodies to collective burial areas are recognisable. This situation makes possible an examination of changes in mortuary practice in an unusually detailed manner.

In order to express the successive changes in the composition of sets of grave goods for each stage

in a cluster, each type of grave good has been given a number of points. In doing so, it is clearly appreciated that this procedure is arbitrary and the figures provide only a rough approximation at best to the relative wealth of graves (Winters 1968). The basis for the scoring is set out in table 12. Emphasis has been given to whether the raw material used was exotic to the site, whether the artefact shows high skill in manufacture, and whether it was rare. While this procedure is arbitrary, the purpose of the exercise is a simple one, of showing crudely how the quantum of goods varied with the age at death of an individual, through time and between members of different cluster. Consequently, the criticism is, for the moment at least, set aside.

The number of grave goods per burial has been computed (Table 13). The average point scores for the burials comprising each cluster and stage have then been calculated. The results are seen, expressed cluster by cluster according to the depth below datum of the grave cuts for each stage, in figure 64. At the beginning of MP2, clusters A, D, B and C were much on a par, with point scores of between 0 and 172. Cluster E, which began slightly later than the other four, is rich indeed (average 2089), but it is difficult to evaluate further because it is on the edge of the excavated area, and no subsequent stages have been identified.

The second and third stages of cluster C remain within the range of 0-172 points, but in stage 4, there was an increase to 436 points. It then fell to 158, 147 and 67 over the next three stages before rising with the final stage in MP4 to 251.

The stages of cluster F present a different sequence. Having begun with two quite wealthy stages, with scores of nearly 248 and 261, they became poorer, with all stages save the last having figures of under 200. During these last stages, the figure rose, along with that of the contemporary burials in cluster C, to 214 and 320, while the only burial comprising the final stage had no grave goods. Thus, as cluster C in stage 4 became rich, the contemporary interments in cluster F became poor. Cluster A, on the other hand, never rose above 185 points. It was always relatively poor. Cluster D began by being poor (no points), then rose to fair wealth, with scores of 326, 189 and 284, at the same time that cluster C during stages 5-6 shows a declining trend. Either due to the sampling difficulties encountered at the edge of the square, or to cultural reasons we can only speculate over at present, cluster D then ceased, although the single burial ascribed to stage 5, which was found 2 m higher, might be linked with this cluster. There are several possible interpretations of oscillating wealth through the putative generations, which will be considered below.

WEALTH AND CRAFT SPECIALISATION

In order to assess the spread of wealth with individuals during these three phases, each grave was given an individual point score using the formula described in the section above. In the main, each phase provides a similar pattern. The majority of graves have fewer than 300 points. In each case, there is also a much smaller group of wealthier graves, with scores of over 500 points. For MP2, this includes a rich adult male, with a score of 7956, three infants, and another male. Three of these rich burials come from cluster F, one from D and the last from cluster E. For MP3, there are two males and a female, all from cluster C stages 4 and 5 (MP3A). Only one grave exceeds a score of 500 during MP4. It is an infant with a score of 2309. It does not belong to any cluster (Fig. 64).

With MP5, the graves became much richer, B15 having a score of 26,968. Burial, 43, a male, scored 12,265 while the infant burials 14 and 16 scored 454 and 3190 respectively. During MP6,

the graves within the chamber had scores of 861, 2714 and 4336, even though two were found in a disturbed condition. Those belonging to cluster H in front of the structure scored 461, 502, 300, 501, 100 and 60, with two infants scoring 0. Perhaps significantly, the cluster H burials could only muster 13 disc beads between them against almost 30,000 for the three graves in the chamber. The three MP7 graves had scores of 576, 540 and 633.

The possibility that mortuary wealth was structured, at least in part, according to the age of the deceased adult has also been considered on the basis of point scores. The figures produced from this exercise suggest that a person's age was not a determining factor in the provision of grave goods (Figs. 53-5). While it is evident that women tended to outlive men, there is no clear signal that either age or sex were associated with more wealth in terms of grave goods.

Khok Phanom Di was a centre of pottery making throughout its prehistoric occupation. This is indicated not only by evidence for clay preparation, the shaping and decorating of pots and their firing, but also by the presence of both clay anvils and burnishing pebbles in some of the graves. Was special treatment accorded craft specialists, if that was the status of those buried with the implements used to fashion and decorate pots? Burnishing stones were found from MP2, but anvils and clay cylinders were placed with the dead from MP3B, and were restricted to the burials of females, infants and children. The few graves in question were generally, rich. Burnishing pebbles were found in association with the graves of 12 females, seven males, three infants and three children. It is notable that all clusters had at least one burial with a burnishing pebble, often among the earliest of the graves encountered. Some of these burials during MP2-4 were richly endowed with offerings, but others were not. There is no consistent pattern. From MP4, seven of the 15 burials have both burnishing pebbles and anvils, and most are particularly rich.

It is concluded that during MP2-4, there was no restriction in terms of pottery making to the members of particular clusters. Some of the graves containing craft items were rich, others were not. With the one exception of burial 9, from MP5, only females, infants and children were associated with pottery-making implements, and they were nearly always rich. Throughout the sequence, some infants and children were interred with burnishing pebbles.

TOOTH EVULSION

Fourteen categories based on the pattern of tooth evulsion were identified (Table 14), the removal of both upper first incisors being the commonest pattern. The only apparently consistent sexually dimorphic pattern was the restriction of the removal of all the lower and the two upper first incisors to women. Groups 1-5 and 10-11 are found only during MP2-4. If we exclude children, the absence of any evulsion is confined to MP1-3. The pattern during MP3A and 3B was similar. Thereafter, all adults had some of their teeth removed. Groups 7-9, all of which involved the removal of the upper or lower incisor row, tended to be later (Table 15). It is possible that the pattern of tooth evulsion varies between clusters. If clusters reflect social groupings, then tooth removal could be seen as an affiliative marker. There are hints that such differences occur. Group 2 concentrates in cluster F (n=4) with one example respectively in clusters A and C. Group 4 was particularly favoured with cluster C, with only one burial in cluster F revealing the extraction of the second upper incisors (Table 15).

TABLE 17. *The mortuary offerings with each burial from Khok Phanom Di*

No.	MP	Cl.	Age	Sex	RO	T	TU	DB	BB	SBB	FB	IB	HB	AT	FBB	SB	BO	PS	FVB	TC	AD	BP	AN	P
1	7	I	9	C	1	—	14	—	—	—	—	—	—	—	—	3	—	—	—	—	—	1	2	2
2	6	H	9m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
3	7	I	3–4m	I	1	—	—	56	—	—	—	—	22	—	—	4	—	—	—	—	—	—	—	2
4	6	H	26	F	1	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—
5a	6	H	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5b	6	H	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	6	—	9	C	1	—	13	17786	—	—	—	—	656	—	—	—	—	—	—	—	—	1	—	—
7	6	H	21m	I	—	—	—	9	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	1
8	6	H	15	C	1	—	12	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2
9	6	H	30	M	1	—	13	3	—	—	—	—	—	—	—	—	1	—	—	2	—	1	—	2
10	7	I	1.25	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	6	—	12	C	1	—	12	12	—	—	—	—	57	—	—	—	—	—	—	—	1	—	—	3
12	7	—	12	F*	1	—	14	730	—	—	—	—	30	—	—	—	—	—	—	—	—	—	—	4
13	6	H	35	F	1	—	9	3	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	4
14	5	—	15m	I	1	—	—	269	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
15	5	—	35	F	1	—	6	120787	—	—	—	950	—	5	—	1	—	2	—	—	—	2	1	8
16	5	—	15m	I	1	—	—	12247	—	—	—	200	—	—	—	1	—	—	—	—	—	1	1	4
17	4	F	12	M*	1	—	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	6	—	42	F	1	—	8	9969	—	—	—	—	700	—	—	—	—	—	—	—	—	—	1	1
19	6	—	25	F	1	1	12	1600	—	1	—	—	—	—	—	1	—	—	—	—	—	2	1	5
20	4	F	12	F*	1	—	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2
21	4	E	8	C	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
22	4	—	21	M	—	—	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
23	4	E	30	M	1	—	12	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—
24	4	F	25	M	1	—	5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	3
25	4	F	19	F	1	—	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	4	E	35	F	1	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27	4	F	41	F	—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
28	4	A	21	M	1	—	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
29	4	F	27	M	1	—	2	330	—	—	—	17	—	—	—	—	—	—	—	1	—	1	—	1
30	4	A	28	M	1	—	6	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
31	4	A	25	F	1	—	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
32	4	A	11	C	1	—	14	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	1
33	4	—	3	C	1	1	—	7845	—	—	—	107	—	2	—	—	—	—	—	—	—	—	1	4
34	4	E	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	4	C	21	F	1	1	8	8	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	2
36	4	C	21	F	1	—	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2
37	4	C	9	M*	1	—	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
38	4	F	29	M	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
39	4	F	25	F	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

Abbreviations are: m: months, MP: Mortuary Phase, Cl: cluster, RO: red ochre, T: bark/asbestos shroud, TU: tooth evulsion code. DB: disc beads, BB: barrel beads, SBB: short barrel beads, FB: funnel-shaped beads, IB: I-shaped beads, HB: H-shaped beads, AT: pierced animal canines, FBB: fish bone bangle, SB: shell bangle, BO: bone object, PS: perforated shell, FVB: modified fish vertebra, TC: turtle carapace ornament, AD: adze head, BP: burnishing pebble, AN: clay anvil, P: pottery vessel, *: tentative identification

TABLE 17. *The mortuary offerings with each burial from Khok Phanom Di (cont.)*

No.	MP	Cl.	Age	Sex	RO	T	TU	DB	BB	SBB	FB	IB	HB	AT	FBB	SB	BO	PS	FVB	TC	AD	BP	AN	P
40	4	F	37	F	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41	4	F	9m	I	1	—	—	41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
42	4	F	29	M	1	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
43	5	—	27	M	1	—	6	56200	—	7	—	435	—	1	—	1	—	—	—	1	—	—	—	1
44	4	D	18	M	1	—	6	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	3
45	4	C	45	F	1	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
46	4	F	4m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
47	4	C	22	F	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
48	4	C	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
49	3B	C	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50	3B	F	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51	3A	B	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
52	3A	B	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53	3B	A	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
54	3B	A	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55	3B	A	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56	3B	F	45	F	1	—	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
57	3B	A	26	M	1	1	2	23	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2
58	3B	F	35	F	1	—	14	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2
59	3B	A	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	3B	F	19	F	1	—	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
61	3A	A	48	F	1	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
62	3B	F	6m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
63	3B	F	20m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
64	3B	C	21	F	1	1	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
65	3A	C	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
66	3A	C	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
67	3B	C	35	M	1	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
68	3A	A	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
69	3A	A	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70	3A	A	0–2m	I	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
71	3A	A	0–2m	I	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72	3A	C	32	M	1	—	4	330	—	—	—	—	—	—	—	—	—	—	—	—	1	3	—	3
73	3A	C	25	F	1	—	13	1260	285	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
74	3B	F	39	M	1	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
75	3A	A	0–2m	I	1	—	—	189	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
76	3A	G	33	M	1	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
77	3B	C	26	F	1	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
78	3A	A	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
79	3B	C	47	F	—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
80	3B	F	0–2m	I	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Abbreviations are: m: months, MP: Mortuary Phase, Cl: cluster, RO: red ochre, T: bark/asbestos shroud, TU: tooth evulsion code. DB: disc beads, BB: barrel beads, SBB: short barrel beads, FB: funnel-shaped beads, IB: I-shaped beads, HB: H-shaped beads, AT: pierced animal canines, FBB: fish bone bangle, SB: shell bangle, BO: bone object, PS: perforated shell, FVB: modified fish vertebra, TC: turtle carapace ornament, AD: adze head, BP: burnishing pebble, AN: clay anvil, P: pottery vessel, *: tentative identification

TABLE 17. *The mortuary offerings with each burial from Khok Phanom Di (cont.)*

No.	MP	Cl.	Age	Sex	RO	T	TU	DB	BB	SBB	FB	IB	HB	AT	FBB	SB	BO	PS	FVB	TC	AD	BP	AN	P
81	3B	F	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
82	3B	C	6m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
83	3A	C	30	F	1	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
84	3A	C	0-2m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	3A	F	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86	3A	G	25	M	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
87	2	C1	24	F	1	-	14	866	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
88	2	F	9m	I	1	-	-	690	16	-	-	-	-	-	3	-	-	-	-	-	-	-	-	2
89	2	F	6m	I	1	-	-	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
90	3A	C	27	M	1	1	14	1500	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
91	2	F	45	M	1	-	13	1294	93	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4
92	3A	D	18	M	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
93	3A	C	42	M	1	-	14	859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
94	2	B	31	F	1	-	13	-	-	55	-	-	-	-	-	-	-	1	-	-	-	1	-	-
95	3A	C	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
96	2	A	4	C	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
97	2	F	6m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
98	2	F	0-2m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
99	2	F	7-8m	I	1	-	-	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
100	2	A	29	M	1	-	4	220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101	2	F	1.50	I	1	-	-	626	13	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
102	2	E	35	F	1	1	-	14	-	-	-	-	-	16	-	-	-	-	3	-	-	-	-	2
103	3A	D	26	M	1	-	1	59	56	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
104	2	E	0-2m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
105	2	F	4m	I	1	-	-	1043	88	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
106	2	C	6m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107	2	C	40	F	1	1	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
108	2	C	0-2m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
109	2	C	31	F	1	-	14	1588	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
110	2	A	36	F	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	1
111	2	C1	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
112	2	F	40	F	1	1	13	542	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
113	2	F	46	F	1	-	14	224	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
114	2	C1	0-2m	I	1	1	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
115	2	C1	38	M	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116	2	-	0-2m	I	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
117	2	D	16	M	1	1	14	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118	2	-	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119	2	A	0-2m	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120	2	B	21	M	1	-	4	327	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Abbreviations are: m: months, MP: Mortuary Phase, Cl: cluster, RO: red ochre, T: bark/asbestos shroud, TU: tooth evulsion code. DB: disc beads, BB: barrel beads, SBB: short barrel beads, FB: funnel-shaped beads, IB: I-shaped beads, HB: H-shaped beads, AT: pierced animal canines, FBB: fish bone bangle, SB: shell bangle, BO: bone object, PS: perforated shell, FVB: modified fish vertebra, TC: turtle carapace ornament, AD: adze head, BP: burnishing pebble, AN: clay anvil, P: pottery vessel, *: tentative identification

TABLE 17. *The mortuary offerings with each burial from Khok Phanom Di (cont.)*

No.	MP	Cl.	Age	Sex	RO	T	TU	DB	BB	SBB	FB	IB	HB	AT	FBB	SB	BO	PS	FVB	TC	AD	BP	AN	P
121	2	B	1.25	I	1	–	–	–	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
122	2	D	52	F	1	–	14	105	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
123	2	D	2	I	1	–	–	120	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	3
124	2	E	0–2m	I	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
125	2	C	0–2m	I	1	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
126	2	C	0–2m	I	1	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
127	2	C	0–2m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
128	2	A	0–2m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
129	2	B	27	M	1	–	14	–	353	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
130	2	B	6m	I	1	1	–	–	17	–	–	–	–	–	1	–	–	–	–	–	–	–	–	2
131	2	C	25	M	1	1	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
132	2	E	34	M	1	1	10	39000	–	11	5	–	–	1	–	–	–	–	–	–	–	2	–	–
133	2	D	5m	I	1	–	–	–	45	–	–	–	–	–	7	–	–	–	–	–	–	–	–	–
134	2	D	6m	I	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
135	2	F	4m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
136	2	C	0–2m	I	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
137	2	C	5	C	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
138	2	C1	0–2m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
139	2	–	0–2m	I	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
140	2	C	17	F	1	1	14	610	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
141	2	B	0–2m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
142	2	D	31	F	1	1	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
143	2	A	0–2m	I	1	–	–	50	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
144	2	A	0–2m	I	1	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
145	2	C	8	C	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
146	2	D	0–2m	I	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
147	1	–	19	M	–	–	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
150	1	–	2.5	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
151	1	–	0–2m	I	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
152	1	–	37	M	–	–	13	11	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
153	1	–	0–2m	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
154	1	–	25	F	–	–	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Abbreviations are: m: months, MP: Mortuary Phase, Cl: cluster, RO: red ochre, T: bark/asbestos shroud, TU: tooth evulsion code. DB: disc beads, BB: barrel beads, SBB: short barrel beads, FB: funnel-shaped beads, IB: I-shaped beads, HB: H-shaped beads, AT: pierced animal canines, FBB: fish bone bangle, SB: shell bangle, BO: bone object, PS: perforated shell, FVB: modified fish vertebra, TC: turtle carapace ornament, AD: adze head, BP: burnishing pebble, AN: clay anvil, P: pottery vessel, *: tentative identification

IV. THE SOCIAL ORGANISATION

THE burials at Khok Phanom Di have been subdivided into seven mortuary phases. Some incorporate grouped burials, termed clusters, within which there are stages of interments. It is now necessary to consider the possible social organisation represented by this mortuary record, and attempt to relate our findings to changes in the subsistence, environment and the material culture. In considering the social dimensions of the Khok Phanom Di cemetery, we become more speculative. The burials were superimposed over a height of 5.3 m. During MP2-4, the clusters concentrated in the same part of the site, and linking them sequentially is straightforward. With MP5, there was a dislocation, and attention will first be given to establishing possible links between the two enduring MP2-4 clusters C and F and subsequent interments.

MP5 incorporates four extremely rich burials. Burials 18 and 19, MP6, were buried under a raised structure, in front of a row of burials ascribed to cluster H. The dislocation between MP4 and 5 also involved a deep vein of continuity. Burials were still interred on the same orientation, fabric and red ochre were maintained in use and the same basic range of grave goods was used, though many new types were added. Some pottery forms continued in vogue, as did the implements used to make them. There is still much evidence for burning and the disposition of food remains near the graves. The possibility of linking clusters C and F of MP2-4 with the rich burials of MP5-6 therefore requires consideration.

This begins by stressing the apparent importance attached to the orientation of the dead and where they were buried. Throughout the use of the cemetery, there was a consistent absence of burials along an axis running approximately from north to south across the central part of the excavated area. The orientation of late burials in cluster F during MP4 was 60-65° east of north. This same orientation was found in the case of the unique B22, which lies beside B15 and contained a headless male (Fig. 68). Cluster H maintained this orientation a member of which, B4, was located over B22 and just to the side of B15 (Fig. 72). In terms of the placement of the grave, it is not difficult to identify continuity from MP4 cluster F to B15 and so to cluster H. This continuity is matched by the presence in each of these contexts of a female buried with an anvil placed in the same position relative to the body (Bs. 20, 15 and 4). Moreover, the form of two of the pots found with Bs. 20 and 15 is virtually identical. There are, then, some grounds for suggesting that B15 has affinities with clusters F and H.

Using the same arguments, interments under the raised structure during MP6 would have their origins in the people of cluster C. Here again, we find a parallel orientation between Bs. 35-36 and Bs. 18-19. Burials 18 and 6 directly overlie B35. Finally, all four adults are female. Having proposed social continuity, it is necessary to consider the possibility that individuals comprising each cluster were consanguinally or affinally related (Fig. 66). The most promising avenue of research on this question lies in the extraction and sequencing of MtDNA. In the meantime, Choosiri (1991) has analysed a series of genetically-determined features found in the crania, teeth and post-cranial bones. These pinpoint possible relationships between individuals, for if such genetically transmitted characters are present in individuals interred in the same cluster, then people were probably consanguines. This issue is considered first on the basis of people buried in the same grave or in a close physical and chronological relationship. In the case of cluster E stage 3, we



FIG. 66. The clustering of burials is seen as a significant factor in seeking relationships between individuals. Here, in cluster F mortuary phase 2, a male (burial 91), female (burial 113) and an infant (burial 99) lie in a row

its worth on two counts. The first is whether the successive “generations” display chains of individuals who share genetically-determined bone structures. Second, it is suggested that, if the pattern of tooth evulsion was determined other than in an *ad hoc* manner, successive generations should follow the same or similar pattern of tooth extraction. The reader is referred to Choosiri’s detailed consideration of the distribution of unusual features in the bones and teeth (Choosiri 1991). This brief summary as it applies to cluster C concentrates on a few of the variables which

encounter a male and young child in the same grave (Bs. 23 and 21), alongside the grave of a female (B26), who had borne children. Whereas the male and female have no unusual features in common, the child’s cranium combines nearly all those found in the two adults. The presence of sagittal wormian bones in the crania of Bs. 21 and 23 is particularly interesting. Only four instances of this feature were present in the site. It is likely, on the basis of this evidence, that the three individuals represent a father, mother and child.

The same situation is found with cluster H. Burials 8 and 9 are a 15-year-old and an adult male, and they were buried alongside each other. They are also the only individuals in the site whose crania have a bregmatic bone at the intersection of the coronal and sagittal sutures. Burials 9 and 4, those of an adult male and female, share the retention of the medio-frontal suture (metopism). The four crania from Bs. 4, 8, 9 and 13 have lambdoid wormian bones and a parietal foramen, while Bs. 4, 8 and 13 have a posterior condylar foramen. Such links support the hypothesis that some individuals were related to each other by blood.

Given this situation, the successive stages of clusters A, D, C and F have been linked in a series of putative genealogies (Fig. 67). It is self evident that this begins from a speculative position, but it is possible to assess

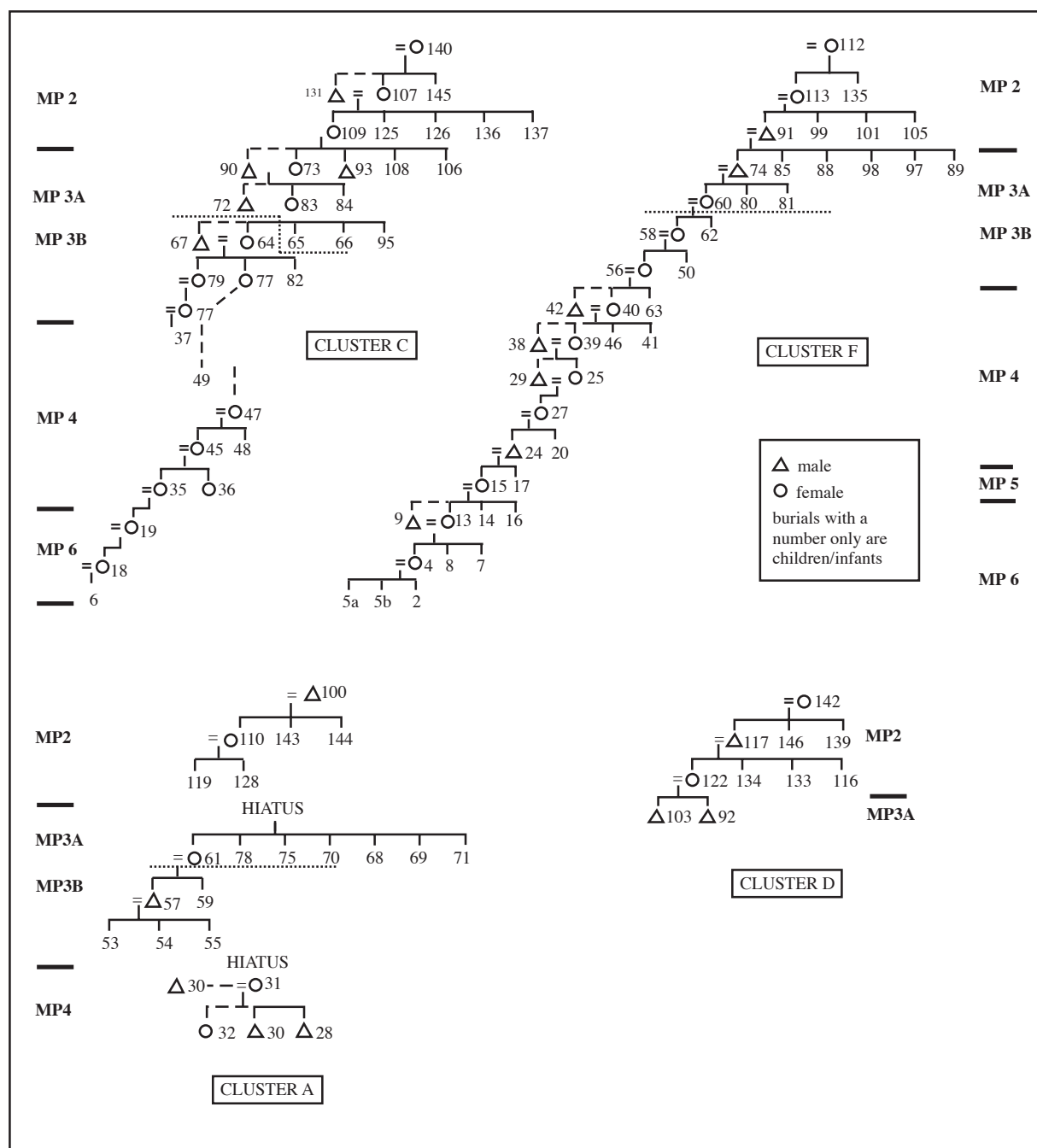


FIG. 67. The proposed genealogies for clusters A, C, D and F



FIG. 68. The enigmatic burial 22, at left, lay alongside burial 15. The grave contained the skeleton of a headless male

provide the clearest pattern.

Three abnormal conditions concentrate among the people of cluster C: the highest nuchal line, precondylar tubercle and the posterior ethmoid foramen. Seventy-eight skulls were examined for these conditions. Of the 14 revealing the highest nuchal line, nine come from cluster C. Ten of the 15 crania with a precondylar tubercle (two from C1, Fig. 69) and 11 of the 19 having a posterior ethmoid foramen are likewise from cluster C. This encourages the idea that the traits are hereditary and that they were transmitted through successive generations of the same family. It is also noted that the posterior ethmoid foramen was present in three successive putative generations represented

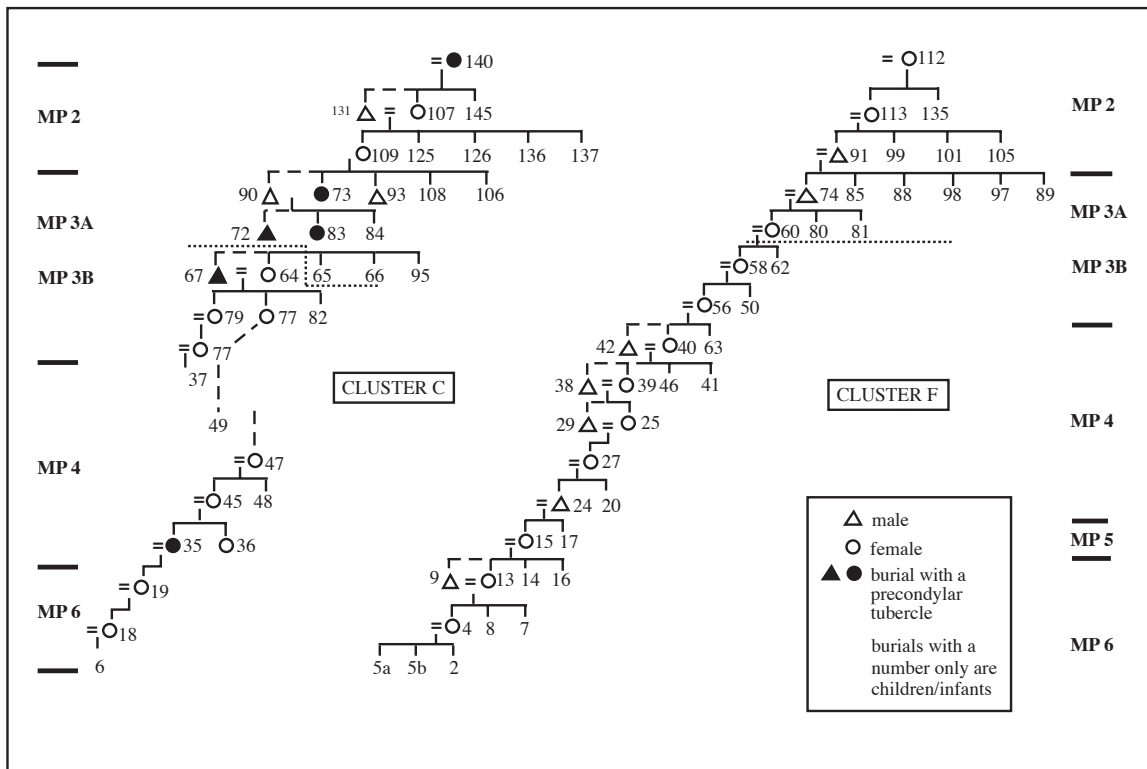


FIG. 69. The presence of the precondylar tubercle in individuals belonging to clusters C and F

by females Bs. 109, 73 and 83, and again with females Bs. 47 and 18. It is particularly interesting to find that the males Bs. 90, 93, 72 and 67 also have this condition. Given its rarity in the sample as a whole, it is suggested that its presence in males and females in this group from B109 is more compatible with the males being siblings rather than spouses of the females with whom they were interred. Again, Bs. 79 and 77 are likely to contain sisters, or a mother and her daughter.

To a certain extent, the highest nuchal line presents a similar pattern, beginning with the male B131, and proceeding in at least one member of the succeeding four generations, including the males Bs. 72 and 67. The precondylar tubercle is present at the beginning of the cluster with B140, and then occurs over five generations from Bs. 73 to 37. Two males, Bs. 72 and 67, reveal this condition. The presence of an open supra-orbital foramen or notch is found in members of nine succeeding generations from B109 down to one of the two females under the raised structure (B19). Burials 18 and 19 also have coronal wormian bones which are present in the crania of Bs. 35, 45, 64 and 83. Only seven skeletons in the site have the astertonic bone, but two are Bs.

TABLE 18. *The patterns of tooth evulsion in cluster C*

Burial	140	131	107	109	73	93	90	83	72	64	67	77	79	47	45	35	36	18	19
Pattern	—	4	—	—	u/k	—	—	—	4	4	u/k	4	u/k	2	9	8	8	8	u/k



FIG. 70. Burial 20, cluster F, mortuary phase 4. The grave of a person who died when about 12 years of age. A potter's anvil was placed next to the lower right leg (arrow)

45 and 47, who were buried beside each other, a finding compatible with their placement in figure 67 as mother and daughter.

Teeth also reveal a recurrence of unusual forms over several “generations”. The first five generations of cluster C include individuals with a cingulum on the upper first incisor. Members of seven generations display a mesiolingual or “Carabelli’s” cusp on the upper first molar. This feature also links B6 with the preceding Bs. 35 and 36. In terms of tooth evulsion in cluster C, no teeth were removed from any of the first four generation members, male or female. Pattern 4, that involving the removal of both upper second incisors, was found two males (Bs. 131 and 72) and two females (Bs. 64 and 77). Burial 45 revealed pattern 9 (involving all upper and lower incisors), while successively Bs. 35, 36 and 18 had pattern 8, in which all four lower incisors and the upper first incisors were removed. Given the number of options open, it is held that the consistency of this pattern involving males and females is compatible with the notion of specified markers for successive members of the same family line (Table 18).

Cluster F also reveals a continuity of burials during MP2-4. In figure 71, a proposed genealogy is set out, including both Bs. 14-16 and the members of cluster H. To a certain extent, it is possible to test the validity of the cluster F genealogy by comparing it with that devised for cluster C. A major discrepancy in terms of the number of putative generations for each would prejudice the conclusion that they represent successive members of the same descent line whose dead accumulated over the same period. Again, to find that members of one group have genetic markers not matched in the other would add some credence to their exclusive nature and even lack of intermarriage between their members. There is less consistency in the pattern of tooth evulsion than might be expected, and less than was observed for cluster C (Table 19).

TABLE 19. *The patterns of tooth evulsion in cluster F*

Burial	112	113	91	74	60	56	58	40	42	39	38
Pattern	—	—	u/k	4	11	—	—	2	9	2	2
Burial	29	27	25	24	20	17	15	13	9	4	
Pattern	2	u/k	8	5	u/k	—	6	9	u/k	7	

Nevertheless, pattern 2 was present in Bs. 40, 39, 38 and 29, while for Bs. 15, 13 and 4, which reveal patterns 6, 9 and 7 respectively, there is in common the complete extraction of either the lower or upper incisors, or both.

When reviewing the two genealogies, it is noted that Bs. 56, 58 and 60, which together comprise stage 4 of this cluster, are set out as females from three succeeding generations. Males are also set out in such a way that they could represent husbands or siblings of their contemporary females. Each reveals 16 generations. When we consider the relationship between the two putative genealogies in conjunction with the stratigraphy, and in particular the depth of the grave cuts

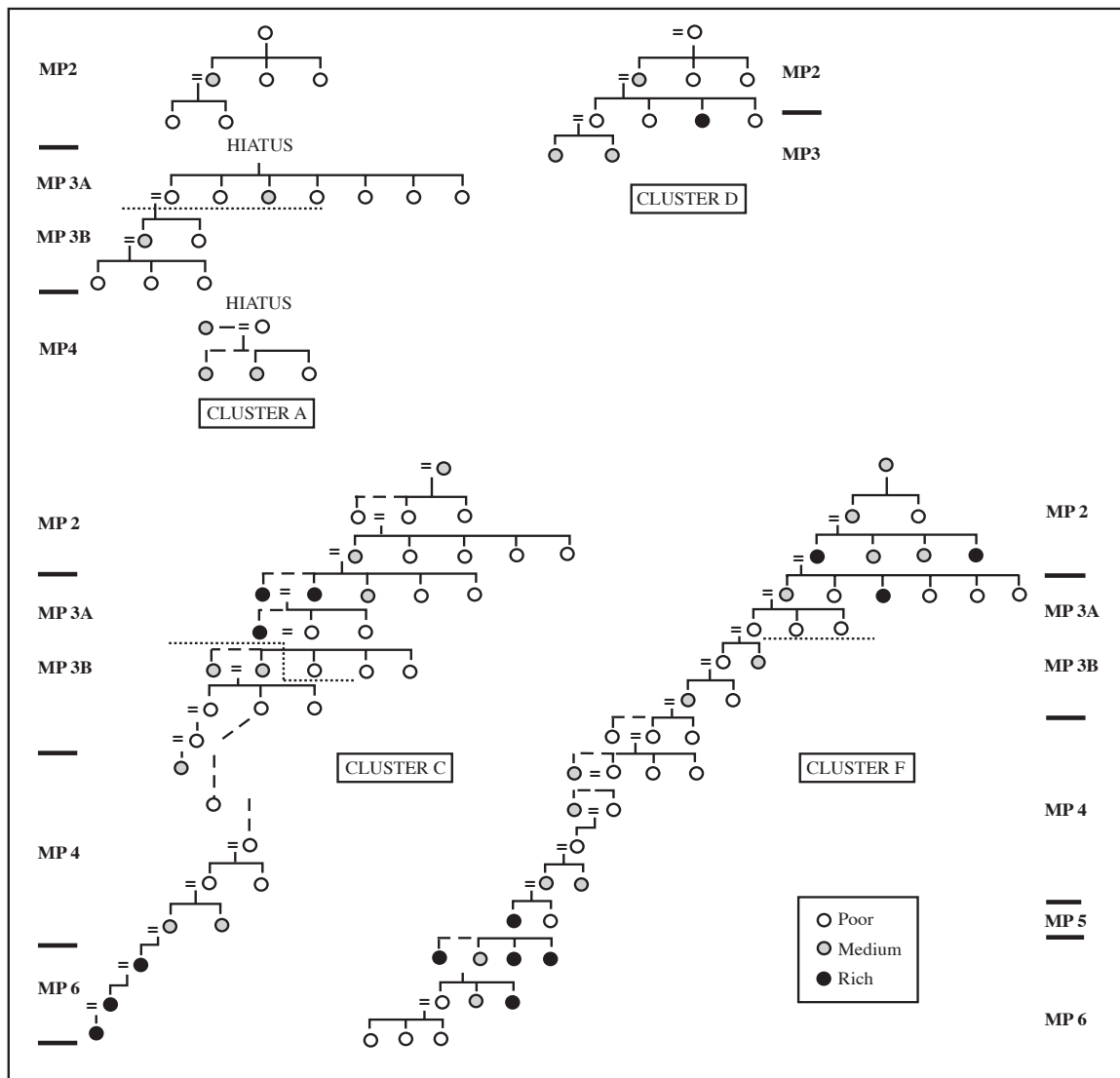


FIG. 71. The genealogies of clusters A, C, D and F showing the relative wealth of each individual. Poor: 1-175 points, Medium: 175-500 points, Rich: over 500 points

below datum, it is found that cluster F seems to have commenced one or two generations later than cluster C. There is also a discontinuity in cluster C between Bs. 77 and 47 and probably also between Bs. 56 and 42 in cluster F, where *c* 70 cm of deposit built up in the period between these two interments. Given such discontinuity, it is felt that the fit between the number of generations in each cluster is reasonable.

The second issue concerns the presence of males and/or females in successive generations. It will be noted that cluster F provides three generations in which there is an adult male but no female. There are also nine cases where an adult female was not accompanied by a male. As with cluster C, there is an apparent trend stressing the female in successive generations.

In reviewing this mortuary sequence, we will assume that the area excavated, which is close to the centre of the mound, was not occupied significantly later than any other part of the site. There is some evidence which sustains this assumption. In the two other squares which have been excavated to natural, the cultural deposits were considerably deeper. The 1979 square reached natural material at a depth of 8.50 m, while Pisnupong's test square, located 16 m to the south, attained a depth between 7.5 and 8 m. This situation suggests that the natural slope of the terrain at initial occupation was away from the 1985 excavated area where natural was reached at a depth of 6.8 m. If the land in the vicinity was low-lying, a situation indicated by all available biological data, then initially occupying available elevated ground would have been sensible. Again, the basal layers in the 1985 square comprise thick ash spreads compatible with both burning off the vegetation, as well as firing pottery vessels in the open. The base of the 1979 excavation, however, comprised a thick shell dump.

Burials were first interred after approximately 30 cm of cultural deposits had accumulated. These comprised ash and midden spreads which could have built up quickly, and it is considered likely that the first burials were interred not long after the site was occupied. The distribution of the six graves assigned to MP1 was not as tightly clustered as during the ensuing phases, but the two infants Bs. 151 and 153 lie directly under the later cluster A graves, Bs. 150 and 152 are in the area of cluster C, B147 lies under cluster B and B154 is found not far from the area later assigned to cluster F. The basic elements of the mortuary ritual were also established: extended inhumation on the back, with the head pointing to the east. Only B150 varies from this, being found in a crouched position. The first two interments did not involve the use of red ochre, but a source for the slaty shale used to provide the red powder used in mortuary ritual had been identified by the time B151 was interred at a depth of 6.29 m below datum. Shortly after, with the male buried at a depth of 6.20 m, disc beads were in use. Thirty cm above the level from which the last MP1 grave was cut, the first clusters of graves were laid out. Again, a rapid build up of deposits is thought to be in question. It is felt unlikely that the interval between initial settlement and the first burial clusters exceeded two or, at the most three, generations.

Mortuary phase 2 commenced with activity in six clusters. Clusters A and B were the earliest, soon to be followed by C, D, E and F. Two possible generations were found for clusters A and E, one or two for cluster B and three or four for clusters C, D and F. If it is correct to assign a generation to each of the stages, then this phase represents about 60 years, at 20 years per generation, within about 60 cm of cultural deposits. Some generations are either missing, or are perhaps located beyond the excavated area. During this mortuary phase, the tight nucleation of the graves was accompanied by the excavation of circular pits adjacent to the demarcated burial area, while some posthole configurations suggest the construction of wooden buildings, or at least the provi-

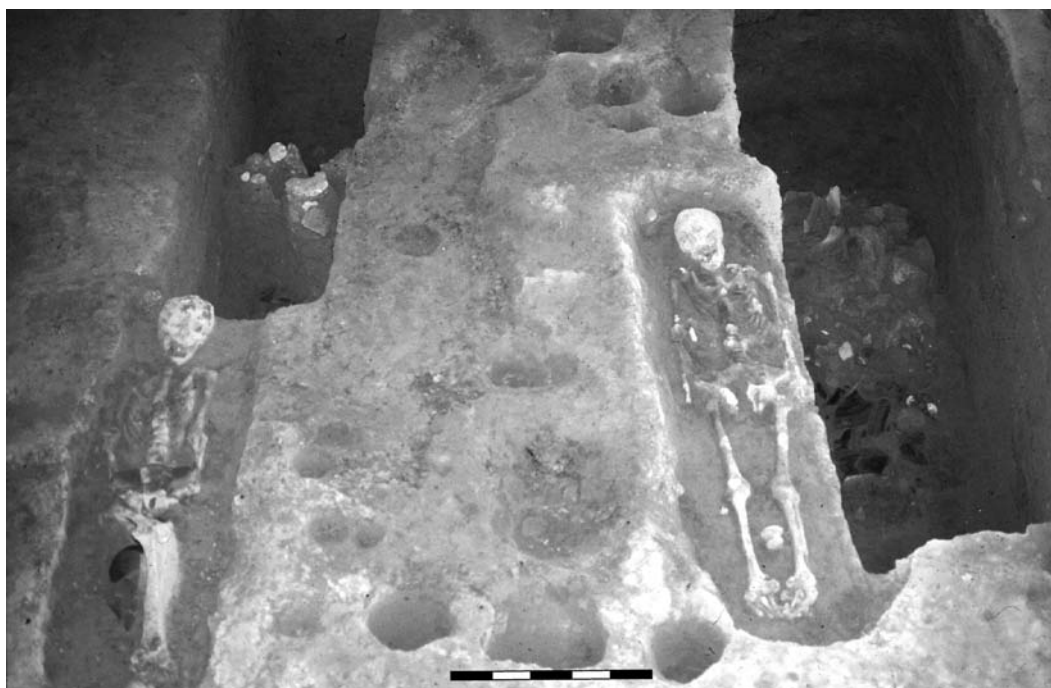


FIG. 72. Left to right, burials 8, 16, 4 and 15. Note the anvil between the legs of burial 4, and the burnishing stone by the right knee

sion of a fenced perimeter, round the clustered graves. In considering the succession of graves within each cluster, it has been found convenient to ascribe to each a point score which reflects in a very approximate manner, the wealth of its grave goods (Fig. 71).

The provision of shell beads and pottery vessels was now firmly established as part of the mortuary rite. One male grave stands out as being richly endowed with 39,000 shell beads. The first three generations of cluster F were also relatively rich. These individuals were interred rather later than the rich cluster E person, and we find that infants with the rich cluster F adults were buried in the same manner, and were accompanied by an impressive number of shell beads and pots. With stage 3 in cluster F, however, the male in B74, ascribed to the fourth generation, was found with no beads. Nor did either of the infants buried alongside him have any. The cluster C graves contemporary with these rich F individuals were not quite as consistently well endowed with shell jewellery, although B109, a female, compared with any in cluster F. It is notable that none of the cluster C infants was favoured with an opulent assemblage of grave goods, although they died rather younger than those in cluster F.

During MP3, clusters B, D and E terminated. Only two infants were found in the B burial area. There is one stage for cluster D early during this phase. In the case of this cluster, we may only have encountered the edge and more may will lie north of the excavated area. The same may apply to cluster E, which during MP2 and 4, was found only just within the excavation square. There are four generations for clusters C and F.

The mortuary ritual began similarly to that described for MP2. Stages 4 and 5 of cluster C



FIG. 73. This group of burials from cluster A, mortuary phase 4, includes males with turtle carapace ornaments, and pottery vessels placed beyond the feet. From the foreground, burials 30, 28, 31 and 32

include burials well endowed with shell beads and pottery vessels, but the contemporary cluster F individuals were relatively poor. Nor were the interments of cluster A stages 2 and 3 particularly wealthy. A series of subtle changes took place with the transition from MP3A to 3B. In terms of technology, it witnessed the onset of ceramic period 3. Pottery vessels now followed slightly different forms and methods of decoration, and were smashed rather than placed whole in the graves. At this same time, the ceramic technology changed, both in terms of fabrics and firing techniques. The quantity of shell beads declines sharply, and burials followed a slightly different orientation. These changes took place when there was a surge in freshwater rather than marine indicators. Females predominated in both clusters C and F, clusters A and D ceased to be active.

To a certain extent, these trends continued, after a hiatus in mortuary activity reflected in the accumulation of *c* 50 cm of deposit, into MP4 (Figs. 73-4). There are five generations of cluster C during this phase, in which all the adults are female. Only eight shell disc beads were found. For cluster F, there are also five generations, with males and females in the same proportion. Just under 400 shell disc beads were recovered from these burials. Pottery vessels predominated among graves goods, and males were consistently interred with large turtle carapace ornaments. No generation within any cluster stood out as being particularly wealthy.

Mortuary phase 5 saw a major change in aspects of the burial rite, along with underlying continuity. While the dead were still interred with the head pointing to the east, and the bones were still



FIG. 74. Burials 47 (left) and 45, cluster F, mortuary phase 4, were placed in close proximity. Both are female, the former having an infant on her left arm

covered in red ochre, clustering of graves ceased, to be replaced by four rich interments. Burial 15 involved an unusually large grave located next to the shallow grave of a headless adult male. The woman was buried, with considerable wealth in terms of shell jewellery, under a mound of clay cylinders. The same ritual was applied to the infant buried alongside her, even down to the provision of a miniature clay anvil matching that found beside the adult woman's right ankle. It has been argued that this woman represents a continuation of cluster F. It is unfortunate that an outstandingly rich male burial was only just present in the excavated area, but he, like the woman in B15, was provided with an abundance of shell jewellery including a large disc fashioned from tridacna shell. The woman in B15 had two such discs, one on each shoulder. Two generations, the woman and her presumed children, seem to be in question.

The quantity of shell jewellery fell with MP6, but the energy expended on at least three rich graves was still impressive. The remains of two females, together with a child, were found under a raised structure. The women were buried with much shell jewellery and clay anvils. The child was accompanied by a fourth shell disc. It is considered likely that these people can be linked with cluster C. Cluster H, located in front of the structure, was poor by comparison. Only 15 disc beads were found, against nearly 30,000 for the three contemporary burials under the raised structure.

It is, unfortunately, not possible to offer much information on the nature of MP7, except that infants were buried with rich goods, shell beads continued to be employed, and bangles of shell were placed with young individuals.

THE INTERPRETATION OF THE MORTUARY DATA

When interpreting prehistoric mortuary data in social terms, it is possible to follow one of two different paths. The first is based on the propositions, originally formulated by Binford (1971) and Saxe (1970), that there is a link between mortuary ritual and the organization of the society responsible for it. The second path is less optimistic in that it identifies ethnographic instances where the assessment of similar cases in prehistory would lead to errors of interpretation (Ucko 1969, Hodder 1982). A summary of the approach advocated by Binford and Saxe is now almost *de rigueur* as an introduction to prehistoric mortuary analyses. Its essential proposition is that individuals in society have their own social identity. High status involves distinct identities, such status as father, specialist or chief, the sum of which provide his or her social persona. It is axiomatic within this approach, that status

in life is recognized as part of individual treatment at death. A simply-organized society might recognize sex and age distinctions in addition to personal achievements. A more complex social organization would grade mortuary rites according to the social persona of the deceased.

Usually, analyses of a given prehistoric cemetery following these precepts concludes that the society in question subscribed to one of several principles of social organisation, of which the most common groups are egalitarian, acephalous and ranked, or centralized as chiefdoms. In determining which is in question, several aspects of the mortuary behaviour are scrutinized. These involve where a person was buried, whether graves were found in clusters over time, what individuals were buried with and how this varied with the person's age and sex, the amount of energy expended in a person's burial and how they were interred.

The issue of clustering of burials, whether in a collective tomb, or a defined inhumation or cremation cemetery, is one which has attracted particular attention. Saxe (1970:119), for example, has proposed that the presence of "formal disposal areas for the exclusive disposal of their dead" is closely linked with corporate groups linked by lineal descent and concerned to maintain rights to defined, crucial, restricted resources". Further consideration of the ethnographic record by Goldstein (1976) has supported this contention. Saxe himself has tested it in the context of a Mesolithic cemetery, site 6-B-36 at Wadi Halfa (Saxe 1971). While the variations in the treatment of individuals recognize age, sex and probably some element of personal achievement, the corporate nature of the cemetery itself is seen as reflecting rights to critical local resources by a sedentary community.

King (1978) has employed the same approach in considering prehistoric mortuary remains in California. He noted the consistent presence of mortuary clusters, some of which were distinguished by more elaborate burials, and suggested that there was considerable time depth to the presence of ranked social organisation among sedentary hunter-gatherer groups.

In her examination of cemeteries at Indian Knoll and Dickson Mound, Rothschild (1979) has considered the presence of segmentary and hierarchical forms of social organisation. In the former, which is seen as the more egalitarian, Rothschild anticipated distinctions in treatment on the basis of the primary variables of age and sex. In other words, a person's sex or age defined the mortuary treatment, rather than personal achievement or inherited status. She proceeds to anticipate that where status was achieved rather than inherited, infants and children should not be interred with any or many grave goods on the premise that the young could not have achieved the personal attributes warranting special treatment. In general, her predictions were found to be justified on the basis of the treatment of the dead.

The issue of formal disposal areas and their relationship with the ownership of critical resources has been followed in depth by Chapman (1981). He cited numerous prehistoric instances of group interments over time in a sample largely restricted to prehistoric Europe. Among the most interesting, from the vantage point of Khok Phanom Di, is the identification of formal cemeteries in the "Mesolithic" communities which commanded estuaries. These are considered in conjunction with the demonstration that even in temperate conditions, estuaries rich in food resources are well capable of sustaining permanent hunter-gatherer settlements. The presence of formal burial areas has now been documented not only in the well-known Breton sites of Tévéc and Hoëdic, but also at the Tagus River, and in southern Scandinavia. While critical resources in these contexts were surely concerned with fishing, in later examples drawn from prehistoric Europe control of good

agricultural land is stressed. He concluded that the emergence of formal cemeteries was closely linked with the expression of corporate ownership of critical resources through descent from the ancestors.

The approach generated by Binford and Saxe, and followed by many since, has been criticized by Hodder following his ethno-archaeological fieldwork in the Sudan (Hodder 1982). The growing consensus that mortuary data are a useful and valid tool in evaluating extinct social systems was challenged on several grounds. He began by quoting Tainter's remark that:

"Binford's ethnographic survey of mortuary practices confirms beyond serious contention the argument that variability in the form and organisation of mortuary practices must be understood in terms of the variability in the form and organisation of social systems" (Tainter 1978:107).

The Mesakin Nuba, the group considered by Hodder, maintain cemeteries adjacent to their settlements, wherein clusters include the grave of a chief and represent a named section of the community. A person's belongings are broken and placed in or on the grave. This should imply that these people were sedentary, practiced ascribed ranking and signalled land ownership rights through the maintenance of ancestral graves. Hodder concedes that forty years ago, land was inherited, and that improvement to the land was due to the labour of the ancestors. At the same time, women who lived elsewhere in their husband's community would be returned to their home settlement for interment, and occupants of settlements which had been settled by fissioning away from the parent village would likewise be brought "home" for burial. Again, Hodder notes unspecified changes in land ownership as the Mesakin were drawn into a national Sudanese economy. These people view death as impure, and therefore the breakage of the deceased's possessions and placing them on or in the grave is a means of removing impurity. Hodder argues that a change in attitude towards impurity might result in a mortuary rite where the artefacts ceased being broken and incorporated in a grave, but that such a change might not involve a less complex form of social organisation. In essence, Hodder stresses that the Mesakin Nuba burial rite is not a direct reflection of social organisation, but rather a representation of an ideal state, of matrilineal groups "assembled pure, without the husband's presence" (Hodder 1982:199).

The analysis of mortuary remains has developed considerably since our excavation. Some of the principal trends have been summarised by Brown (1995), who has found much to support in the basic tenets advanced by Binford (1971) and Saxe (1970), and areas to criticise in the rebuttals of Hodder (1982). Where the latter stressed the role of ritual in burial rather than social practices, Brown emphasised the effect of social complexity upon that of ritual. Where Hodder advanced ethnographic exceptions to counter the proposed relationship between social organization and burial behaviour, Brown identified such variance as a strength in an area involving shades of grey rather than black and white. Building on and modifying elements of the Binford and Saxe proposals, Brown has identified several interactions which are considered germane to our consideration of the remains from Khok Phanom Di.

Foremost is Saxe's eighth hypothesis, that there is a relationship between formal cemeteries and the control of access to critical resources. The Merina system of interment of members of a corporate land-holding group of kin in a collective tomb is cited as the classic example of this relationship, since the Merina kin group depends upon restricted access to its ancestral rice lands. Goldstein (1976) has reformulated this linkage and has concluded that:

"If there is a formal bounded disposal area, used exclusively for the dead, then the culture is probably one which has a corporate group structure in the form of a lineal descent system." (Goldstein 1976:62).

Brown then refers to the conclusions of Charles and Buikstra (1983) which are so appropriate for the Khok Phanom cemetery that they deserve to be quoted:

1. "Utilization of formal cemetery areas will correlate with sedentary subsistence strategies employed by the group(s) using the cemetery;
2. The degree of spatial structuring present in the mortuary domain will correlate with the degree of competition among groups for crucial resources.
3. Within the larger society, corporate groups will be distinguished by inclusion in separate cemeteries or in spatially distinct areas within a single cemetery.
4. Inclusion of individuals in the cemetery implies inclusion of those individuals in the corporate group" (Charles and Buikstra 1983:119-20).

Binford (1971) outlined the importance of the social persona of the dead in attracting more or less energy expenditure on the rituals attending interment. Brown has suggested that economic and political factors help determine how the dead are treated. Thus in a society where wealth items are accumulated by individuals, one might expect competition to continue in the provision of wealthy grave goods. As resources and labour increase in availability, so extravagant displays of wealth consumption attend the funeral rituals, whether in protracted feasting, or the destruction of valuables physically, by immolation or both.

It is readily conceded that there is no formula permitting the social organisation of a prehistoric society to be read off on the basis of the burial record. We may follow two principal routes. One is to present the data and shy away from any social interpretation due to the obscurities and difficulties involved. The second is to recognize the possibility that an assessment of the broad principles of economic, political and social organisation, however strongly hedged by provisos, is incumbent on the investigator provided the data are presented in such detail that alternatives can be formulated.

SOME RELEVANT SOCIAL AND PHYSICAL VARIABLES

Before proceeding with possible interpretations, some relevant findings will be addressed. During the initial occupation, the site was located on an estuary within reach of a mangrove-fringed shore, extensive inter-tidal mud flats, and saline flats behind the mangal. This location progressively became distanced from the sea and probably the river, a dislocation which probably took place between MP3A and 4. The period corresponding to MP4 saw an increase in freshwater indicators, and the presence of shell reaping knives and granite hoes. It is suggested that rice cultivation took place during this interval before, with MP5, there was a reversion to more saline conditions, and with it, the disappearance of reaping knives (Fig. 25).

The people were well-nourished. They lived in a rich habitat, and their bones were robust.

The cortical thickness of the metacarpals is compatible with a population to which the food supply was not a matter of anxiety. Choosiri (1991) has isolated numerous genetic markers in the cranial and postcranial bones which are present through successive mortuary phases, while her examination of the teeth has revealed that tooth evulsion was practiced from MP2 onward, the pattern becoming progressively more complex. These findings suggest that we are dealing with the same population through time, albeit with the arrival at certain periods of individuals raised in different environments.

Khok Phanom Di was a centre for the manufacture of pottery, and the presence of the implements used to make pots in graves provides us with some evidence for sex-specific roles in this pursuit. Shell ornaments were also probably locally made. On the other hand, high quality stone was not locally available. Pisnupong has identified several sources for the stone adzes, all being exotic to the lower reaches of the river valley in which the site is situated. The slaty shale used in the mortuary rite originated some 45 km to the southwest. The origin of the smaller shell beads has not been resolved, but Mason has identified the cowrie shells as *Cypraea errones*, a species requiring clear coralline conditions. One fragment of coral grit was found within one of the cowries. The large discs from the MP5 burials come from tridacna, while I-shaped beads are probably fashioned from trochus. These two species are also adapted to clean coral conditions not likely to have been found near the turbid estuary of a large river. We are, then, on relatively firm ground in ascribing some raw materials for the shell jewellery to an exotic source. Unfinished shell ornaments, as found with B43, evidence local manufacture.

Khok Phanom Di occupied a strategic position. Food supplies were assured so long as there was access to the resources of the estuary and inland freshwater swamps and streams. There were local deposits of potting clay. Like any settlement at or near a major estuary, the inhabitants controlled access to the hinterland, where there were sources of high quality stone. The upper gulf provided the opportunity for coastal exchange, which involved exotic marine shell. It is a location which on several grounds, would have provided resources encouraging permanent settlement and proprietary tendencies. These advantages would have been offset by malaria, anaemia, high infant mortality, low life expectancy and an environment liable to unpredictable change.

INTERPRETATION OF THE MORTUARY RECORD

It is suggested that the occupants of a central estuarine location used the same cemetery over a period of about 20 generations. The timespan of four centuries for the 20 generations is in harmony with the available radiocarbon dates. The mortuary data are compatible with several interpretations.

Interpretation 1

This first interpretation begins with four assumptions.

1. That where a person was buried was important.
2. That the stages in each cluster reflect family groups or at least individuals more closely related to each other than individuals buried in other clusters. This qualification acknowledges the possibility that brothers or sisters might be present in different clusters following marriage. Males and females buried contemporaneously are more likely to have been affinally or consanguinally

related than not related at all.

3. Grave goods, and particularly shell jewellery, reflect in some measure the status of the deceased.

4. That a lineage is a group of families related to each other through sharing a common ancestor. The time depth of a lineage may be measured as four or five generations. After this period, there may be so many families with increasingly distant relationships with the common ancestor that lineage groups may develop.

Mortuary phases 1-3A

This interpretation begins by stressing the continuity of the basic mortuary rite, the shared genetic markers over the generations and mutilation by tooth evulsion being seen as indicators of a basic continuity of first a lineage at the site, and if the population grew, of lineage groups. The scattered and relatively few graves belonging to MP1 are interpreted as the founding population. These people may well have brought with them the well-used adzes found cached at the base of the cultural deposits, and were familiar with pottery making and decoration by burnishing. The strontium isotope analyses indicate that both men and women of MP1 came to the site from a different environment. After the first one or two generations, six nucleated and formal disposal areas were demarcated, each containing adult males and females as well as infants. These follow a grid pattern. It is held that each cluster represents generations of families, and that the clusters as a whole represent people descended from the founding ancestral group.

Status, indicated by the quantity of shell ornaments and pottery vessels, oscillated between groups. Cluster E contained a very rich male. Just later, cluster F included two or three generations of rich adults, whose wealth was also expressed through their children. Such achievement of mortuary wealth oscillated between clusters: cluster C during early MP3A went through two generations of relative wealth while cluster F was poor. While some families advertised status through rich mortuary ritual and endowments to their dead infants, there was no permanent inherited status. Rather, status was obtained through individual prowess or skill. Each cluster during this early stage includes individuals buried with the burnishing stones used to decorate pots. One such skill may well have been in the field of ceramics.

While the maintenance of formal disposal areas for the dead over the graves of the ancestors continued during MP3, we can detect changes. Some families ceased to be represented. If this reflects something more than the effect of sampling only a 10 by 10 m area, it could have resulted from the extinction of a particular family through high infant mortality, or the fissioning of a family to found another settlement. The despatch of a surviving member of a family as a marriage partner to another settlement is a third alternative. There is also no clear-cut continuity within, for example, cluster A. Whereas during the same period cluster C presents three generations, cluster A has one or two, followed by a hiatus of some length before the next interments. In this case, we can explore the possibility that a family had no direct descendants. Thus, the woman in B110 died in her mid thirties and had borne children. She was buried close to four infants. The greater the number of infants, the less is the likelihood that a family reproduced itself. It is, for example, possible that the stage 2 interments in cluster A represent re-use of this designated burial area by a more distantly related family. The strontium isotope analysis indicate the several women in MP3B graves came to the site from a different physical environment to Khok Phanom Di.

Mortuary phase 4

The two enduring families were clusters C and F. We encounter a change in both, to a predominance of adult females. The strontium isotope analyses now indicate that both men and women were probably born and raised at the site. For cluster C, females and infants were now found to the exclusion of males. Females outnumbered males in cluster F. It is suggested that this represents the stressing of the female line and matrilocality in this particular lineage. Under such a matrilineal descent system, males may have been introduced into it as marriage partners from other settlements and returned there for burial, or males from other lineages at Khok Phanom Di itself may have been introduced into clusters C and F and then returned to their own mortuary area for interment. Two females interred in the same stage could then represent a mother buried with her adult daughter, or her sister. The rarity of shell jewellery during this phase could represent a dislocation in established exchange relationships or new preferences.

Mortuary phase 5

At the end of MP4, representatives of the cluster C and F lines were still interred over their ancestors. With MP5, this changed abruptly. The family of cluster F is seen as continuing and achieving unprecedented wealth. The status of the woman buried in B15, status displayed through the size of the grave and the splendour of the offerings, is mirrored by that of two adjacent infants. She was buried next to a shallow grave containing a headless male. Her two shell discs are a new and rare form of artefact which is seen as a high status symbol, while her anvil and burnishing stones again draw our attention to the role of the master potter in this community. It is suggested that one of the clusters, after a period of competitive emulation between related families, achieved high rank in the person of this woman. Whether she was uniquely accorded high status and rank is not known. It may be that she was not alone because at the very edge of the eastern side of the excavation, we encountered the grave of a male which, while not as rich as B15, was still endowed with 56,200 disc beads, 418 I-shaped beads, a shell bangle, turtle carapace ornament and a pottery vessel.

Mortuary phase 6

There is no evidence that the high status accorded the woman in B15 continued among her descendants. Quite the contrary. Cluster H was laid out on the same orientation as B15, and the old female in this cluster, B4, was interred in a grave adjacent to that of B15. The dead were interred progressively from north to south, beginning with an adult female, proceeding through an infant, a 15-year-old, then a male, new-born twins, an infant and finally, the women in B4. They are poor in relation to the two women and a child buried under the adjacent raised structure at the same time. Here, we find the most compelling evidence that, during the later part of the mortuary sequence, there was inequality of wealth between two groups. The two women with their potter's anvils and abundant shell beads, together with the child buried with a shell disc, are most likely to be descended from the line of cluster C. With their rise in wealth, that of cluster H fell away. Yet in both, we again encounter a predominance of women in the ratio of 4:1, and all four women

were buried with the tools for making pottery vessels.

INTERPRETATION 1: SUMMARY

In this interpretation of the mortuary data, we have the following main conclusions:

1. During MP1-3A, the occupants of the site were favoured by access to a major river estuary with its abundant food resources. The shellfish of the mud flats and crabs of the mangrove could be collected by young and old, while anadromous fish came up the river to spawn. The river gave access to a hinterland which provided resources of stone. So too did the then coastline, while maritime exchange would have brought exotic shell and stone to the site. Its occupants would then have had an advantageous position from which to control the distribution of valuables to sites in the hinterland.

2. Specified areas for interring closely-related family members were established within about 2-3 generations of initial settlement. The basic mortuary rite was maintained throughout the 20 or so generations represented. However, during MP3B, there is evidence for women arriving at the site from a different physical environment.

3. These clusters are interpreted as the collective burials of members of families related to each other and tied to common founding ancestors. Burials were accompanied by the digging of pits and probably feasting. Food remains were placed in these pits.

4. Some families display relatively high wealth expressed through grave goods, while contemporary families were poor. The wealth of these rich adults was matched by similar treatment for their infants. It is suggested that such wealth oscillated between families based on the personal qualities of their members.

5. While the lines represented in clusters C and F continued over a long term, those of E, D and B effectively terminated during MP2 or MP3A. This could reflect their extinction or the fissioning of a group to live elsewhere. The poor health and high infant mortality would have involved a struggle to maintain a group to the next generation.

6. During MP3B and 4, women assumed increasing importance as the producers of pottery vessels. Their predominance in clusters C and F is seen as evidence for the development of matrilocality with husbands being introduced from other settlements, but within the same physical environment as Khok Phanom Di, or from other lineages at the site itself.

7. The dominant position of women potters reached a peak during MP5 and 6. Firstly the family of cluster F achieved prominence, but this was followed by a reversal, with the cluster C family dominating over the descendants of cluster F, now labelled cluster H. Much energy was expended on individual graves, but high status was not permanently retained by one lineage. Again, we find oscillating wealth and status.

8. The provision of wealthy graves for infants and children continued into MP7, but this was

the last episode in the history of this cemetery.

INTERPRETATION 2

The second interpretation makes assumptions not about the data recovered already, but about what might lie in the unexcavated part of the site. It begins with the same tenets as for interpretation 1, but incorporates the further assumption that during MP3-4 the population of the site was expanding, and new family burial areas were established on the periphery of an expanding cemetery.

There is some slight evidence in support of this assumption. In 1982, Pisnupong excavated a trench measuring 7 by 3 m, located 16 m to the south of the 1985 square. He only encountered burials equivalent to our MP4. The sex ratio for this cluster was five females to two males. No earlier interments were present. Noksakul in his 1979 excavation uncovered 13 burials, probably equivalent to our MP1-2 and MP4-7.

The principal point of this alternative interpretation is that initial status competition between families within a lineage was superceded, under the condition of population growth, with rivalry between lineage clusters. To confirm this interpretation, it would be necessary to identify a group of clusters contemporaneous with our MP3-4 containing a richer set of graves than those we encountered. This might then reflect an increasing restriction on access to shell jewellery by the more highly-ranked lineage group.

There is just one fragment of evidence in favour of this. Burial B33 belongs to MP4, and was found at the northern edge of the excavated area. It did not belong to any of the clusters. The three-year-old infant was easily the richest burial found in MP4, being associated with 7,845 disc beads, 107 of the rare and beautiful I-shaped beads, two pierced animal canines, a clay anvil and four pottery vessels. This alternative proposition could readily be tested by excavating to the north of the 1985 square.

If this interpretation were to be supported by further research, then it would follow that during MP5-6, the lineage group represented by Bs. 6, 14-16, 18, 19 and 43 superceded a putative rival group to assume a particularly high status position. While possible, this interpretation is not advocated with enthusiasm. This reflects the difficulty in accommodating the disparity in wealth between the interments under the raised structure, and those assigned to cluster H in front of it.

INTERPRETATION 3

The third possible interpretation brings down a different set of assumptions. It denies that there was a relationship between status and the inclusion of shell jewellery, or of anything else for that matter, in a person's grave. The inclusion of goods reflects, following Hodder (1982), an association between death and impurity. We have already noted that ash, and therefore, burning, was often associated with the mortuary area. But from MP3B, the rite also included the breaking of artefacts, as with the Mesakin Nuba. Turtle carapace ornaments were broken before being placed with the dead. Pots were often smashed or the rim removed. Following this line of argument further, we could argue that the presence or absence of shell jewellery followed the vagaries of casual exchange, particularly that involving sea voyaging. A dislocation in exchange transactions, as with the loss of a boat and its crew, or outbreak of conflict, is all that needs to be invoked to explain fluctuations in the availability of shell

jewellery. It would also rather neatly account for the rarity of males, those most likely to undertake voyaging and fighting. The ideal world expressed in the mortuary remains could have involved equality between the different families and lineages with personally-owned artefacts being buried to remove the threat of impurity. The ideal, not fulfilled in all cases for reasons including hazardous voyaging, was that of the nuclear family.

It is not easy to test this contention for MP1-4. It is, however, held to be highly implausible for the burials representing MP5-6. This reflects the much greater energy which was expended on the burial rites for these graves, and the use of the rare and unusual shell discs. These, and unique shell artefacts found with B15, are held to be more consistent with the presence of high-status individuals within the community. Since the roots of this behaviour are found in the preceding phases, the abruptness of the transition from assumed equality to such marked ranking is hard to countenance.

INTERPRETATION 4

This interpretation calls on the question of the place of the community represented at Khok Phanom Di and contemporary settlements in its orbit. During the course of the site survey undertaken in early 1984, a number of other prehistoric sites were identified (Fig. 2). The only site rivalling Khok Phanom Di in terms of size and height was Khok Karieng. This mound was probably also located in an estuarine situation, about 15 km south-west of Khok Phanom Di. Any points raised about this site are speculative in the absence of excavations. To judge from its size, however, it is a site which might have rivalled Khok Phanom Di in terms of both its strategic, estuarine position and the wealth of its occupants.

This interpretation involves a fresh set of assumptions. The first is that Khok Phanom Di began as a relatively small site, but expanded with population growth. The second is that the fine pottery vessels and shell jewellery were items of exchange, between the inhabitants of Khok Phanom Di and other sites in its orbit. The third is that exogamy involved the movement of marriage partners between communities. A marriage partner leaving a community would have been compensated for by the payment of valuables from the recipient group. It is also assumed that some settlements were founded by emigrant groups from Khok Phanom Di, and that they maintained relations with the parent site through the exchange of valuables.

Under this interpretation, Khok Phanom Di began as one of a number of similarly-sized settlements, status being a matter of competitive emulation between first the early families and then, perhaps, between lineage groups. When a series of other communities increasingly participated in the exchange network, we find that the leaders of Khok Phanom Di had an advantage on at least two counts. Being a specialist potting community, they could feed into the system a determined number of fine vessels. These, to judge from the Khok Phanom Di cemetery, were regularly employed in mortuary rituals. Being located on a large estuary, they occupied a nodal position in exchange, involving exotic marine products, and in particular shell jewellery. If we are correct in assuming that these items were used in marriage payments, those able to control their distribution would have found a predictable route to status and rank which extended their influence well beyond the confines of Khok Phanom Di. We could add a third decided advantage. While food for subsistence was probably not a concern at this estuarine community, food for prestige may well have been. The provision of food surpluses destined for ceremonial feasting, as in the death feasting rituals, would

have come much more easily to them than to those in more marginal inland communities.

It is, therefore, suggested under this interpretation that the deep-seated changes observed with MP5-6 occurred as the leader or leaders of the community at Khok Phanom Di assumed increasing control over the regional distribution of prestige goods.

WEIGHING THE ALTERNATIVES

In a sense, we are only dealing with two alternatives, because those numbered 1, 2 and 4 complement each other, as each takes the interpretation first to a broader stage, the whole site itself, and then to the place of Khok Phanom Di within a regional settlement pattern. The difference between these and alternative 3, is the assumption that the presence of goods in the graves, and energy expended in making an interment, have a deeply-embedded relationship to status and persona which we can detect, even if in a blurred and incomplete manner. It remains possible that ash lenses and the breakage of some artefacts reflect ideals of removing impurity, with the range of goods indicating recent success or failure in exchange relationships, but proceeding beyond speculation in further reviewing this possibility is not easy. From MP5, however, the wealth and exclusive nature of some of the burials makes this interpretation less plausible. It hardly needs to be stressed that the islands of South-East Asia, and in particular the recent societies of Melanesia, are a rich source of ethnographic information on the operation of exchange networks involving both inland and marine resources. Further insight into the situation which might have obtained between 2000 and 1500 BC on the mainland of South-East Asia will therefore be considered on the basis our appreciation of recently documented behaviour.

Insight into the exchange of shell valuables in Melanesia is almost synonymous with the early development of social anthropology as a scholarly discipline. Long distance, hazardous ocean voyages to exchange apparently valueless shell ornaments, the *kula*, was an absorbing aspect of the lives of the occupants of the Massim area, the islands to the east of New Guinea. Irwin (1983) has approached the issue of chieftainship in the Trobriand Islands from the point of view of the advantages conferred by a central location. He found that the communities most centrally placed for exchange and communication were those occupied by the highest-ranked lineage. This situation might well have had a parallel in the advantageous estuarine location of Khok Phanom Di. Irwin also stressed the scarcity of pottery-making centres, and the distances over which vessels were exchanged within the *kula* area.

Lepowsky (1983) has described the principal elements of exchange in the Louisiade archipelago, which lies to the south-east and at the periphery of the classic *kula* islands. It is in this context, and in particular on the island of Sudest, that we encounter behaviour which allows insight into the system represented in the Khok Phanom Di cemetery. On Sudest, trading with communities living in neighbouring islands is concerned not only with essentials, such as food, but also with ceremonial items, such as adze blades, pottery vessels, polished pearl shell spoons, hair combs, shell armbands and bead necklaces. Men and women can aspire to prestige and power through the acquisition and then the gifting of valuables in quantities greater than the norm. In Lepowsky's own words:

“Exchange activities in the Sudest area are an avenue to potential wealth, prestige and power

open to any woman as well as any man who chooses to exceed the minimal demands of custom in obtaining valuables". (Lepowsky, 1983:500).

What were the valuables used for? We find that they were essential in the provision of gifts during memorial feasts for the dead, for bride price prestations and in settling disputes. Exchange voyaging was a means of finding marriage partners among widely-dispersed communities. Funerary feasts made a major call on the production of food above subsistence. They could be given over periods of between three and 20 years, depending on the status of the deceased. The economic value of exchanging goods between specialist communities in an ecologically diverse area is obvious. We find specialists in canoe construction, in diving for conus shell, pottery making, pig-raising, wood carving and shell bead manufacture. But for the socially ambitious, success in ceremonial exchange was the road to increased status and power as a big man or a big woman. Nor is this attainment of high status by women restricted to Sudest Island. Battaglia (1983) has noted a similar phenomenon on Sabarl Island on the eastern Calvados chain, where women travel on their own expeditions to exchange ceremonial valuables. She has also stressed the role of the matrilineage in exchange transactions, and noted how a "strong woman" may advance in status through the production of more food than is necessary for subsistence, sponsor feasts and show expertise in the field of ceremonial exchange. Particular stress is given to mortuary feasting, because "Ancestors' graves anchor their memories as well mortuary ritual, feasting as their supernatural services to their earthly vicinities" (Battaglia 1983:449).

Goto (1996), in her analysis of shell bead manufacture among the Langalanga of Malaita, has noted their importance in exchange and the provision of brideprice. Shell beads are manufactured from, among other shells, *Anadara granosa*, by women. Work is undertaken individually, but groups of women will often assemble to make beads in a group for company. Strings of shell disc beads are used in engagement ceremonies, followed by feasting, in the establishment of new kinship ties. They are made into armrings, bracelets, necklaces, chest bands, head bands and hats. The shell beads are vital resources to which unauthorised access is prohibited. Many women spend between two and five hours a day making beads.

Such ethnographic examples help us appreciate more clearly the possible significance of what was found at Khok Phanom Di. The settlement was a centre of pottery making which resulted in the manufacture of masterpieces used in mortuary rites. It is felt very likely that women potters were pre-eminent in the local provision of valuables. Ambitious women could, by feeding their products into the exchange, acquire further valuables, such as exotic shell jewellery, which gave them status. We find an increasing stress on women. They came to predominate numerically over males, and by MP5-6, some were accorded lavish burials. It is very hard to imagine the society allowing highly-skilled women to join other communities as marriage partners, and there are grounds, among the genetic markers in human skeletons, to suspect that the society was indeed matrilineal. A concentration of valuables essential to appropriate mortuary ritual and perhaps marriage settlements would, it is argued, have conferred rank and prestige on the women of Khok Phanom Di.

We know less about the manufacture of shell ornaments, except that a disc found with B43 had been cut in such a way as to suggest that it was a partially completed bangle. It is, however, noted that the location of Khok Phanom Di would have conferred advantages for the acquisition of high quality shell and its distribution inland. Virtually every Neolithic and Bronze Age cemetery found in the interior valleys of South-East Asia contains burials associated with shell disc beads.

Moreover, the Khao Wong Prachan Valley site of Huai Yai has yielded H beads very similar to those from later graves at Khok Phanom Di. In the case of the former variety, Khok Phanom Di displays outstanding numbers, indeed B15 alone has probably provided more than the cumulative total from all other excavated cemeteries in Thailand. In her examination of the organisation behind the production of shell beads among the Chumash of coastal California, Arnold (1994) has suggested that increased output was associated with environmental stress. Specialisation in manufacture on Santa Cruz Island provided an opportunity for increased social standing for those who could control their distribution through the ownership of boats. While not attached specialists in the connotation of Brumfiel and Earle (1987), there remained the potential to manipulate bead production to the advantage of emerging elites.

Arnold (1995) has also suggested that the control of maritime transport contributes to the development of social hierarchies. In the case of the Chumash again, this occurred largely due to the rarity of quality timber from which to construct craft capable of crossing the Santa Barbara Channel. Drift redwood originating up to 500 km to the north was particularly prized in the skilled construction of the *tomol*, or plank canoe. Ownership of such vessels opened the possibility of controlling the passage of goods between the islands and the mainland. We feel that a parallel situation at Khok Phanom Di is unlikely not because maritime and riverine transport was unimportant, quite the contrary. Rather, access to the raw materials for boat construction would not have been so restrictive. As is seen in the robust musculature of the men from MP 2-3, not to mention the quantity of fish bones, the use of boats was probably widespread.

TABLE 20. *The ages, incidence of pregnancy and the number of infants interred in association with the females of clusters F and C*

Cluster	Burial	Age at death	pregnancy	N infants interred	Cluster	Burial	Age at death	pregnancy	N infants interred
C	140	17	yes	1	C	107	40	yes	4
C	109	31	no	2	C	73	25	yes	1
C	83	30	yes	3	C	64	21	yes	1
C	79	47	yes	1	C	47	22	yes	2
C	36	21	yes	0	C	35	21	yes	0
C†	19	25	yes	0	C†	18	42	yes	1
F	112	40	yes	4 ¹	F	113	46	yes	4 ⁴
F	60	19	yes	3 ²	F	58	35	yes	3 ⁵
F	56	45	yes	3 ³	F	40	37	yes	2
F	39	25	yes	0	F	25	19	yes	0
F	27	41	yes	0	F††	15	35	yes	2
H	13	35	yes	2	H	4	26	yes	3+ [§]

† assigned to cluster C, ††: assigned to cluster F, §: probable twins, ¹including B113, ²including Bs.56 and 58, ³including B58, ⁴including B112, ⁵including Bs.56 and 60

IMPLICATIONS OF THE MORTUARY BEHAVIOUR

If the clusters are seen, for the moment at least, as representing generations of lineages related to the founding ancestor, then it becomes possible to speculate on the relative success of each in terms of the maintenance or increase in their numbers (Fig. 67). Take, for example, the females belonging to cluster C (Table 20). We find that five of the 12 women died when less than 25 years and all indicate evidence for pregnancy. The remainder lived beyond the age of 25. Burial 109 did not reveal any evidence for pregnancy, but the others had borne children. When we consider this evidence against the number of infants interred with the presumed mother, we find that four of the first five generations had a high incidence of infant mortality, a situation militating against a marked population increase, while the last seven reveal a decline in infant mortality and more offspring could have attained adulthood. Of course, this poses the issue of the location of the graves of those supposed to have attained maturity during MP4-6.

All stages of cluster F included women who had experienced pregnancy. This, measured against the number of dead infants, suggests the possibility of a greater degree of biological success, if that be represented by population growth, of one family line compared with another. On the basis of the available figures, it is apparent that cluster C struggled to maintain itself during the first five generations, but then numbers increased. For cluster F, there was less stress to maintain numbers.

If clusters C and F reveal lineages which maintained themselves over about 16 generations, the same cannot be said for clusters A or D. The former commenced with an adult male (Fig. 67), who, in the interpretation offered, fathered a daughter who lived to adulthood and two infants. This woman, B110, reveals evidence for pregnancy before her death at the age of *c* 36. She was buried with two infants, Bs. 119 and 128, and there the lineage came to an end. There was a further series of graves in cluster A at a later date during MP3. Their relationship with the earlier three generations is unknown. Here, we find that the founding female, B61, again had experienced pregnancy. It is suggested that she bore a son who grew to manhood and an infant. This adult male, B57, is seen as having fathered three infants. At this point, the line failed. Two further generations were interred some time later, during MP4. Here, we find a woman, B31, who had been pregnant. If the assumption that Bs. 32, 28 and 30 were her offspring and were later interred alongside her, then this lineage too may have failed.

Cluster D was initiated with the interment of a woman, B142, who bore children before she died when aged about 31 years. In the proposed genealogy, she raised a son who survived to adulthood and two infants who died at or soon after birth. This son fathered a daughter, B122. The proposed genealogy shows that she may have raised two sons who reached adulthood, and one infant.

The demise of this lineage, and those represented in cluster A, could have been the result of a failure to produce daughters in the next generation. This would have been increasingly relevant if matrilineal descent came into favour with the passage of time. It is worth recalling Fox's comment on such a situation:

"If a lineage in a matrilineal society fails in one generation to throw up any daughters, then it is finished". (Fox 1967:122)

It might well be in such lineages, where it is possible to combine the three dimensions

of spatial clustering, the passing of many generations, and fecundity, that social change among prehistoric communities can be most intimately appreciated.

COMPLEX HUNTER-GATHERERS AND KHOK PHANOM DI

Our excavations at Khok Phanom Di have provided, rather unexpectedly, data which contribute to a general understanding of the behaviour of complex hunter gatherers. It is notable, for example, that in her recent exhaustive summary of the origins, organization and nature of such communities, Arnold (1996a) has relied almost exclusively upon examples drawn either from the recent past, or prehistoric groups illuminated, at least in part, through contact with literate societies. Indeed, Khok Phanom Di was one of the few fully prehistoric examples she drew upon. Arnold has outlined four headings under which we might profitably explore the development of complex hunter gatherer societies: conditions, consequences, correlates and causes. These will be summarised before we consider their implications for the sequence of events at Khok Phanom Di.

The environmental and social conditions which favour the development of social complexity among hunter-gatherers begin with a rich subsistence base. The tropical estuary, which attracted initial settlement of Khok Phanom Di, is one of three richest habitats known in terms of biological vigour, the other two being the tropical rain forest and the coral lagoon (Russell-Hunter 1970, Odum 1971). This wealth is based on the mangrove leaf fall, which sustains the base of a complex food chain. South-East Asia is dominated by the monsoon, which brings succeeding wet and dry seasons. During the latter, biological activity declines sharply. Many species of fish and shellfish aestivate, trees shed their leaves and annual grasses wither and die. But proximity to the coast offsets the impact of the monsoon and food resources, while subject to seasonal fluctuations, are still sufficiently reliable to sustain sedentary groups. If a chosen habitat commands a desirable resource but lacks access to needed materials, then encouragement is given to the establishment of exchange networking and the distribution of resources. Endicott (1988), for example, has noted that even in the case of the Batek of Malaysia, a society given to sharing will develop wealth differential with the onset of exchange with external groups. Again the location of Khok Phanom Di and the probable distribution of other communities in its orbit favours the development of complexity, for its inhabitants controlled access to potting clay and marine shell, but lacked high quality stone. By 2000 BC, we also have evidence for the establishment of inland agricultural communities which reveal an acquisitive interest in marine shell jewellery.

Trends to social complexity have consequences which involve changes in behaviour some of which may be detected on the basis of archaeological evidence. Arnold's suggestions include changes in household size, individual relationships in terms of power and influence, new and intensified methods of production, including specialisation, and new leadership structures. These important behavioural changes may be documented through new burial strategies and behaviours, technological skills, the range of symbols used to denote status and evidence for the accumulation of personal or group wealth. Finally, and most importantly, what possible causes can be identified? Arnold has suggested a series of epiphenomena, but has identified as central, changes in the way labour was organised. Where one or a few individuals command or control the output of non-kin producers, then complexity is in place. Yet there are many other possible causes, and no broad measure of agreement as to their relative merits or significance. Conditions favouring vested au-

thority, such as the need to control the distribution of valuables, the need to galvanise followers for security, the driving ambition of one or more individuals, the growth of a community to a size invoking scalar stress, all these singly or in combination, might be in question. Hayden (1994) has paid much attention to the provision of competitive feasts by aspiring elites in a process which encourages inequality through failure to reciprocate. Again, this procedure returns us to the need to occupy areas with the potential to provide significant food surpluses through the investment of labour.

Much of our appreciation of complex hunter gatherers has been raised on the basis of coastal societies which in the twilight of their development, were visible to ethnography. We have to cope at Khok Phanom Di with an extinct society illuminated only on the basis of archaeological data. Nevertheless, we feel that examining the data from this site from the vantage point of accumulating information gained from such ethnographic studies might assist us in understanding the sequence of events we have documented. Moreover, the information we have obtained for Khok Phanom Di provides such an intimate and tightly controlled set of linkages between various data sources, that it could be argued that this site could itself contribute to a broader understanding of how societies change.

We suggest that the settlement was initiated by a group of hunter-gatherers about 2000 BC. They chose a mangrove-lined estuary giving access to extensive intertidal mud flats, backed by salt flats. This is not a habitat which would favour the cultivation of rice, and there is no evidence for domestic animals. Yet their settlement took place, as far as can be judged, at a time when rice cultivation was already being undertaken in inland stream valleys, at such sites as Ban Kao and Non Pa Wai. This early occupation was probably sedentary, though we cannot demonstrate this beyond reasonable doubt. There are six burials belonging to phase 1, of people already indicating resistance to malaria by an inherited blood disorder. Their ancestors, we feel, were long since adapted to a marine habitat.

A formal cemetery was established with MP2, linked perhaps with the expression of ownership rights over the estuary. Exotic materials reached the site, such as cowries and good quality stone and pottery. The rice may also have been obtained through exchange relationships with inland groups; there is no artefactual evidence for cultivation or harvesting. Some individuals were interred with unusual mortuary wealth. Burial 132, for example, was a male who attained an age of about 34 years. He was interred with 39000 disc beads, five funnel beads, 11 barrel beads, a bored canine tooth and two burnishing stones. Burial 72, also a male who died in his thirties, was associated with 330 shell disc beads, a barrel bead, three pottery vessels, three burnishing stones, a nautilus shell, shaped animal tusk, pendant made from a shark's dorsal spine, a stone chisel and the skeleton of a fish. The woman alongside him had two burnishing stones. There is also a concentration of mortuary wealth with burials 90 and 91, and with some infants particularly when interred close to richer adults. This period was a heyday for men: they were robustly muscled, relatively tall, and seem to have spent time on the water and away from the settlement. We suggest that there are hints of inequality, expressed in the relative wealth of certain graves, but that this status was individualising and confined to one or at the most, two generations, for no cluster demonstrates continuing pre-eminence in terms of wealth. The provision of a richer than usual set of grave goods might have been due to personal qualities in the provision of goods used in exchange, such as pottery vessels or shell jewellery, and the ownership and disposal of items obtained in return.

The community was exposed during MP3, to a change in the environment which might have

been abrupt. Freshwater shellfish rose in frequency as those from the mangrove declined, and other indicators of surface freshwater also increased, including plants, fish and crabs. At the same juncture, we encounter two new artefact forms in the shell harvesting knife and the granite hoe. The rice comes without doubt from a cultivated variety, and was probably stored on the site, for people ingested mouse hairs and beetles known to infest rice stores today. Such changes might well have been associated with the arrival in the site of women from a different area. The associated changes in mortuary ritual reveal the maintenance of the same clusters, but now with a greater concern for individual graves, a sharp decline in mortuary wealth, a reduction in the ornament given to pottery vessels, and the recognition of gender differences through the provision of clay anvils for women and children, and turtle carapace ornaments for men. Men at the same time were less physically robust and tooth wear suggests that they shared the same diet as women. We suggest that this period saw a slow down in exchange relations and new labour requirements for cultivation and fish trapping rather than line fishing. Early wealth differences expressed in mortuary ritual virtually ceased, under 400 disc beads were found for the entire MP4 group of graves, if one discounts the enigmatic burial 33.

There was an even more dramatic change with MP5. In terms of the environment, we can pinpoint an increase in mangrove shellfish and decline in freshwater plants and bivalves with the transition from MP4 to 5. The last shell sickle was found just before the interment of MP5 burials. At this same juncture, a new range of exotic materials appeared, including ivory, tridacna shell, and slaty shale. These changes were accompanied by the abandonment of a pattern of corporate burial clusters which had lasted for ten or more generations by large individual graves containing outstanding mortuary wealth. It is worth stressing that the 120,000 shell disc beads found with burial 15 outnumber the accumulated number of such beads from every excavated prehistory cemetery in Thailand. In addition, we also encounter a new and impressive range of shell ornaments made from exotic shell, including discs and bangles. The pottery forms were larger than hitherto, and ornamented with a range of new and complex designs. Again, we find the role of the potter stressed in the provision of marked clay anvils, burnishing stones and prepared clay cylinders. In attempting to understand underlying causes for this change, we quote Arnold:

“there were periods in every part of the world when that richness was occasionally diminished by climatic events or cultural practices. What Hayden argues is that these were never times of ascending social complexity; what others contend is that, in some cases, such periods were precisely the times that certain members of society were able to stimulate the reorganization of labor and the development of ranking.” (Arnold 1996a:99)

The sequence of events reconstructed for Khok Phanom Di supports the link between stress and development of social complexity. We perceive stress originating in an increase in saline conditions following the establishment of rice agriculture as part of the subsistence base. Such stress would be accentuated if rice had filled the role of a prestige or ceremonial food. In addition to the role played by skilled women in producing the pottery vessels some of which may well have been used in exchange, we also have the possibility that shell bead manufacture magnified far beyond previous levels. We have no information on where and by whom these beads were made, but the ownership of over 120,000 by one person suggests their use in advertising status. There is also the presence of a new range of exotic goods, one of which, tridacna shell, was turned into large

discs. We feel that the changes to the resource base through environmental change stimulated exchange which ramified to include a new range of goods. Personal ability and perhaps ambition to take advantage of these conditions is manifested archaeologically in the new levels of energy expended in mortuary ritual.

This trend continued with MP6, but we have a new dimension to the mortuary data. Three rich burials were associated with a raised structure. Although two were only partially recovered due to prehistoric disturbance, they were still accompanied by over 30,000 shell disc beads, a new variety of H beads, and in the case of a child, a large shell disc behind the head. But the row of burials found in front of the building were associated with only 14 disc beads and none of the H form. As far as we can judge, these two groups of burials were approximately contemporary. The possibility is posed that by this period, when conditions remained unfavourable for rice cultivation, but exotic goods continued to be obtained, there was a social hierarchy reflected in a sharp distinction in how the dead were treated. Unfortunately, we cannot proceed further because after the brief episode of MP7, use of this part of the site as a cemetery ceased. Nevertheless, it is suggested that the attainment of status indicated by unprecedented levels of mortuary wealth followed the onset of environmental stress, and that the reaction took place rapidly, even within the space of a lifetime.

V. KHOK PHANOM DI IN WIDER PERSPECTIVE

INTRODUCTION

THE excavation of Khok Phanom Di was undertaken with many objectives, one of which was to test alternative hypotheses for the transition to economies based on rice agriculture. As the scope of our findings unfolded, so we began to appreciate a responsibility to consider many aspects of South-East Asian prehistory above and beyond the adoption of rice cultivation. Foremost was the need to identify the nature and interrelationships between the changing environment, the subsistence base, social organisation, exchange patterns, health and the technology of the people of Khok Phanom Di. As this analytical work progressed, so the march of research in prehistory and related disciplines has caused us to pause constantly and reconsider the place of Khok Phanom Di in the wider contexts of Central Thai and South-East Asian prehistory.

In doing so, we have been particularly impressed by the similar issues approached by colleagues working in Central Europe, southern Scandinavia and California. The main thrust of work in California has been the definition and understanding of the culture of rich, sedentary hunter-gatherer communities, and we feel that the results obtained at Khok Phanom Di in fully prehistoric contexts contributes to this area of research. Second, one of the major changes in our thinking since 1985 has been the link between prehistory and linguistics. In Europe, the expansion into temperate Europe of the *linearbandkeramik* (LBK) culture, has been associated with the introduction of early Indo-European languages (Renfrew 1987). The LBK economy was based on agriculture and stock raising. When settlement approached southern Scandinavia and the low Countries, intrusive agriculturalists encountered indigenous coastal hunter-gatherers. The relationships between the two groups have been considered by many workers over the past decades, on the basis of numerous excavated sites. Three alternatives have been proposed: that agriculture was introduced to southern Scandinavia by the settlement of intrusive farming communities, that there was an indigenous development of agriculture, and that agriculture began among hunter-gatherers through contact with intrusive farmers (Keeley 1992, Price *et al.* 1996).

Parallels with East and South-East Asia are clear. Blust's (1996) proposed expansion of rice cultivators who spoke early Austroasiatic languages into South-East Asia matches that for the spread of farmers into temperate Europe. In Scandinavia, there were sedentary coastal hunter-gatherer communities in place. What was the relationship between the putative intrusive agriculturalists and the indigenous hunter-gatherers? This is the issue we face in any attempt to place Khok Phanom Di in its wider perspective.

THE AUSTRIC HYPOTHESIS

In 1985, the possibility of an expansionary movement of cultivators originating in the Yangzi Valley did not enter our calculations: we were firmly on the side of a transition to rice cultivation within South-East Asia. The confirmation of the Austric hypothesis and Blust's proposal that Austroasiatic (AA) languages were introduced by such a movement has expanded our perspective. The relationship between the distribution of languages and the progress of expansionary human

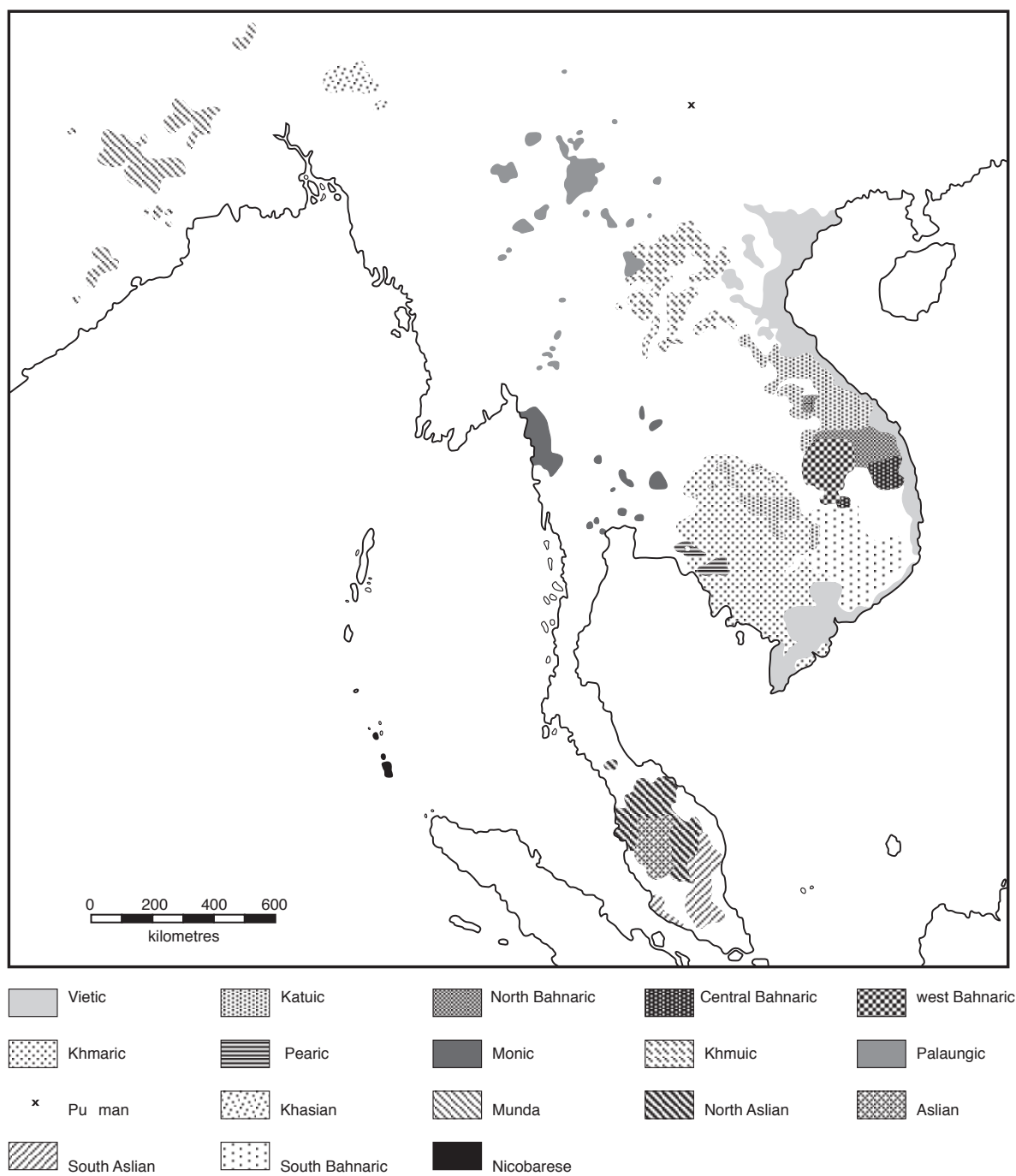


FIG. 75. The distribution of Austroasiatic languages

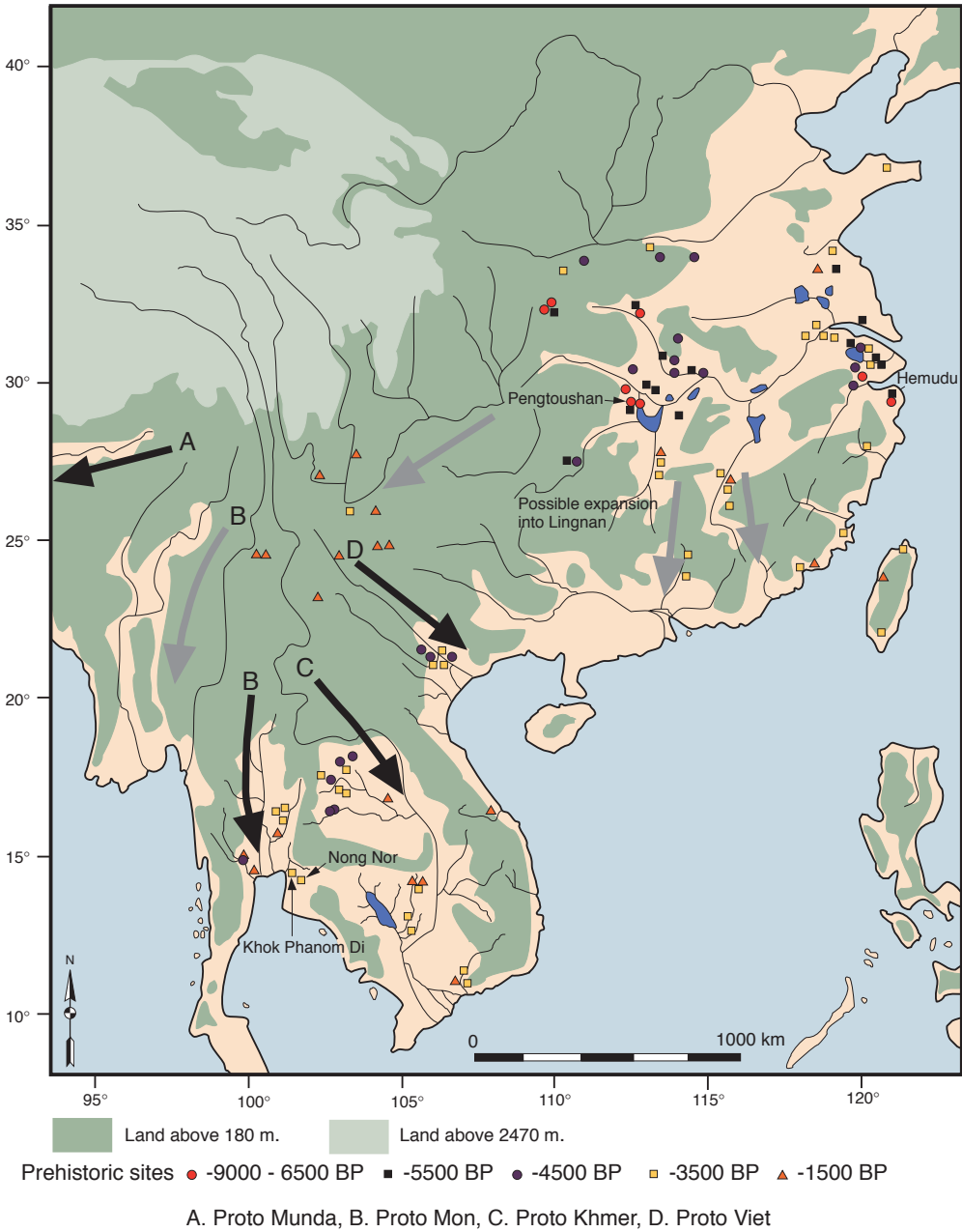


FIG. 76. The possible expansion of rice agriculturalists into South-East Asia

settlement has long contributed to an understanding of the prehistory of Melanesia and Polynesia (Blust 1985, Bellwood 1985, 1989, 1993). Studies in historic linguistics have identified relationships between the Austronesian languages which, according to Blust (1985), indicate the greatest time depth among the indigenous languages of Taiwan, thereby linking remote Austronesian languages with those close to the Asian mainland. It is much easier to relate languages spoken on scattered islands to each other, than to trace relationships on a continental scale, particularly where the situation is as complex as it is in East Asia. Nevertheless, Renfrew (1987) has proposed that the distribution of Indo-European languages in the Old World is best explained as the result of the expansion of agriculturalists which originated in the region stretching from Anatolia into the Levant. While controversial, this proposal has focussed our own interest on the possible relationships between early rice agriculture, population growth, expansion of human settlement and the present distribution of languages in East and South-East Asia.

These languages are usually ascribed to Austroasiatic, Austro-Tai, Austronesian or Sino-Tibetan (AA, AT, AN and ST). AA languages are the most important to our review, because they have the greatest time depth in South-East Asia, have a wide distribution, and share cognates for rice and aspects of its cultivation (Fig. 75; Zide and Zide 1976).

The possibility that AA languages reflect the expansion of rice cultivators has received support from Reid's (1993) confirmation of the Austric hypothesis. Over time, languages with a common ancestry may diverge such that they share few, if any, cognates. But some elements of their form and structure may still hint at a common origin. Schmidt (1906) has suggested that AA and AN languages originated in the Austric phylum, but this has lain in a suspense account until Reid's finding that Nancowry, an AA language, exhibits AN morphemes. This link contributes to understanding the transition to rice cultivation and the expansion of village communities, for if the greatest time depth for AN languages is found on Taiwan, then it is logical to look to the Yangzi Valley as the most likely area for the original split between proto AA and AN languages. And it is in the Yangzi Valley that we have the earliest evidence for rice cultivation. Rice remains have been found at Pengtoushan and related settlements in the swampy lacustrine environment of the middle reaches of the Yangzi River. Pengtoushan is a prehistoric settlement covering about a hectare, where pottery was tempered with rice dated between 7500-6500 BC (He Jiejun 1986, Yan Wenming 1991, HAI 1990). The site has revealed features which represent a fundamental change in society, and which were to be encountered over much of lowland East and South-East Asia over the ensuing millennia: the village community with an inhumation cemetery, the use of both local and exotic goods as grave offerings, and a subsistence base incorporating rice.

Blust (1996) has proposed that rice cultivators who spoke AA languages expanded their area of settlement into South-East Asia from the Yangzi catchment, a movement facilitated by rivers. Thus, proto-Vietnamese was introduced into Bac Bo by movement down the Red River. Proto-Mon and Khmer speakers would have expanded south via the Mekong, Chao Phraya and Salween rivers and the bearers of proto-Munda languages of eastern India, by passage down the valley of the Brahmaputra (Fig. 76). Our conception of this expansionary process is one of gradual population growth involving the foundation of new settlements over many centuries if not millennia. We do not envisage a motivated migration on a grand scale.

Bellwood (1992, 1993) is a leading advocate of this model. In terms of linguistics, he has stressed the likelihood of agricultural origins in areas of major linguistic diversity. By a process of demic fissioning, he then proposed an expansion of the area settled by cultivators which, naturally,

involved their language and physical attributes. For mainland South-East Asia, the former involved AA languages the latter, southern Mongoloid people. He has, for example, noted that the southern Mongoloids present physical features, such as skin pigmentation, which indicate an origin north of the tropics (Bellwood 1993). In a bold hypothesis to account for physical and linguistic diversity in Malaysia, he has suggested that the Semang Negrito hunter-gatherers could descend from the original Hoabinhian hunter-foragers, while the Senoi could represent the descendants of intrusive agriculturalists who spoke an early AA language and intermarried with the indigenous inhabitants. Much later, AN languages were introduced by the ancestors of the Malays.

The hypothesis that there was a progressive expansion of southern Mongoloids who spoke early AA languages ultimately from the Yangzi Valley into South-East Asia, including Lingnan, has not won universal acceptance. Meacham (1985, 1991) has countered with a local developmental model in which, he asserts, “For North China, South China and Indo-China, a great migration during the Neolithic now seems out of the question”. We agree entirely with this statement. Greater South-East Asia includes the land up to the valley of the Yangzi, and our suggestions have no bearing on events further to the north. Our conception has no role for a great migration, but rather of a gradual process whereby communities fissioned, and a small group moved to establish a new settlement nearby. Over millennia, this involved a widening area devoted to agriculture. Nor does our preferred hypothesis rule out the local adoption, or even the local and independent development, of rice cultivation. Meacham has suggested that the occupants of southern China from the local “middle Neolithic” to the Bronze Age spoke AA languages, ruling out the need to introduce them from anywhere else, while AN languages developed in a broad area from Sumatra to Sulawesi with a northward expansion to include Taiwan. He has also directed our attention to the loss of the continental shelves with the Holocene rise in sea level, linked with the possibility that a transition to rice cultivation took place in that former flat, lowland terrain. Alternative hypotheses will be reviewed in the light of the excavation of Khok Phanom Di.

THE PREHISTORY OF CENTRAL THAILAND

The principal issue, in reviewing the archaeological sequence in this region, lies in identifying when inland agricultural communities were established, and how they related to the people of Khok Phanom Di. There are many alternatives. At one extreme, the settlement of Khok Phanom Di might have involved intrusive agriculturalists whose forbears had progressively infiltrated the inland river valleys. On the other, rice cultivation could represent an innovation at sites such as Khok Phanom Di, with a subsequent expansionary movement inland leading to the establishment of settlements there. A third alternative lies between these polar extremes. There might have been a pattern of progressive expansionary settlement by agriculturalists which reached the Chao Phraya catchment from the north, involving interaction with sedentary coastal groups represented by Khok Phanom Di. In reviewing this possibility the results of $^{87}\text{Sr}/^{86}\text{Sr}$ analysis, set out in the appendix below, provides some insight into the arrival in the site of individuals born and raised in a different environment to that of Khok Phanom Di.

Ordering these alternatives in terms of plausibility requires a control over chronology, and the availability of fully-documented inland sites for comparative purposes. There are few such sites. Support for the first alternative outlined above would require first, the existence of inland settlements which antedate Khok Phanom Di, and contain matching mortuary behaviour, material culture, and

evidence for rice cultivation. The second alternative would entail the presence of inland sites later than Khok Phanom Di cultural phase 2 (*c.* 1750-1650 BC), when rice cultivation was probably practiced there, again with a matching material culture. The third would be supported if it could be shown that agricultural settlements were established by 2000 BC in the inland areas, and that there was a strong likelihood of exchange between such people and the inhabitants of Khok Phanom Di. Further confirmation would be obtained if it could be shown that affluent foragers lived in the coastal area before the settlement of Khok Phanom Di who disposed of a similar material culture.

The last issue will be considered first. Are there coastal sites which predate Khok Phanom Di, provide no evidence for cultivation, but which have a similar material culture? Nong Nor is located 14 km south of Khok Phanom Di, and has been excavated over three seasons (Higham and Thosarat 1998). It has two occupation phases. The first involved a small settlement, located on the shore of a marine embayment and dated to about 2450 BC. The second involved the use of the early occupation mound as a Bronze Age cemetery. Phase 1 saw the accumulation of a shell midden representing an occupation which probably lasted for months rather than years (O'Reilly 1997). The cultural deposits included many artefacts, evidence for the local manufacture of pottery vessels, and subsistence based on hunting, gathering and fishing in a coastal habitat. The evidence for fishing has opened a vista on these people, for they brought in tiger and whaler sharks and eagle rays, all large and powerful, the tiger shark growing to six metres (Mason 1997). It is difficult to avoid the conclusion that they were heirs to a long and successful maritime tradition. There is no evidence for the presence of rice during phase 1. Nong Nor is thus a key site because it is earlier than Khok Phanom Di. A closely similar material culture would be compatible with a local, coastal origin for the people of Khok Phanom Di.

O'Reilly (1997), and Higham and Thosarat (1998) have compared the material culture from Nong Nor and early Khok Phanom Di. There are many similarities in the form and decoration of artefacts. Some of the pottery vessels are virtually indistinguishable, and decoration incorporated the same burnishing and incised patterns. The stone adzes follow the same forms. Nong Nor has furnished a grooved bone stylus point which falls easily within the equivalent assemblage at Khok Phanom Di. The fishhooks from both sites are barbed one-piece artefacts. Sandstone abraders and burnishing pebbles are common to each site, as are clay potters' anvils, although at Nong Nor, most lack a handle. The earliest phase at Khok Phanom Di and the Nong Nor assemblage are also notable for what they lack: there are no dog bones, shell knives or stone hoes. These similarities support a local origin for the first inhabitants of Khok Phanom Di without ruling out cultural contact and exchange with inland agricultural communities. Indeed, the latter could be the source for the exotic dog, which made its appearance during mid phase 1, and the rice remains. Both environmentally and in terms of material culture, rice cultivation in the vicinity of the settlement during phase 2 is unlikely. Fishing, seen in the abundance of large one-piece fishhooks and net weights, as well as the presence of large fish bones, may integrate with the evidence of strong upper body musculature in men.

The prehistoric settlement of Central Thailand behind the coastal zone involves two principal alignments. On the one hand, there are rock shelters occupied by small groups of foragers, and on the other, there are open sites comprising inhumation cemeteries. The latter were, it is presumed, also foci for settlement based on rice cultivation and the raising of domestic stock. As will be seen, coastal sites in Vietnam incorporated seated crouched burials, pottery vessels and polished stone

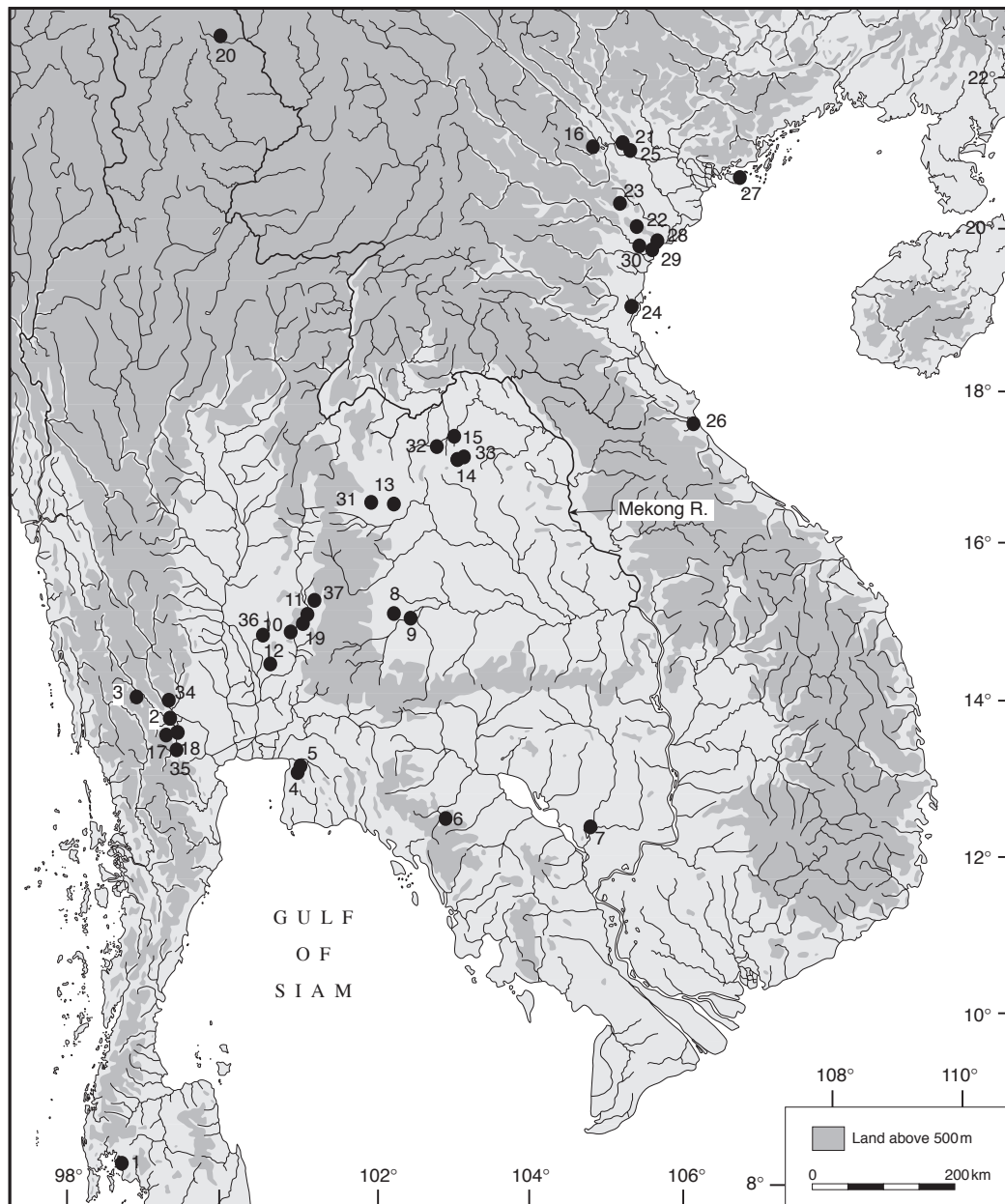


FIG. 77. The distribution of relevant sites. 1. Lang Rongrien, 2. Ban Kao, 3. Sai Yok, 4. Nong Nor, 5. Khok Phanom Di, 6. Laang Spean, 7. Samrong Sen, 8. Ban Lum Khao, Ban Non Wat, 9. Ban Prasat, 10. Khok Charoen, 11. Sab Champa, 12. Non Pa Wai and the area of the Khao Wong Prachan valley, 13. Non Nok Tha, 14. Ban Na Di, 15. Ban Chiang, 16. Phung Nguyen, 17. Khao Heap, 18. Khao Talu, 19. Lam Maleng valley, 20. Shifodong (approximate location), 21. Lung Hoa, 22. Con Moong, 23. Xom Trai, 24. Quynh Van, 25. Dong Dau, 26. Bau Tro, 27. Cai Beo, 28. Da But, 29. Hoa Loc, 30. Den Doi, 31. Non Pa Kluay, 32. Ban Phak Top, 33. Non Kao Noi, 34. Hang Songchram, 35. Rai Arnon, 36. Phu Noi, 37. Ban Nong Sakae Si

implements which date between 5000-2000 BC. Often termed Neolithic, no such site has yielded evidence for domestic rice. There was also occupation of inland rock shelters which, in their upper layers, sometimes included potsherds. In Central Thailand, we see parallels to the former at Nong Nor. There are also inland rock shelter sites which parallel in many respects, those in Vietnam. At Sai Yok, van Heekeren and Knuth (1967) have investigated such a settlement. Pookajorn (1984) has excavated a series of similar rock shelters on the left bank of the Khwae Noi River just behind the open settlement of Ban Kao. At Khao Talu and Khao Heap, he found cord-marked potsherds in upper layers, for which there are four radiocarbon dates. At two sigma, the corrected ranges are 2943-2558 and 4112-2112 BC (Khao Talu) and 3381-1862 and 3874-1924 BC (Khao Heap). The large standard errors make it hard to evaluate these determinations, but there is a thread of evidence in favour of a local ceramic industry in at least the third millennium BC. Pookajorn has noted that these sherds come from cultural contexts which include flaked stone implements of the Hoabinhian tradition of hunter gatherers. He has suggested that they represent exchange in ceramics with agricultural communities seen, for example, at Ban Kao.

Cord-marked pottery has also been recovered from cultural layer II at the Cambodian rock shelter of Laang Spean, where Mourer has cited a date of 4290 BC (Mourer 1977). Cultural layer III above had furnished two radiocarbon dates (2643-2197 and 2709-2268 BC), which come from a layer rich in pottery decorated with incised bands enclosing impressions not unlike that from Nong Nor. Again, the evidence supports a regional ceramic industry during at least the third millennium BC which might well extend back to a period equating with the earliest evidence for pottery in coastal Vietnamese sites.

There has been little research on the establishment of sites belonging to the second alignment, the village settlement and cemetery. The principal Neolithic site is Ban Kao, excavated by Sørensen (Sørensen and Hatting 1967). The early occupation of Tha Kae has yielded probably Neolithic burials (Siripanish 1985). Basal Non Pa Wai has also produced Neolithic contexts and all sites could well have been occupied in the late third and early second millennia BC. Khok Charoen remains enigmatic (Ho 1984), but the pottery from the burials there has distinct Neolithic characteristics. Other sites are later than Khok Phanom Di, and have no relevance for the adoption of agriculture. They do, however, provide some evidence for mortuary practices and exchange patterns, and will therefore be described.

Mudar (1995) has extended our knowledge of the early settlement phase in Central Thailand though an intensive site survey in the Lam Maleng Valley (Fig. 77). Basing her seriation on the ceramic sequences of Tha Kae and Non Pa Wai, she has recognized early and middle prehistoric phases (2500-1500 BC and 1500-1000 BC). Settlements concentrate on the upper terrace soils unsuited to the cultivation of rice where water control is needed for a successful harvest. On the other hand, some form of rice husbandry reliant on rainfall might have been undertaken. Several sites also evidence the local manufacture of shell and high-quality stone bangles. In Kanchanaburi, Shoocondej (1996) has undertaken surveys designed to illuminate the importance of sedentism and seasonality in prehistory.

BAN KAO

Excavations at Ban Kao revealed 44 burials in an area of almost 400m². The dead were inhumed in a supine, extended position, associated with grave offerings which included pottery vessels, adzes and shell jewellery. Radiocarbon dates suggest occupation between the late third to the middle

of the second millennium BC. Sørensen noted some parallels in the form of pottery vessels with examples from China, and suggested that the settlement involved an expansionary movement from that quarter (Sørensen and Hatting 1967). This prescient proposal met with little support.

The lack of clear stratigraphy and of superimposed burials made it difficult to order the graves chronologically. Sørensen set the graves out in order of depth below datum, on the assumption that earlier graves were the lower. He then divided the pottery vessels into different forms and sought a correspondence between the forms, form groups, and the depth of the graves. He concluded that the graves belong either to an early or a late Neolithic phase. There are, however, intermediate graves, indicating that the two groups were not separated by a long interval.

The early availability of Sørensen's report on the burials has attracted several attempts to re-work his data and modify his conclusions. Parker (1968), for example, has paid particular attention to burial 12, one of two graves with an iron artefact. It included three pottery vessels which are distinct from those ascribed by Sørensen to the Neolithic phases. Several other vessels were found beyond the feet of burial 12, which may well have belonged to burial 3, a Neolithic grave. Parker seems to have misunderstood this qualification, for he regards them as part of the grave furniture for burial 12 itself. Having noted parallel forms in the Neolithic graves for these vessels, Parker suggested that the entire cemetery belongs to the Iron Age, and that graves were cut into a Neolithic settlement. Subsequent research on sites which are similar to Ban Kao, and a greater



FIG. 78. The distribution of the graves at Ban Kao (after Sørensen and Hatting 1967)

understanding of the nature of Iron Age pottery in this area, rule out Parker's alternative.

Solheim (1969), on the basis of the chronological changes in the orientation of graves at Non Nok Tha, then considered this variable as a key to understanding the sequence. His results bore little relationship to changes in pottery forms and MacDonald (1978) has rejected it during a statistical analysis of the distribution and contents of the graves. Macdonald then applied statistical tests to the contents, distribution, orientation and wealth of the graves. He set aside Sørensen's use of the depth of the human remains as an index of relative chronology because he claimed that the depth of a grave could indicate energy expenditure rather than the part of a sequence during which it was cut. He then applied Robinson's index of agreement to the pottery forms in each grave, on the assumption that changes in pottery related to the passage of time. Having placed the graves in a sequence on this basis, he noted that a majority of supposed late graves are located in the eastern part of the excavated area, on an east-west orientation. He then subdivided the burials into eastern and western groups, but his dividing line follows a curious course with no obvious rationale other than to sustain the integrity of his eastern group.

The basic problem with MacDonald's interpretation is his assumption that two graves with different sets of pots are distinct chronologically. At Khok Phanom Di, where relative chronology is intimately known, there are contemporary burials with different assemblages of vessels. Some might have been locally made, others obtained by exchange and used as symbols of status. A pot might also have been provided as part of the mortuary offerings by a person related to the deceased, but from another settlement. While pottery preferences change with time, this is not sufficient in itself to permit the seriation of a group of graves. It has also led, in this case, to a sequence in which graves in close proximity and on the same orientation are set apart on the chronological list. MacDonald also suggested that the east-west alignment of most members of his eastern group is explained if two social groups within the community had their own burial area. This is an interesting possibility, but relies on a sinuous dividing line between them.

We will now look at the Ban Kao sample in the light of the evidence from Khok Phanom Di that the location of burials might reveal social information (Fig. 78). During the early phase, the dead were placed on their back, and there was no preference for an easterly orientation. Only one infant was reported. Perhaps they were interred separately, but it is hard to envisage a community without higher infant mortality, particularly given the skeletal evidence for thalassaemia. The graves were not clustered in the manner of Khok Phanom Di, but there was an orderly pattern. Burials 34 and 36 lie alongside each other on the same orientation. The former is an adult, buried with one pot, the latter is a ten-year-old child with two pots. Burials 31 and 33 are also found adjacent and on the same orientation. One was probably a male aged about 30 at death. He was accompanied by a pottery vessel. The other was a 35-year-old adult with two pottery vessels. At the eastern edge of the excavated area, there are five early phase burials. The three intact graves are orientated in a south-westerly direction. From west to east, burial 18 was an adult, lying on the broken remains of three pottery vessels with the sherds from a further five being found over the lower limbs. Burial 29, which lay alongside, was also an adult. A stone adzehead was found under the skull, and six broken pots were present in the region of the head and shoulders and below the knees. Burial 28 was associated with at least three pots, while with burial 27, we have another adult on a south-westerly orientation with an adze under the skull. Twelve broken pots were associated with the human remains, three over the chest, the balance over the lower limbs. The last of the five comprises a row of eight pots in a straight configuration, but with no human remains.

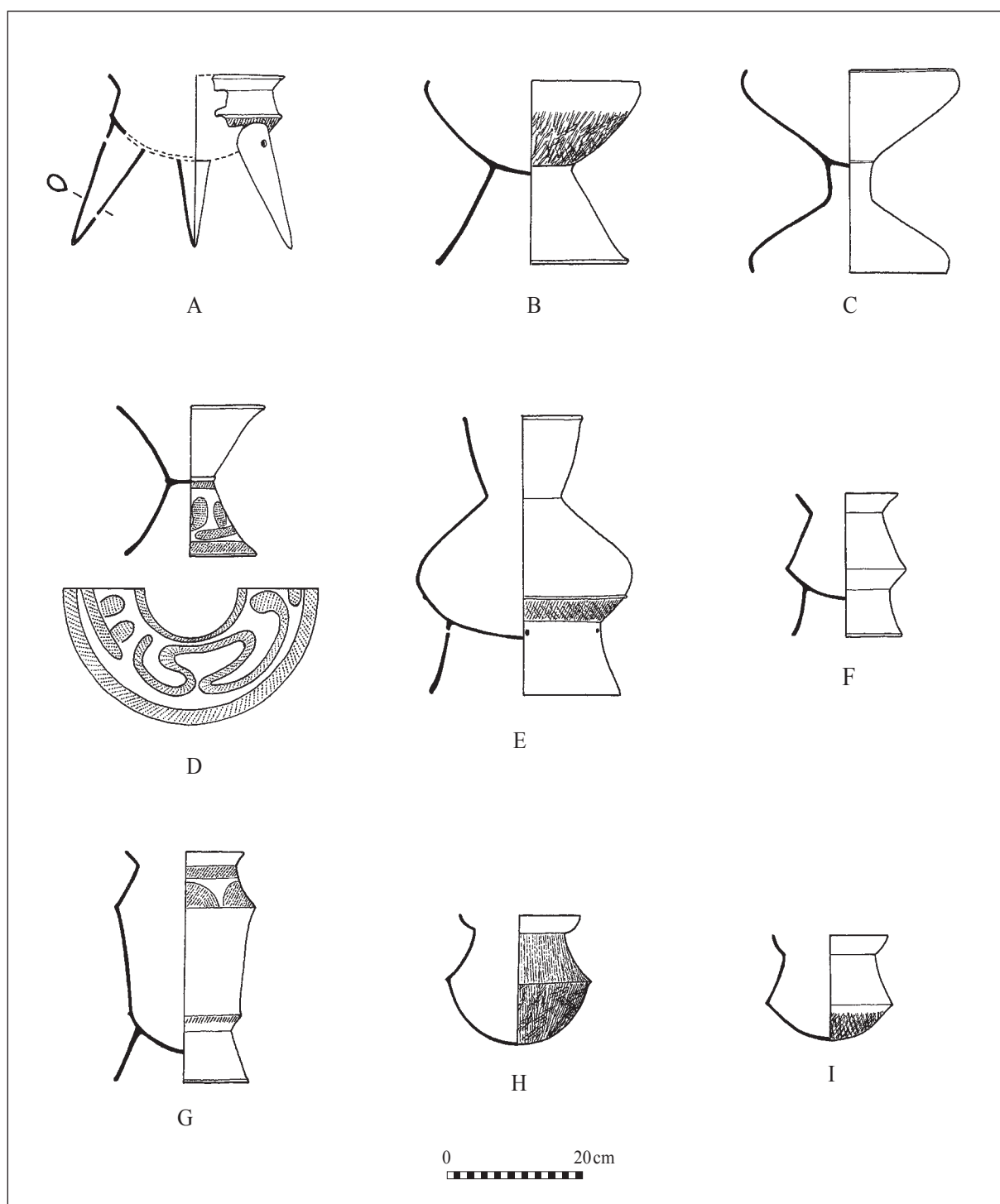


FIG. 79. The main forms of pottery vessels from the first phase at Ban Kao (after Sørensen and Hatting 1967)

Graves for burials 19 and 20 also lie alongside each other. The former, which contained a young adult, included three complete pots, one beside the face and two beyond the feet. The latter involved an adult, interred with four complete pots and a stone adzehead under the skull. The graves are orientated in opposite directions, one to the north-east, the other to the south-west. The last pair of early graves, burials 4 and 5, contain a woman aged about 35 years and an 18-year-old. They were both interred with the head to the north-west. Six pots and two stone adzeheads were placed beside the woman's head and beyond the feet. The same disposition of five pots was found with the other burial, and a stone adze was present under the skull.

The early phase at the Ban Kao cemetery will now be considered to see if the location might be patterned. There are five pairs of graves. Most of the remainder are located towards the edge of the excavated area, and could, therefore, have been paired. Although there is no regular orientation, the paired burials lie parallel with each other. In four cases, the head was pointing in the same direction but burials 19 and 20 are found in opposite directions. Unfortunately, the preservation of the bone has ruled out sexing more than a handful of the skeletons, so the possibility that the pairs were male and female cannot be determined. The paired interments lie at virtually the same depth below datum. In the case of burials 31 and 33, both were relatively poor: one had two pots, the other one. The same situation obtains for burials 34 and 36. Burials 19 and 20 contained three pots, and four pots and an adze. Burials 4 and 5 were much richer, the former having six pots and two adzes, and the latter five pots and one adze. The pots were also placed in the same locations relative to the body. Again, the pair interred in graves 18 and 29 were accompanied by many pots: eight in one case and six, together with an adze, in the other.

Such grouping continued into the late phase. Burials 9-11 lie parallel with each other on a north-east to south-west orientation, the two females have the head to the south-west, the male in the opposite direction. In each case, grave goods were markedly richer and more varied than hitherto. Burial 9, a 35-year-old woman, was accompanied by 11 pottery vessels, eight of which were disposed in a line beyond the feet, such that the grave would have been at least 5 m long. One further vessel was found between the knees, and two beyond the head. Burial 10 lay almost 2m to the east. The male was over 50 years at death, and his grave goods included four pottery vessels beyond the head. In this same area, there was also a large stone ring with a hole in the centre, traces of polish hinting that it is unfinished. There were also two stone adzes between the ankles, and a remarkable deer antler, the tines of which were cut at right angles to the shaft and shaped into tubular ends. The remains of two young pigs were also found beyond the head. Burial 11, a woman who died when about 30 years old, was particularly rich. There were nine complete pottery vessels, six beyond the feet, two at the left knee and one by the right shin. Six adzes were distributed round the body, which to judge from the location of a pig's foot bones, had been partially covered by a pigskin shroud. There was also a necklace made up of two strands of 642 shell disc beads and two tubular stone beads.

The next group also includes three burials. Burial 6 is a female aged about 45 years at death, interred in a grave orientated with the head to the north-west. Ten pots were associated, two beyond the head and eight beyond the feet. There were also six stone adzes, pig's bones disposed round the body and four pebbles. Two were placed beside the left ankle and two in the vicinity of the abdomen. Though not described as such in the text, it is possible that these were burnishing stones. Three modified shells from a freshwater bivalve were also present.

Burial 7 was poorer. The male, interred with the head pointing east, was found with two crushed

pots in the ankle area. He was about 30 at death. Burial 37 was another male, found with the head orientated in the opposite direction to burial 6. He, too, had been buried with a freshwater bivalve under the head. Three pots covered his lower body, and a cut bone and carved stone in the form of a phallus were also found.

Burials 1 and 2 lie parallel. The former, a male, was laid out with the head to the north-east, the latter, a female, in the opposite direction. The man, who died when about 40 years old, was interred with seven pots, two adzes, two barbed bone harpoons and two small shell disc beads. The woman was five to ten years older, and was accompanied by five pots located beside the head and beyond the feet, and four stone adzes. Burials 38 and 39 were also found in close proximity to each other, but only just impinged into the excavated area.

BAN KAO: MATERIAL CULTURE

Does the material culture of Ban Kao during the earlier mortuary phase provide any similarities with that of Khok Phanom Di? The majority of burial offerings are pottery vessels. Sørensen has divided these into twelve principal forms (Fig. 79). The two major divisions involve vessels with or without supports. The former include tripods, fruit stands, pedestal and stemmed bowls, funnel-necked jars and ring-footed carinated bowls with a biconical body. Among the latter, we find beakers, ovaloid carinated bowls and wide-mouthed, shallow carinated bowls. Surfaces were burnished or cord marked. These forms have no parallels at Khok Phanom Di. Only two vessels at Ban Kao from burials 35 and 44, bear decoration resembling the incised and impressed ornamentation found at Khok Phanom Di (Fig. 79). The designs, a series of six arcs and a snake, are not matched at Khok Phanom Di however. No early phase grave contains shell disc beads, and only three late phase graves provide any. The total number found, 811, represents 0.6 per cent of the quantity found from Khok Phanom Di burial 15. Some adzes provide general similarities between the two sites, but no specific parallels are seen either in form or the raw materials. Both sites share the use of harpoons, but these are biserial at Ban Kao, and uniserial at Khok Phanom Di. It is possible that more parallels will be seen when the material culture from non-mortuary contexts at Ban Kao are available, but at present, the two sites are quite different in terms of their artefacts.

There is much evidence for continuity between early and late phases at Ban Kao. When superimposed, burials from the latter do not disturb the former. Presumably the location of graves was known. The mortuary ritual, despite some modifications, remained similar. Graves in close proximity were found on a similar orientation, with males and females being placed in opposite directions. People were still interred with pottery vessels and stone adzes, although offerings were more varied and abundant. New items include shell disc and stone beads, worked shell, bone harpoons, a carved sandstone phallus, a modified antler and pigs' foot bones. A perforated stone disc was found in the same grave as the worked antler.

There are similarities and differences between the mortuary ritual at Ban Kao and Khok Phanom Di. The former is a much smaller sample, but it is argued that grave layout was structured: orientation may not have been so regular, but people were still interred in clustered groups, and there was a regular contrast between the orientation of males and females. Pottery forms display changing preferences within the same ceramic tradition which, to judge from the number of bur-

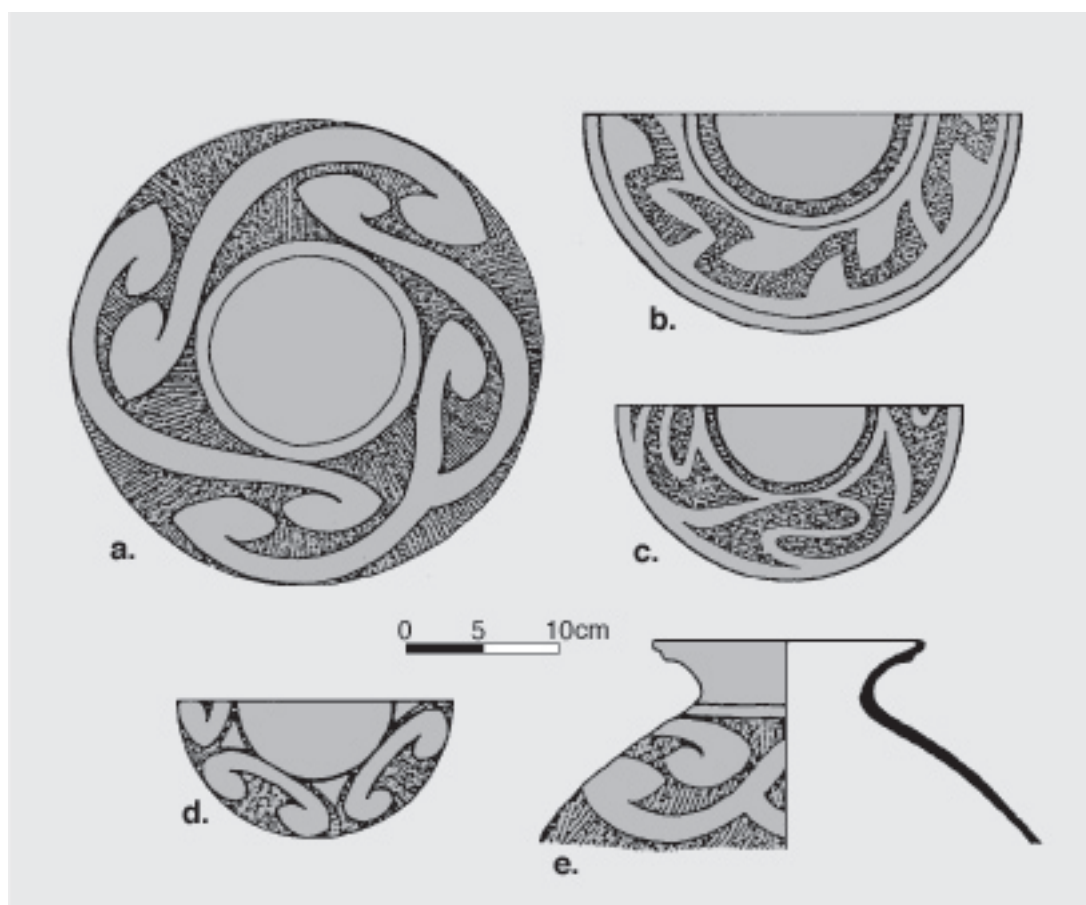


FIG. 80. Pottery vessels and decorative motifs from Tha Kae (after Siripanish 1985)

nishing stones recovered, involved local manufacture. Finds from non-burial contexts also evidence the local manufacture of stone bracelets. Grave goods became richer with time, and there is some evidence to suggest that paired burials had similar wealth. Pottery and stone adzes predominated, while shell jewellery was rare. This contrasts with Khok Phanom Di, where adzes were hardly ever encountered in burials, but shell ornaments abounded. Ban Kao was also a much smaller site, covering only 16 per cent of the area of Khok Phanom Di. The pottery forms in each site differ, those from Ban Kao having their parallels in the Khao Wong Prachan Valley, peninsular Thailand and Malaysia. It was a small inland settlement, located on a river flood plain where aquatic resources, and presumably marshland suited to rice cultivation, were available. Its inhabitants never displayed the same high level of wealth in mortuary ritual which characterized MP5 and 6 at Khok Phanom Di, yet they participated in an exchange network, and some individuals, particularly in the later phase, were interred with an impressive collection of grave goods.

The forms of the mortuary pottery vessels differ from those of Khok Phanom Di. Nor are there any convincing parallels in other items of material culture. Yet many sites are known which portray a widespread occupation from western Thailand to Jenderam Hilir in Selangor to the south. Two

burials with Ban Kao style pottery vessels and shell ornaments have been found at Han Songchram and a further similar burial comes from Rai Arnon (Shoocondej 1996; Fig. 77). Lang Rongrien, a large cave in peninsular Thailand, has produced burials containing pedestalled pottery vessels which recall the Ban Kao repertoire, and have no parallels at Khok Phanom Di (Anderson 1990). The cave of Gua Cha has produced two cultural contexts, an earlier Hoabinhian and a later Neolithic cemetery (Adi 1991). The latter includes extended inhumation burials associated with pottery vessels incorporating incised and impressed designs, and stone bracelets with a T cross section. A single radiocarbon date from the base of this deposit suggests occupation by the middle of the second millennium BC (3120 ± 230 BP, 1880-821 BC). Four radiocarbon dates have been obtained for Jenderam Hilir. Two come from an early phase containing tripod pottery (2144-1863 and 2211-1805 BC), and indicate contemporaneity with the early occupation of Ban Kao. A later Neolithic phase has been dated to 1457-1208 and 1408-1048 BC. Leong (1990, 1991) has suggested that the earlier phase and related sites represent the introduction of agriculture to the western coastal plains of peninsular Malaysia, and few would disagree that Ban Kao represents the same situation in the western margins of the Chao Phraya Plains.

THE KHAO WONG PRACHAN VALLEY AND ASSOCIATED SITES

Much research has been undertaken in the prehistory of the Khao Wong Prachan Valley and its environs (Fig. 77), an area rich in copper ore. Reports of the excavation at Tha Kae evidence settlement during the Neolithic. Excavations were undertaken in 1980, under the direction of Surapol Natapintu, in 1983 by Rachanie Thosarat and more recently by Roberto Ciarla (1992). The cultural sequence has been divided into three distinct phases of which the earliest is Neolithic. Twenty one inhumation burials were found. They have in common a north-south orientation, and the placement of pottery vessels beyond the head and feet and in one case, under the knee. Other offerings include shell beads, bangles and earrings, a bone point and polished stone adze. It is the pottery vessels which attract most attention, for we encounter not only a profusion of forms, but also of motifs. The latter were incised on the surface of the vessel, and highlighted by being surrounded by cord marking, or receiving impressions within the confines of the incised lines (Siripanish 1985). There are C and S shaped patterns, stylised snakes an interesting and harmonious opposition of like motifs which are reminiscent of the Khok Phanom Di repertoire (Fig.80). Hanwong (1985) has described the artefacts from Tha Kae, and noted the presence of marlstone and turtle carapace bangles, and the central cores removed from tridacna shell to create bangles. The site was thus a centre for the manufacture of shell ornaments. Tha Kae is just the sort of community with which the inhabitants of Khok Phanom Di would have traded, and obtained their dogs and the notion of cultivating rice. Unfortunately, we do not have any radiocarbon dates for this site, but these earliest layers probably belong within the period 2500-1500 BC.

Rispoli (1992) has identified vessels similar to those of Tha Kae at Non Pa Wai early period and Khok Charoen. Again, some Tha Kae vessels bear parallel incised lines accentuated by impressed decoration. The latter includes shell impressions, and these strike a chord with some of the mortuary vessels from Khok Phanom Di. At Non Pa Wai, examples are found in the early phase of occupation, dated to the second half of the third millennium BC. The early period cemetery

at Non Pa Wai is likely to prove of considerable significance to this investigation, although at present we have no information on the details of the material culture. It is, however, evident that this was a Neolithic cemetery, established in all probability by rice cultivators. The two available radiocarbon dates indicate establishment before cultural phase 1 at Khok Phanom Di, but slightly later than the occupation of Nong Nor during phase 1.

Excavations at Huai Yai by Natapintu (1988) have yielded a material culture similar to that of early contexts at Ban Tha Kae. The burials were accompanied by pottery decorated with curvilinear designs, marine shell ornaments and H-shaped beads which match those found at Khok Phanom Di during MP 6. There was abundant non-mortuary evidence for the manufacture of stone bracelets and adzes, as well as well as copper casting. Radiocarbon dates, however, are lacking. Natapintu (1988) has also exposed an area of 3 by 5 m at Phu Noi, 30 km to the north of the valley, and found an extraordinary concentration of 32 burials. Grave goods include marine shell ornaments as well as items made from turtle carapace, ivory and exotic stone. Again, no radiocarbon dates are available, and the principal relevance of this site is the further demonstration of exchange between inland and coastal communities during the second millennium BC. Further evidence for exchange has been identified in 2004 at the site of Ban Nong Sakae Si, near Si Thep in Petchabun province.

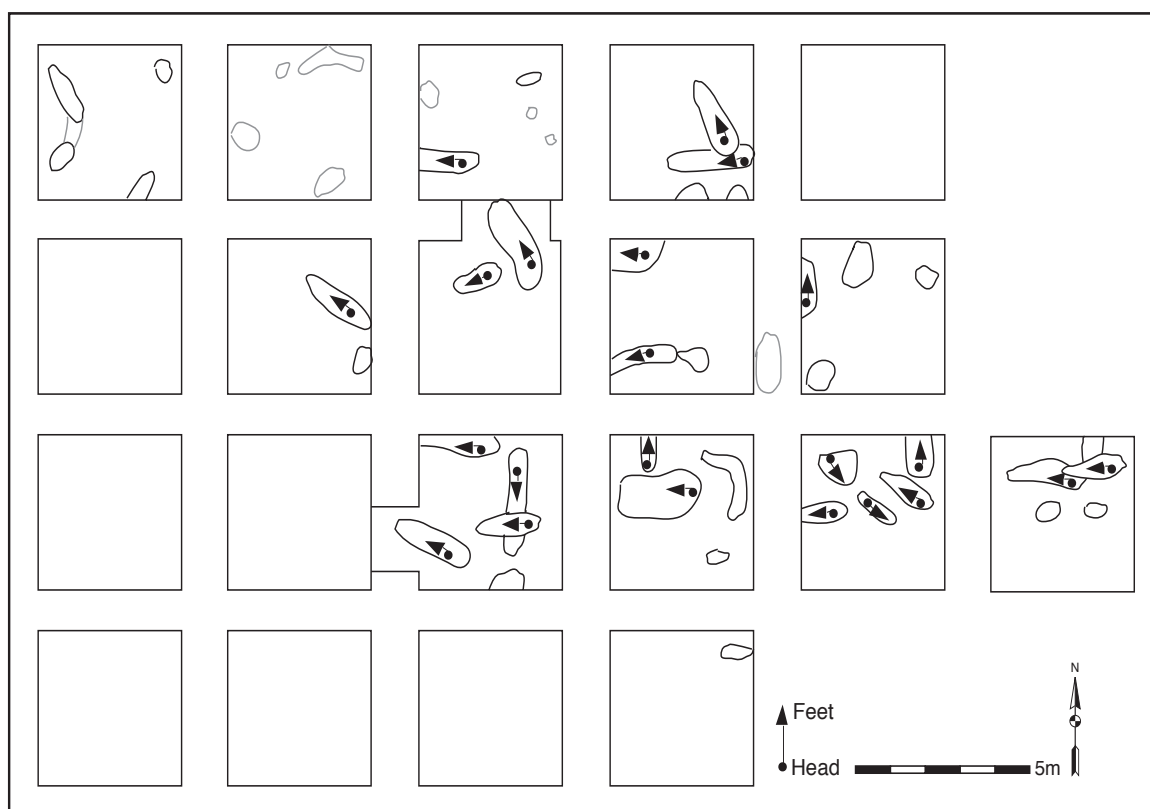


FIG. 81. The distribution of burials from Khok Charoen (after Ho 1984)

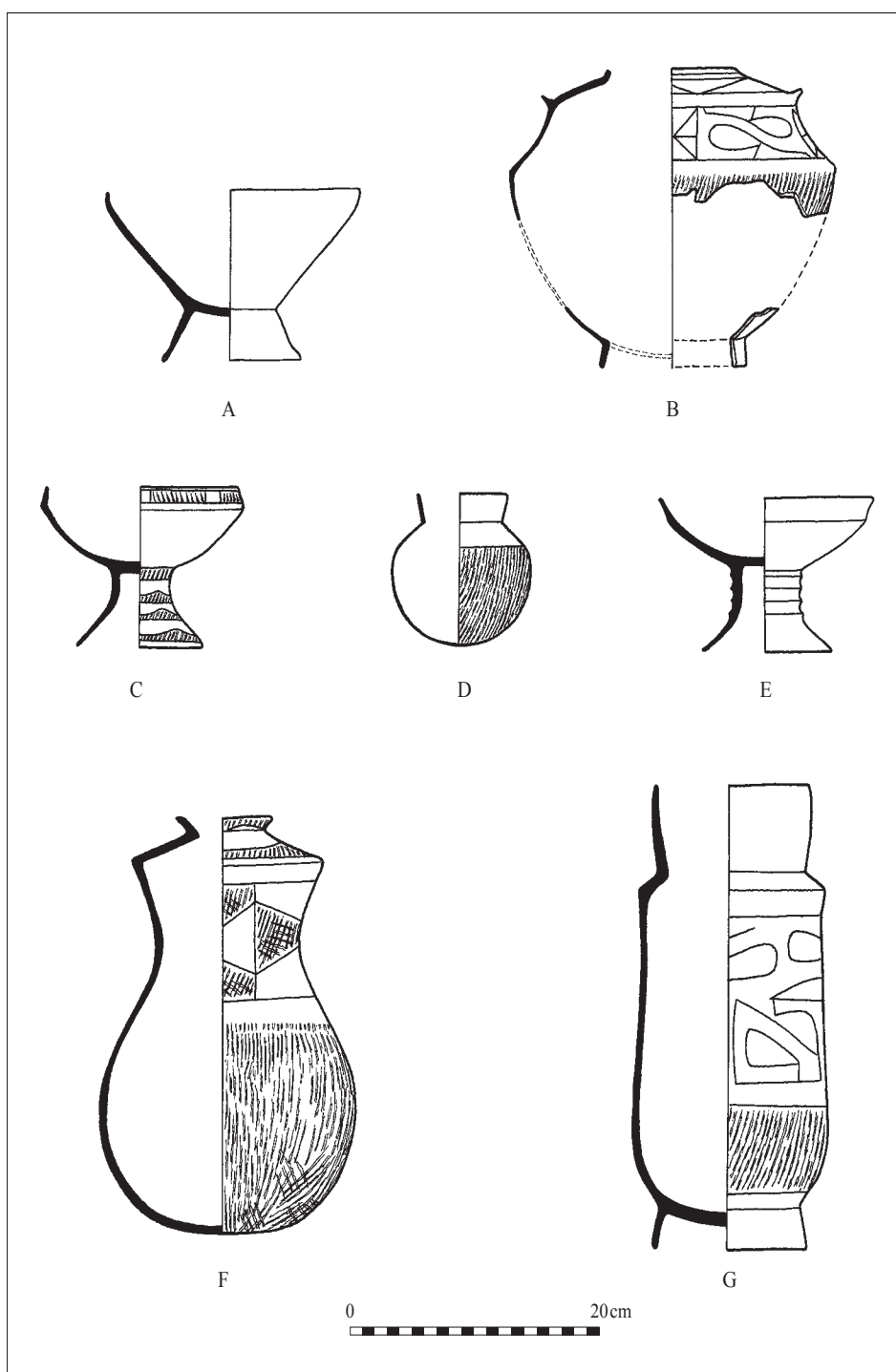


FIG. 82. Ceramic vessels from Khok Charoen (after Ho 1984)



FIG. 83. A pottery vessel from Ban Nong Sakae Si, in the vicinity of Sab Champa, showing identical design characteristics to a second vessel from Khok Charoen (see figure 82)

There, a number of I-shaped beads typical of MP5 have been identified.

Khok Charoen

Khok Charoen, located 100 km north-east of Tha Kae, was excavated in four seasons between 1966-70, and the material from the first two have been considered by (Ho 1984). An area of 320m² was excavated to an average depth of 1.1 m, and 44 inhumation graves were revealed (Fig. 81). Ho (1984) has suggested that the inhabitants had "some knowledge of rice cultivation". The date of occupation is not known with assurance, but there are two TL dates which suggest that it falls within the period 1400-800 BC and Ho (1984) ascribes them to the early Metal Age. No bronze grave goods were recovered, but this does not rule out a bronze age context. At Ban Lum Khao on the Khorat Plateau, for exam-

ple, we have uncovered 110 Bronze Age graves again with no metal grave goods.

Ho (1984) has divided the mortuary vessels into 14 forms (Fig. 82). The assemblage differs markedly from that of Khok Phanom Di in form and finish. At Khok Charoen, the range of forms included vessels with ring feet or pedestals, and others which were round based. Decoration includes overall burnishing, as well as zones of red slip and cord marking. Some rare forms, such as 9, 10 and 14, include patterns demarcated by incised lines infilled with stamped or impressed surfaces. Loofs-Wissowa (1997) has published further examples recovered during the third and fourth seasons.

There are some vague similarities in the incised or impressed designs with those seen at Khok Phanom Di, including KPD 3:17, semicircles with shell edge impressions, 3:11, repeating shell impressed triangles, 3:31, lenticular shapes filled with stamp impressions and 3:32, wavy line and straight line enclosing impressions (Fig. 82). Particular attention, however, is drawn to a large, decorated vessel (Fig. 82B). The incised and impressed decoration on the shoulder incorporates opposing human figures closely matched at Khok Phanom Di and Ban Non Wat, the latter in clearly Neolithic contexts dated to about 1700-1400 BC. An identical vessel has recently been identified

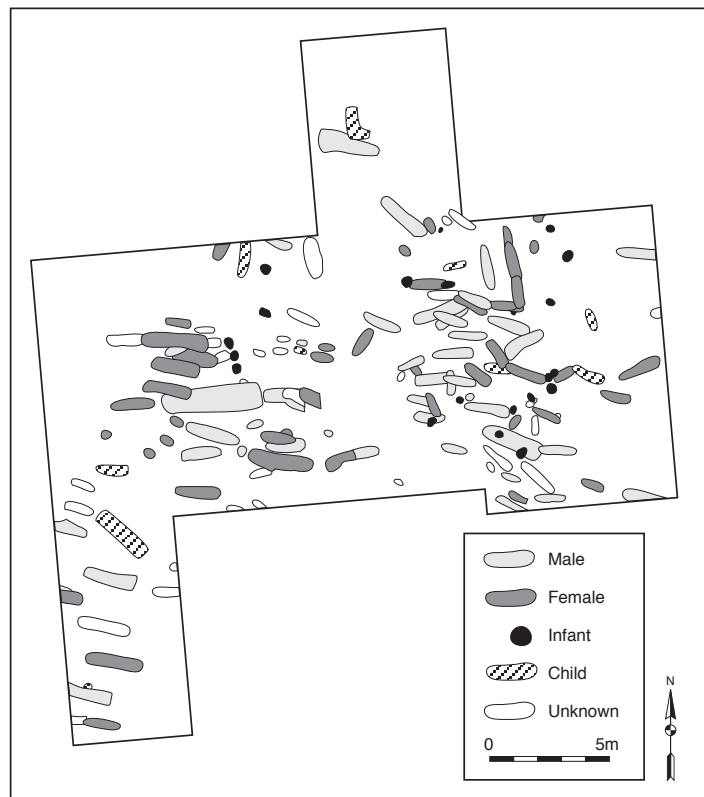


FIG. 84. The layout of Bronze Age graves at Nong Nor

in the vicinity of Sab Champa, near Khok Charoen (Fig. 83). The shell jewellery includes shell disc beads, but never in the quantities attained at Khok Phanom Di, the maximum number in any grave being 843. The shell head ornament from burial 15 at Khok Phanom Di is paralleled at Khok Charoen in form and size, each having a diameter of about 4 cm. Khok Charoen has yielded a moderate quantity of trochus bangles and rings, and there are also two conus rings. There are also marble and green stone ornaments which find no parallels at Khok Phanom Di.

Watson (1992) has noted that some of the pottery fabric from Khok Charoen probably comes from a source 40 km to the north, indicating exchange in ceramics. He, too, has stressed the broad affiliations of the rouletted meander form of decoration, particularly noting parallels in Yunnan and the Red River valley.

Nong Nor

The earlier of the two occupation phases at Nong Nor involved coastal foragers, and has been dated to about 2450 BC. During the second, a Bronze Age cemetery (1100-700 BC) was cut into the old shell midden (Higham and Thosarat 1998). Only 14 kilometres south of Khok Phanom Di, the Nong Nor cemetery also includes graves with the head orientated to the east, associated

with pottery vessels and shell disc beads. It is stressed that the forms and decoration of the mortuary pots offer no parallels with those of Khok Phanom Di. Rather, the numerous red-slipped, cord-marked open bowls recall the wares from Khok Charoen and Ban Tha Kae to the north (Debreceeny 1997).

The layout of the cemetery also reveals a series of grave rows, which lie to the west of a large cluster of burials (Fig. 84). We think that the latter are slightly later, since constituent graves include one or two novel pot forms and nearly all the jewellery of exotic talc, serpentine, carnelian and jade. Various statistical analyses of the 50 complete graves fail to reveal enhanced mortuary wealth on the basis of age or gender. The range of variation from richest to poorest was not great, and certainly not of the same order of magnitude as at Khok Phanom Di, but one enclave of burials, a man and four women, do stand out for the number of pottery vessels and ornaments of marble, shell and bronze (Higham and Thosarat 1998).

THE KHORAT PLATEAU

There have been several site surveys on the Khorat Plateau in order to identify the distribution of prehistoric settlements. Wilen (1989) concentrated to the west of Phu Wiang in the Huai Sai Khao basin. Higham and Kijngam (1984) undertook surveys in the middle Chi valley and the environs of Lake Kumphawapi, and Bannanurag and Bamrungwongse (1992) have surveyed widely in the Sakon Nakhon Basin. Welch and McNeill (1991) have identified many prehistoric sites in their surveys in the Phimai area, but few have provided evidence for settlement before the first millennium BC. Many sites have yielded pottery decorated with incised designs cited by Ho (1984) and Higham (1996) as possibly belonging to a broad, early Neolithic South-East Asian tradition. Some examples have also been found at excavated sites, such as Non Nok Tha, Non Kao Noi, Ban Chiang and Ban Phak Top (Schauffler 1976, White 1982, Bayard 1984, Higham and Kijngam 1984). Radiocarbon dates from Non Nok Tha and Ban Phak Top suggest that this tradition dates certainly from the second millennium BC, and possibly

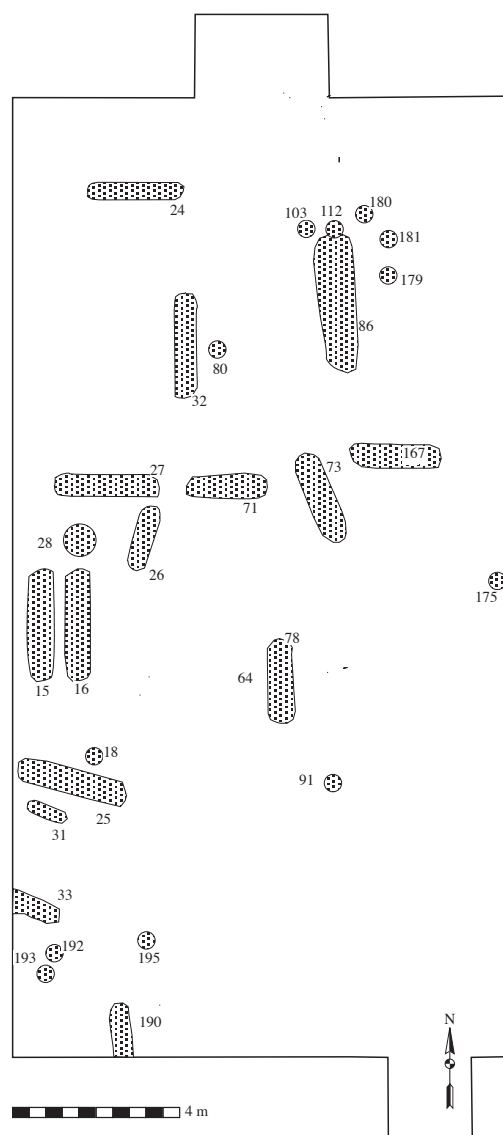


FIG. 85. The distribution of Neolithic burials at Ban Non Wat

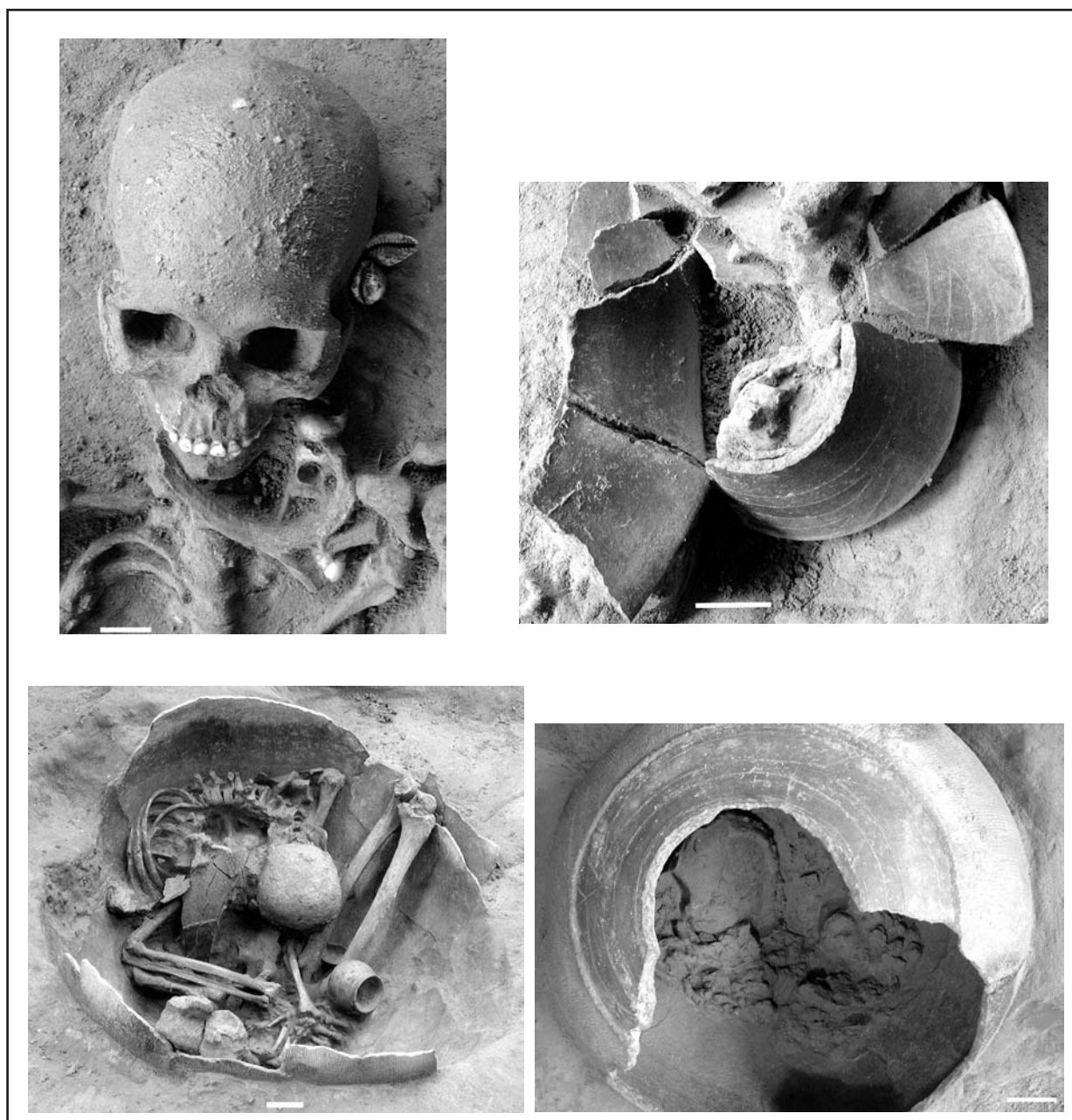


FIG. 86. Neolithic burials from Ban Non Wat. Clockwise from top left: burial 86, showing two cowrie shell ear ornaments; burial 86, showing incised mortuary vessels; burial 103, an infant jar burial bearing incised designs; burial 28, a man interred within a large lidded mortuary jar. Scales 5 cm



FIG. 87. Mortuary vessels from Neolithic burials at Ban Non Wat. Scale 20 cm

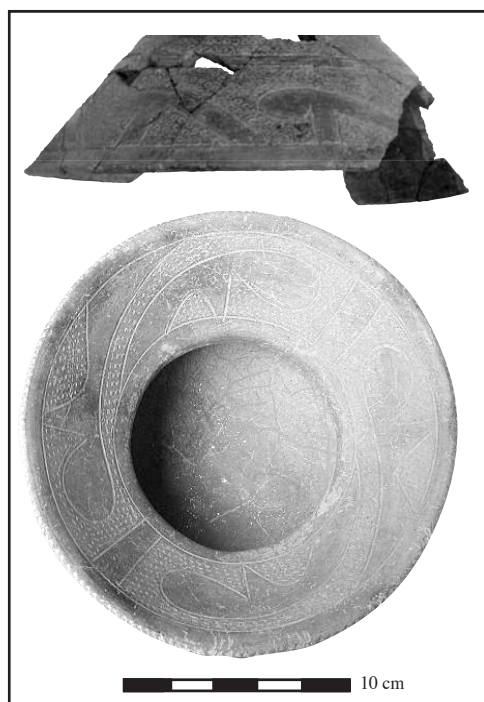


FIG. 88. The human figure motif from Ban Non Wat (above) and Khok Phanom Di

back into the third. The date of the initial occupation at Ban Chiang has been clarified with two AMS 14C dates which place Early Period II within the period 2200-1500 BC. It is most unlikely that the preceding Early Period I occupation is older than 2200 BC by more than a century or two (White 1997).

Ban Non Wat

Excavations by the authors at Ban Non Wat, a large moated site in the upper Mun Valley in 2002-4, have revealed a long sequence, covering the Neolithic to the Early Historic periods (Fig. 85). The initial occupation by a Neolithic community has been radiocarbon dated by several determinations, between 2100-1400 BC, thus making it a contemporary of Khok Phanom Di. It is too soon after the excavations to be able to make definitive statements on the subsistence economy, save that domestic pigs, cattle and dogs were raised, and that there was much fishing and shellfish collecting. Rice grains have been found with the Neolithic burials. The dead were interred either

within lidded mortuary jars or as extended supine inhumations. One adult male was found in a seated, crouched position within a large lidded mortuary jar (Fig. 86). A smaller but otherwise identical vessel was found to contain the remains of an infant. The inhumation burials were associated with broken ceramic vessels some of which reached a considerable size. These, as with the mortuary jars, were embellished with incised curvilinear designs infilled with impressed designs or red pigment, and enhanced by burnishing. The resulting vessels reveal a remarkable similarity to those from Khok Phanom Di from MP5. Incised decoration on the base of these vessels also matches a pot from Ban Kao (see figures 79D and 87). There is also a close resemblance between the opposed human-like design on a vessel from burial 179 at Ban Non Wat, and that on a mortuary pot interred with burial 11 at Khok Phanom Di (Fig. 88). One individual lay under the remains of at least three pigs' skeletons, and wore two pierced cowrie shells at the left ear (Fig. 85). There was thus long-distance contact through exchange with coastal communities. The favoured technique for applying decoration to pottery vessels was very similar to that seen at Khok Phanom Di at least from MP5. The relevance of this site, the first major exposure of Neolithic settlement in the Mun Valley, lies in this similarity of mortuary tradition with Khok Phanom Di, and

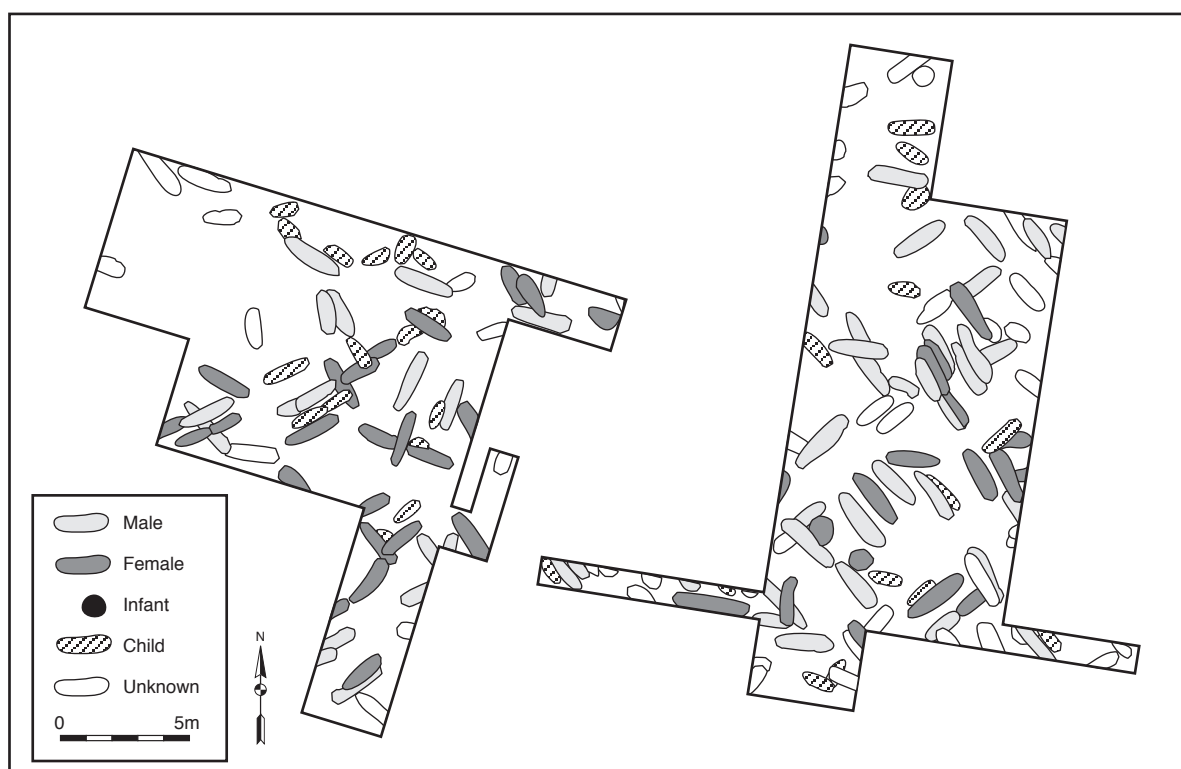


FIG. 89. The distribution of graves from the 1966 (left) and 1968 excavation of Non Nok Tha. Note that the two areas were not adjacent as shown above

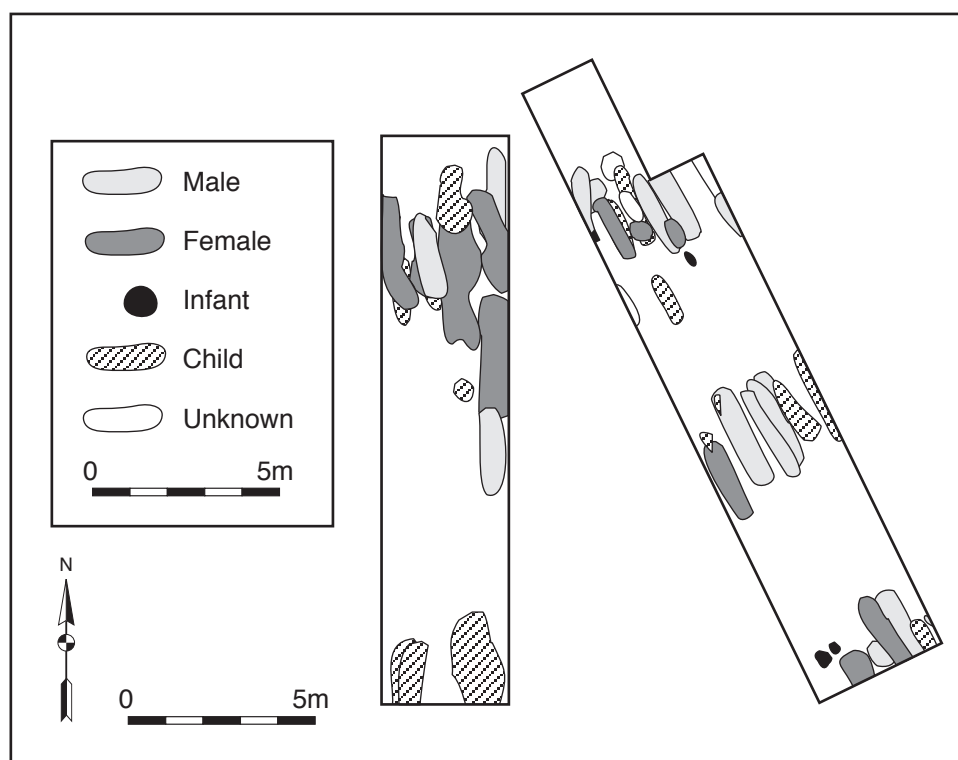


FIG. 90. The distribution of Bronze Age graves at Ban Na Di (left) and Ban Chiang

evidence for long distance trade contact between such new Neolithic settlements in the interior, and those able to trade in shells taken from clean, coralline seas.

Non Nok Tha

Employing Non Nok Tha for comparative purposes is difficult because no excavation report is available, and the site's chronology has been controversial (Fig. 89). However, a recently obtained series of AMS dates on rice chaff from provenanced pottery shows that the Bronze Age cemetery probably falls between 1500-1000 BC with the possibility that the initial use of the site goes back to about 2000 BC. Two seasons of excavation in 1966 and 1968 have revealed a series of inhumation burials contained within just over a metre of cultural deposits. People were interred with pottery vessels, stone adzes, shell disc beads, the bones from domestic dogs, cattle and pigs, freshwater bivalve shells and occasionally, bronze bracelets, axes and sandstone bivalve moulds.

Ho (1984) has suggested that four of her pot forms from Khok Charoen are paralleled at Non Nok Tha. In Bayard's (1977) review of the latter sample, we encounter six classes, which include large round-based vessels, footed globular pots, cups, footed bowls, round-based bowls and jars. The last named includes unusual bases in the form of an elephant or a frog. This provides a very close match with a vessel from Phu Noi in Central Thailand, where such a cup is borne by a bovid

(Charoenwongsa 1987). The presence of zoned areas of red slipping and polishing combined with other areas bearing cord-marked impressions suggests closer similarities between these two sites than of either with the ceramic tradition seen at Khok Phanom Di. One variety, rare and early at Non Nok Tha, is form IB, which has a zone of incised and impressed designs just below the neck.

In his review of this material, Bayard (1984) stressed the presence of two pot forms which present a mutually complementary distribution in the burials. From this, and the different degrees of wealth between the graves associated with each form, he proposed that the cemetery was used by members of two distinctive, probably land-holding, affiliated groups. This situation, following his view of the site's chronology, would have lasted for at least one and possibly two millennia.

Higham (1989) has noted that the two pot forms do not present a complementary distribution. Some graves have examples of both. Second, he followed up the alleged long-term use of the cemetery by plotting the graves assigned by Bayard to successive phases of burials. Having first plotted the distribution of graves for each phase separately, he then combined them in a single distribution.

It was found that graves which, according to Bayard's proposed chronology would have been separated in time by centuries, were placed in an orderly manner alongside each other. When viewed in conjunction, the graves fall into at least two rows. From this, Higham proposed that the cemetery was in use for only a limited span, perhaps in the order of a few centuries, and contains the remains of people related to each other. Bayard's view implies an extraordinary stability of population and styles of material culture. The beginnings of the use of the bronze at the site, while having an impact, in his view, on the degree of social ranking at the site, would have taken place very slowly. Higham's views on the chronology, if validated, would envisage social change occurring much more rapidly, with the layout of the graves related to social preferences rather than being fortuitous and random.

Non Kao Noi, Ban Chiang and Ban Na Di

These three sites lie between the headwaters of the Songkhram River and the eastern shore of Lake Kumphawapi. Non Kao Noi is a small (0.5 ha), shallow settlement, located at the confluence of two small streams. Small-scale excavations in 1981 revealed five burials associated with pottery vessels. These are distinguished by applied cordons running round the middle of the pots, areas of cord marking, and in one case, parallel incised lines infilled with impressions. This last vessel recalls those found in early contexts at Ban Chiang.

Ban Chiang, like Non Nok Tha, remains unpublished and the chronology is controversial. There have been many excavations, those arousing most publicity taking place in 1974 and 1975 (Gorman and Charoenwongsa 1976, White 1982). The area excavated was limited by modern structures, and only hints of the layout of the cemetery are available (Fig. 90). The earlier graves uncovered during the 1974 season include the incised and impressed designs in which parallel lines were infilled with impressions. To judge from the few available illustrations, the impressions were made with the edge of a bivalve shell. Motifs include spirals and meanders. Neither these, nor the forms of the vessels, provide parallels with the material from Khok Phanom Di. The 1975 sequence began with the Bronze Age, and probably belongs in the later second millennium BC.

At Ban Na Di, the narrow configuration of the excavation resembled Ban Chiang rather than Non Nok Tha, and occupation began during the Bronze Age (Fig. 90). It thus lacks the incised and

burnished wares found at early Ban Chiang (Higham and Kijngam 1984). However, the excavators encountered a nucleated cluster of graves in the main area investigated, together with a second about 30 m away in a smaller square. The latter contained numerous burials placed alongside and over each other, dated within the period 1000-500 BC. It is apparent that they encountered the edge of a cluster of graves. Their social interpretation rests on the finding that the two clusters of graves, while separated by 30 m, were contemporary.

When the grave goods were considered, with particular reference to exotic against local origin, it was found that the graves in one cluster were consistently the richer. Higham and Kijngam (1984), for example, have noted that over 90 per cent of the shell disc beads, all the imported trochus bracelets, clay figurines of men and animals, exotic stone bracelets, the majority of the bronze items and the first and only objects of iron were found in the richer of the two clusters. The excavators have suggested that there were at least two groups in question, each probably comprising related individuals. If we can equate the ownership of exotic objects with rank, then members of one of these groups had consistently higher status. Some of these exotic objects are marine shell, which stresses the role which might have been played in exchange relationships by the occupants of such coastal sites as Khok Phanom Di.

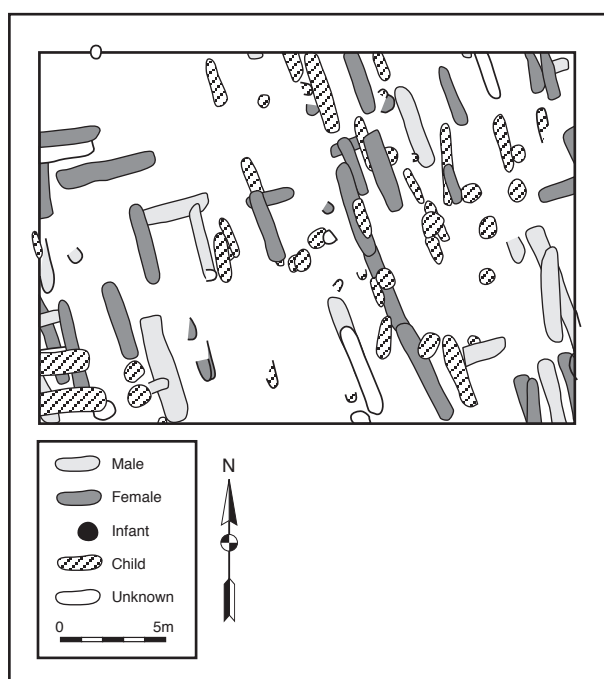


FIG. 91. The layout of burials at Ban Lum Khao

Ban Lum Khao and Ban Prasat

Ban Prasat is a large, moated site in the upper Mun Valley, the excavation of which involved leaving burials in place, in order to establish an open museum (Monkhonkamnunket 1992). The sequence reveals Iron Age graves over a Bronze Age cemetery. Graves belonging to the latter were laid out in rows, with a range of goods which incorporated many red, burnished pottery vessels, shell and marble bangles and the rare bronze: a socketed axe and several bangles. The excavation of Ban Lum Khao was undertaken in order to find out more about the Bronze Age occupation of the upper Mun Valley. Excavations in 1996 uncovered 110 graves, which were laid out in rows with the preferred orientation of the head to the south-east (Fig. 91). Men women and children were found buried close to each other, and infants were interred in lidded jars often beyond the head of an adult. Many infants

within these pots, were laid out with the head to the south-east, and were accompanied by pottery vessels. Although falling within the Bronze Age, no bronzes were found with burials. Many marine shell and exotic stone bangles were found, however, together with red burnished pottery vessels matching those from Ban Prasat. There are several similarities

with Non Nok Tha, including the use of large, nacreous bivalve shell fish and pig bones as grave goods.

Samrong Sen

Some of the pottery from the Cambodian site of Samrong Sen falls within the South-East Asian tradition of incised and impressed decoration, but the illustrated artefacts from this site also reveal some close similarities with material from Khok Phanom Di (Mansuy 1923). These include the form of some adzes. Among a wide variety of shell ornaments, including some fashioned from tridacna shell we find a pierced disc virtually identical with that from burial 15 at Khok Phanom Di. A specific parallel is seen in the worked fish vertebra in which grinding has produced two parallel ridges. Samrong Sen has not been properly excavated or published, so its date is not known with any precision. The single radiocarbon date is 1749-1253 BC.

BAC BO AND YUNNAN

Bac Bo, the name given to the lower reaches of the Red River valley and adjacent shore, has attracted much prehistoric research. The prehistoric sequence has much in common with that described for Central Thailand. It begins with inland Hoabinhian hunter-gatherers, who lived contemporaneously with more permanent groups which occupied the coast. Probably during the third millennium BC, we encounter agricultural villages, known as the Phung Nguyen culture and these developed through several stages to the Dong Son chiefdoms of the later first millennium BC.

The coastal settlements have many variables in common but also their own distinct characteristics. From north to south, we begin on the islands of Ha Long Bay, and in particular the site of Cai Beo. The interesting point about the first of the three phases at this site, is the similarity between the flaked stone tool industry and that identified in the upland Hoabinhian cave sites. There is also an abundance of pottery, decorated with basketry impressions. Ha Van Tan (1994) reports that the ceramic vessels were rather crudely made and fired at a low temperature. Vessels were thick, lacked ring feet or cord marking, and had everted rims (Nguyen Kim Dung 1983, Ngo The Phong 1985). During the middle phase, axes with shoulders were encountered, and these were often polished on both sides but not to the extent of removing all the flake scars which result from the initial shaping of the implement. This trend towards polishing the surface of axes continued into the third phase. Dating the sequence is based on five radiocarbon determinations, of which at least two, with readings in excess of 40,000 years, are unacceptable. A determination of 4609-4352 BC for the base of the middle layer is the most likely to be accurate.

This is supported by the dating of related groups to the south. The sequence in the lower Ma Valley, for example, begins with the site of Da But, followed first by the material from Con Co Ngua and finally, that from Go Trung. With time, these sites were located progressively closer to the modern shore, probably as a result of progradation and a lowering of the sea level. Da But was first examined by Patte (1932). He encountered 12 burials in which the body was interred in a seated position, accompanied by pottery vessels, shell jewellery, stone axes and red ochre. It is not a large site, covering only 50 by 32 m, but attains a depth of 5 m. The deposits largely comprise

shellfish from an estuarine habitat. Pollen also indicates the presence of salt marsh nearby (Nguyen Dich Dy *et al.* 1980). Bui Vinh (1991) has described more recent excavations, from which it has become clear that the site was the scene of domestic activities. There are hearths, much pottery and animal bones. The pottery is described as being coarse and basket-impressed, the clay being tempered with laterite. Ha Van Tan has stressed the lack of any cord marking, and noted similarities with early pottery from Cai Beo (Ha Van Tan 1985). Some of the stone adzes were polished and these, together with the pottery, are closely paralleled in some of the rock shelters in the outliers of the Truong Son range to the west, such as Con Moong and Xom Trai in the Cuc Phuong region. According to Vu The Long (1979), some of the animal bones come from a bovid of domestic size. The five radiocarbon dates suggest occupation within the period 4500-3700 BC.

Con Co Ngua covers 2000m², and like Da But, contains burials in a seated position. The hundred interments examined also include those buried in crouched and extended positions (Bui Vinh 1991). Basal shellfish indicate a continuation of the maritime adaptation, but in the upper layers, they ceased to be found, suggesting that occupation continued after a fall in the sea level, or coastal progradation, had seriously altered the environment. It is in this later context that Bui Vinh has noted a series of significant changes in material culture. These, dated to about 3500 BC, included net sinkers and stone hoes, as well as bones ascribed by Vu The Long to pig and water buffalo of possible domestic origin.

Go Trung is located to the east of Con Co Ngua and Da But, and excavations there in an area of 170m² reveal continuity, although the site has been dated at least 500 years later than Con Co Ngua. The excavators also recovered pestles and mortars, net sinkers and the remains of sea fish. Over 50,000 pieces of pottery were found, which exhibit parallels in the Da But assemblage, but no evidence for agriculture has been cited.

The Quynh Van culture sites concentrate in the lower reaches of the Ca River, about 100 km south of Go Trung. While the mortuary ritual of seated, flexed burials recurs, the stone industry differed from the Da But and Go Trung sites, for edge grinding is rare. The pottery industry differs from that described for the lower Ma Valley sites, because the vessels were coiled, have pointed bases, and were mostly decorated with comb impressions (Nguyen Kim Dung 1983). Radiocarbon dates for this site indicate settlement at *c.* 2700 BC. Later sites in this region, however, saw increased edge grinding and the manufacture of stone hoes. The succeeding Bau Tro culture saw the development of round-based vessels decorated with cord marking or incising. Further south still, we encounter the same flexed, seated burial tradition at Bau Du, which was located in a coastal, probably estuarine setting. Despite its relatively late dates of 2510 and 3030 BC, no pottery or ground stone tools were recovered. Indeed, the flaked stone tools are very similar to those from the upland Hoabinhian sites (Vu Quoc Hien and Trinh Can 1986).

Bui Vinh (1991) has sought the origins of these coastal communities in upland Hoabinhian contexts. But surely, the most likely antecedents lie on the submerged coastal shelf, as suggested by Ha Huu Nga (1991). Sites on raised beaches are small: 0.2 ha for Con Co Ngua, 0.16 ha for Da But. While the excavators describe the sites as Neolithic, there is no evidence for the cultivation of plants such as rice. As is well known from the Japanese Jomon sites, pottery, polished stone tools and cemeteries can well develop in rich coastal habitats without the presence of agriculture. We are faced with two possibilities. These sites might have been occupied by sedentary foragers, who took advantage of the rich resources to be found on a mangrove-fringed shore punctuated by estuaries. Some groups might have begun gathering and ultimately propagating rice, a trend

which would have been encouraged by environmental unpredictability. Progradation or major flooding could have been stressful. There are signs that these communities enlarged the scope of their material culture: hoes and pestles and mortars hint at the possibility of rice cultivation, but do not demonstrate it.

These coastal sites in Bac Bo are far more numerous, and exhibit a much longer span of time, than is the corresponding case in Central Thailand. Again, however, it is possible to contrast the marine adaptation with a concentration of inland riverine settlements established, it is thought, by agriculturalists. These sites are collectively known as the Phung Nguyen culture. They are far larger than the coastal sites, covering between 1-3 ha. Their dating is vague: early sites probably belong within the late third millennium BC while by 1500 BC, late settlements reveal a transition to the succeeding Dong Dau culture. The eponymous site covers about 3 ha of which 3960m² have been excavated. This exceeds by a factor of at least ten, the area exposed at any of the Thai sites hitherto discussed and in consequence, there is a much bigger sample available of material goods: well over 1000 adzes and 540 nephrite bangles divided into eight forms. There are also stone chisels, arrowheads, grinding and sharpening stones and beads (Hoang Xuan Chinh and Nguyen Noc Bich 1978).

The pottery is distinct from that found on the coastal sites. It includes many forms with pedestals and vessels decorated in parallel incised lines infilled with dentate stamping to form a wide range of motifs. The mortuary vessels from Lung Hoa also include round-based and pedestalled forms, and the outer surfaces include areas of incised and impressed decoration, as well as cord marking, which follow similar lines as those in Central and North-East Thailand. A similar, and almost certainly related range of pottery vessels have been found at Den Doi in the Ma Valley (Bui Vinh 1984), while incised decoration is a dominant characteristic of the pottery from the coastal culture of Hoa Loc (Ha Van Tan 1985).

The mortuary ritual of the Phung Nguyen culture contrasts with that seen in the earlier coastal sites. At Lung Hoa, Hoang Xuan Chinh (1968) has excavated 12 inhumation graves up to 5.2m deep which incorporate ledges and extended inhumation burials. Offerings include pottery vessels, and stone bracelets, beads, earrings and adzes. This method of burial has its closest parallels in sites located in southern China, as in the graves of the Fubin culture of Lingnan.

It is argued that the sequence in Bac Bo provides parallels with that in Central Thailand and the Khorat Plateau. There was a long tradition of coastal foragers adept at making pottery vessels and polishing their adzes. We do not have any data on the possible adoption of rice cultivation in these coastal cultures, but large stone hoes were found at some sites. During the third millennium BC, a new settlement form, the inland riverine agricultural village, appears in the archaeological record. Many novel artefact forms and a new mortuary ritual involving deep, ledged graves made their appearance in these Phung Nguyen sites. Pottery decoration provides tantalising similarities with that seen in the Mekong Valley. These direct our attention to Yunnan, a nodal region from which settlement could have spread by degrees south to the middle and lower reaches of the Mekong, Red and Chao Phraya rivers.

Baiyangcun is a site which provides much critical information (YPM 1981). It is located close to the Lancang and upper reaches of the Red River, in a position which would have beckoned any expansionary settlement of rice cultivators originating in the Yangzi Valley. There is a stratigraphic sequence 5.35m deep, incorporating the remains of houses and an inhumation cemetery with at least 34 burials. The dead were inhumed, with the head orientated to the north or east. Infants

were interred in jars. The mortuary plan suggests the possibility that the dead were grouped. Pottery from the occupation layers - unusually, there were no grave goods with the dead - includes sherds decorated with incised lines filled with impressions highly reminiscent of the decoration seen in early contexts in Bac Bo and the Khorat Plateau sites. The single radiocarbon determination is 2462-2014 BC. If a true reflection of the age of this site, it would be crucial in providing a cultural milieu from which the agricultural expansion to the south could have originated. Dadunzi is a second site in this region (YPM 1977). It too has revealed house plans and a cemetery in an excavated area of almost 500m². The superposition of houses, which followed a north—south axis, suggest long term occupation by a group which, according to the excavators, cultivated rice and maintained domestic stock. Once again, we encounter pottery vessels ornamented with incised bands infilled or highlighted by impressed decoration. The radiocarbon date is 1684-1261 BC.

The evidence from Yunnan sustains the hypothesis that the Phung Nguyen, Khorat Plateau and Central Thai inland settlements could have involved an intrusive movement of rice cultivators down the main river valleys from Yunnan.

SUMMARY

Although there is pollen evidence from the vicinity of Khok Phanom Di for burning and vegetation changes dating to the sixth and fifth millennia BC, there is no compelling reason to ascribe these to the establishment of agriculture. Sites such as Nong Nor during phase 1, which involved coastal hunting and gathering, reveals much evidence for burning activity which could have caused similar changes in the pollen record. The archaeological evidence currently available is compatible with an initial settlement of the Chao Phraya and middle Mekong Valleys by agricultural communities in the second half of the third millennium BC. The sites of Non Nok Tha, Ban Non Wat, Khok Charoen, Non Pa Wai, Ban Kao and earliest contexts at Ban Chiang incorporate inhumation cemeteries in which pottery vessels and shell and stone ornaments were employed as grave goods. Domestic pigs, cattle and dogs were present, and rice remains have been recovered. This tradition of inhumation burial with a range of grave goods continued into the Bronze Age, and is documented at such sites as Ban Non Wat, Nong Nor, Non Pa Wai, Ban Na Di, Ban Lum Khao, Non Nok Tha, Ban Chiang and Non Pa Kluay. Exotic shell and stone jewellery, in addition to a wide repertoire of pottery vessels and domestic animal bones, were used as grave goods, some of the shell items being of marine origin.

How does Khok Phanom Di relate to this pattern of inland agricultural settlement? The first hypothesis is that the site belongs to this wave of advance, and was a community of intrusive rice cultivators. Some support for this contention comes from the presence of rice from the initial occupation phase. But most evidence is negative. The initial settlement was located on an estuary close to mangrove swamps and saline flats. It was dedicated, in terms of subsistence, to marine gathering, hunting and fishing. Is it likely, that the first settlers failed to bring their dogs, and employed a material culture which was, in many respects, the mirror image of that found five centuries previously, along the same shore at Nong Nor?

The second hypothesis sees Khok Phanom Di as a settlement representing an indigenous transition to rice cultivation from which expansion inland occurred. Again, we find this untenable because we know of interior communities with a different material culture, which had access to

rice before the initial settlement of Khok Phanom Di.

In the third hypothesis, the settlers of Khok Phanom Di are seen as the descendants of local coastal hunter-gatherers who chose an ideal habitat for subsistence and exchange purposes. They were able to develop exchange relations with intrusive agriculturalists, which brought in exotic stone and rice, in return for, among other items, marine shell jewellery and ceramic vessels. The results of the strontium isotope analyses have identified two periods when individuals raised elsewhere came to be interred in the site. The first, predictably, was with first settlement. The second came with mortuary phase 3B. This was a period of change in many aspects of both the environment and material culture. Women in particular, entered Khok Phanom Di from elsewhere, and it is considered highly likely that they were familiar with rice cultivation, and their own preferences for the manufacture of ceramic vessels.

We can thus follow the fortunes of the community through the generations, as environmental change first brought conditions suited to rice, and then returned to a more saline habitat which made rice cultivation marginal or impossible. The inhabitants developed the appropriate hoes and harvesting knives, only to cease using them with deteriorating conditions. The change in the environment took place contemporaneously with the growth of exchange in exotic goods, and with it, the rise of certain individuals to positions of great social prestige. It was during this period, that the community appears to have been more internally settled, with no further evidence for the introduction of women from a different environment. One particular advantage lay in their access to marine resources. The wealth of the Khok Phanom Di community can be illustrated by the quantity of shell disc beads recovered. The total found in the entire Ban Kao cemetery, for example, is 0.6 per cent of those associated with burial 15 at Khok Phanom Di. The 60 graves at Ban Na Di provided 12,440 such beads, 10.3 per cent of the number from burial 15. The equivalent figure for Khok Charoen is 1.8 per cent.

When reviewing this hypothesis, we are influenced by the many parallels in material culture between early Khok Phanom Di and Nong Nor during phase 1. Again, there were further similarities between the ceramics and shell ornaments found from MP3B and those from inland agricultural settlements such as Khok Charoen and Ban Non Wat. It is suggested that a coastal hunter gatherer community entered into intense social relationships with rice farmers then infiltrating and settling the hinterland, relationships that included the interchange of goods, ideas and individuals.

There are aspects of the data which worry us, however. Foremost is the relationship between the incised and impressed wares of Khok Phanom Di and Nong Nor phase 1 on the one hand, and that those from interior sites like Non Pa Wai, Tha Kae, Khok Charoen and Ban Chiang on the other. Do these belong to the same general tradition, or are they unrelated? This issue requires detailed analysis of forms, motifs and techniques which we cannot at present undertake due to a lack of published information. There is also the possibility that exchange between coastal and inland groups involved ceramics and thus awareness of alien techniques of decoration.

The second concern lies in the status of Nong Nor phase 1. Was it in fact a coastal settlement of hunter gatherers, or could it have been seasonally occupied by people who were, at another time of year, growing rice elsewhere? We are also conscious that the burial ritual seen at Khok Phanom Di is similar in many respects to that practiced at inland Neolithic and Bronze Age sites. One burial at Nong Nor probably belongs to phase 1. The body was interred in a seated crouched position covered by pottery vessels, quite unlike any interment at Khok Phanom Di. Burials in coastal hunter gatherer sites in Vietnam likewise involved a seated position. Had the initial ritual

at Khok Phanom Di followed this procedure, we would have been more confident in tracing local origins for the people in question. The only distinctive burial in MP1 was a child in a crouched position. The remaining five are all extended inhumations.

These concerns stress the thinness of our data, and the need for more research. In doing so, we feel that one important way of testing these alternatives is to examine the remains of the people. In Scandinavia, for example, Price *et al.* (1996) have reported few if any physical differences between the Ertebølle and TRB culture people. Is there any evidence that the occupants of Khok Phanom Di differed physically from their inland contemporaries? Is the recovery of mtDNA a possible avenue to further refining our alternatives? Pietrusewsky and Douglas (2002) have made an important start on this issue, but much remains to be done.

Despite these reservations and the need for further research on many fronts, our preferred view is that Khok Phanom Di was occupied by a community whose forbears had occupied coastal habitats in South-East Asia for millennia. With the intrusion of agriculturalists ultimately from the area of the Yangzi Valley, they entered into a new web of social relationships which brought females into the community, and with them the exotic dog, a knowledge of rice and its potential as a cultigen, and new opportunities for the exchange of artefacts fashioned from the local shellfish and clay resources. This model now stands for testing at similar coastal sites in Southeast Asia and southern China.

APPENDIX

CHARACTERISING HUMAN MOBILITY BY STRONTIUM ANALYSIS OF THE SKELETONS

R.A. Bentley

This study is an investigation of the dietary mobility of people at Khok Phanom Di through strontium isotope analysis of the archaeological human skeletons. The goals of this study include an investigation of how human mobility changed as agriculture was intensified and de-emphasised through time, as well as how immigration relates to social differences expressed in burials.

STRONTIUM ISOTOPES IN ARCHAEOLOGICAL SKELETONS

The method of this study involves comparing the strontium isotope ($^{87}\text{Sr}/^{86}\text{Sr}$) signatures in teeth from archaeological skeletons to signatures from the region, to identify the geographic area where the diet was obtained during childhood (when the enamel was forming). Unlike carbon and nitrogen isotopes for example, strontium isotopes are conveyed, without measurably fractionating, from eroded rocks through soils and into the food chain. Because $^{87}\text{Sr}/^{86}\text{Sr}$ in rock minerals depend on their original Rb content and geologic age (^{87}Rb radioactively decays to ^{87}Sr , $t_{1/2} = 48$ billion years), $^{87}\text{Sr}/^{86}\text{Sr}$ serves as a geologic, and hence geographic, signature within archaeological tooth enamel (e.g., Price *et al.* 2002). When the method was first conceived (Ericson 1985), it was hoped that $^{87}\text{Sr}/^{86}\text{Sr}$ in the bone and tooth enamel of a single individual could be compared in order to see if someone changed residence from childhood (when the enamel was forming) to adulthood (represented by bones such as the ribs with high mineral turnover rates). Unfortunately, it turns out that bone is prone to biochemical alteration, but fortunately tooth enamel, which contains larger mineral crystals and is less porous than bone, is highly resistant to strontium contamination during millennia of burial (e.g., Chiaradia *et al.* 2003; Horn *et al.* 1994; Hoppe *et al.* 2003; Trickett *et al.* 2003). For this reason, it is usually most useful and cost-effective to measure $^{87}\text{Sr}/^{86}\text{Sr}$ only in the tooth enamel from each human skeleton and not analyse the bone at all. The $^{87}\text{Sr}/^{86}\text{Sr}$ in the tooth enamel can then be compared to the 'local' signature for the archaeological site (how we define the 'local signature at Khok Phanom Di is discussed below), with the most parsimonious interpretation being that signatures within the range identify local individuals, and signatures outside the range identify immigrants. One must be aware, however, that isotopic "locals" may have moved between similar geochemical provinces, and "non-locals" may have been based locally but collected a diet from beyond the local area, such as a mobile forager who later was buried in an agricultural community (Bentley *et al.* 2003).

THE SKELETONS

In order to characterize patterns of human mobility at Khok Phanom Di, we measured strontium isotopes in tooth enamel from selected human skeletons, with sampling preference for the second molar (crown complete between ages 7-8 years; Hillson 1997:123) or third molar (ages 12-16)

wherever possible. The Khok Phanom Di sample includes a tooth fragment from 28 adult females, 23 adult males and 18 children.

ANALYTICAL PROCEDURE

For $^{87}\text{Sr}/^{86}\text{Sr}$ analysis, about 5-20 mg of intact enamel was removed from the tooth. At the Institute of Archaeology, University College London, the samples were soaked overnight in 5 per cent acetic acid (with intermediate H_2O rinse), dissolved in 6M nitric acid, and then purified extraction chromatography using Eichrom[®] Sr resin. After drying and redissolving the solution in 2.0 μl of 2.5 M HCL, the purified Sr was loaded onto a single tungsten filament at the Southampton Oceanography Centre (SOC) for analysis in the thermal ionisation mass spectrometer (TIMS). During a recent period of analyses, repeated measurements of the NBS SRM-987 standard ($^{87}\text{Sr}/^{86}\text{Sr} = 0.710248$) yielded an average $^{87}\text{Sr}/^{86}\text{Sr}$ value of 0.710252 ± 0.000015 (2 s.d., $n = 169$).

GEOGRAPHIC ORIGINS OF ISOTOPE SIGNATURES

Khok Phanom Di is located on the lower Chao Phraya Plain, which is a fault bounded basin that formed during the Plio-Pleistocene and has since filled with almost 2000 metres of Quaternary sediment (Sinsakul 2000). These sediments reflect both the deposits of the Chao Phraya River and its tributaries as well as 15 metres of tide-dominated delta deposits of soft marine clay in the area of modern Bangkok (Sinsakul 2000). The basal layer beneath Khok Phanom Di, consisting of nearly 90 per cent silt, was deposited by floods from the Bang Pakong River (Aitken 1992). However, since the Holocene marine transgression, during which marine clays were deposited, peaked around 5600 BP in the Gulf of Thailand (Aitken 1992), we expect the sediments surrounding Khok Phanom Di during its prehistoric occupation to reflect that of marine sediments ($^{87}\text{Sr}/^{86}\text{Sr} \sim 0.708 - 0.709$).

In fact, the predominant factor in governing the local strontium isotope signature at Khok Phanom Di will have been seawater. Due to the long residence time of Sr in the oceans, $^{87}\text{Sr}/^{86}\text{Sr}$ in seawater is essentially a worldwide constant, currently ~ 0.7092 . The seawater $^{87}\text{Sr}/^{86}\text{Sr}$ value has changed with geologic time (McArthur *et al.* 2001), but since the occupation of Khok Phanom Di is very recent on this time scale, we expect it to have been 0.7092 when the site was occupied. Ocean-derived rainfall would have contributed strongly to the strontium isotope signature in the local soils at Khok Phanom Di. On the basaltic Hawaiian Islands, for example, a substantial fraction of the strontium in plants and soils comes from marine sources (through rain or sea-spray) reaching over 50 per cent marine strontium in soils at the coast (Chadwick *et al.* 1999; Whipkey *et al.* 2000). Compared to Hawai'i, marine strontium probably would not have dominated as much at Khok Phanom Di because the Bang Pakong River also supplies elements to the soils. Nonetheless, as a first estimate we expect the local signature at Khok Phanom Di to be close to the seawater value of 0.7092, both for residents eating seafood and those eating foods raised on local land. Below, we verify this estimate by analysing archaeological teeth of pigs and children from Khok Phanom Di.

Unfortunately, the ubiquity of the seawater value means that immigrants from other maritime communities may be indistinguishable from locals. On the other hand, values significantly different from 0.7092 can be easily identified as non-local. For example, there are a few outcrops of Cambrian

quartzo-feldspatic gneisses in highlands within 50 km of the site, which should have significantly higher $^{87}\text{Sr}/^{86}\text{Sr}$ values (> 0.711 or so).

RESULTS

The results of strontium analyses of human tooth enamel samples are shown in table 21.

The local $^{87}\text{Sr}/^{86}\text{Sr}$ range at Khok Phanom Di

Since Khok Phanom Di is essentially a coastal site, we expect the local $^{87}\text{Sr}/^{86}\text{Sr}$ to be close to the seawater value of 0.7092. Our first estimate of the local value comes from tooth samples from 16 children (excepting two outliers discussed below), which yielded an average $^{87}\text{Sr}/^{86}\text{Sr}$ of 0.70933 ± 0.00005 over seven mortuary phases. We expected the children to have relatively invariant $^{87}\text{Sr}/^{86}\text{Sr}$ values, since most young children were presumably raised locally. The narrow standard deviation in values from children suggests this may be the case, except for two outliers described below.

An alternative way to estimate the local range is to sample the enamel of archaeological pig teeth (Bentley *et al.* 2004; Bentley *et al.* in review). The KPD pig teeth yield a mean value of 0.70924 ± 0.00005 ($n = 7$), whereas a single rat tooth had a value of 0.70926. The mean pig $^{87}\text{Sr}/^{86}\text{Sr}$ value is within 0.0001 of the average in human children's teeth, suggesting they are all representative of local values at KPD. Nonetheless, because the respective ranges are so narrow, the difference between pig and children averages is actually significant ($p < 0.002$). Perhaps the slight difference represents a different diet, particularly if the seawater/seaspray/seasalt contents of pig's and children's foods differed. Assuming children best represent the local human values, we cautiously define the local $^{87}\text{Sr}/^{86}\text{Sr}$ range as within two standard deviations of the mean value in children's teeth, which is 0.70924 to 0.70942.

DIFFERENCES BETWEEN FEMALE AND MALE ADULTS

Over all chronological phases, the mean $^{87}\text{Sr}/^{86}\text{Sr}$ in KPD human tooth enamel samples is 0.70938 ± 0.00015 ($n = 68$, one outlier excluded) among both sexes, including 0.70946 ± 0.00019 ($n = 28$) among females, 0.70934 ± 0.00009 ($n = 23$) among adult males and the children as just mentioned above.

Among adult females, there is a considerable transition at MP4, when the $^{87}\text{Sr}/^{86}\text{Sr}$ values become slightly lower and considerably less variable (Fig. 92). Before MP4, the mean $^{87}\text{Sr}/^{86}\text{Sr}$ for adult females (0.70952 ± 0.00022 , $n = 16$) is significantly ($p < 0.005$, two-tailed t test) higher than the mean for adult males (0.70932 ± 0.00011 , $n = 13$). Also, before MP4 there is significantly more variance in $^{87}\text{Sr}/^{86}\text{Sr}$ among females than among males ($p < 0.07$, one-tail F-test for variances). For phases MP4 and later, the mean $^{87}\text{Sr}/^{86}\text{Sr}$ for females (0.70937 ± 0.00007 , $n = 12$) is statistically indistinguishable from the mean male value (0.70936 ± 0.00007 , $n = 10$), and the female mean value is significantly ($p < 0.06$) lower than for phases MP1 - MP3. Males, by contrast, show a relatively narrow range of $^{87}\text{Sr}/^{86}\text{Sr}$ values throughout the chronological sequence (Fig. 92), with a consistent mean value.

Most of the exceptional human isotope values from Khok Phanom Di come from females. The lowest $^{87}\text{Sr}/^{86}\text{Sr}$ measurement (0.70917) of all the adults is from Burial 58, a 35-year-old female

from MP3B. This woman was one of the largest females in the group and the tallest in MP3, with muscular shoulders and lower limbs. The highest $^{87}\text{Sr}/^{86}\text{Sr}$ value (0.70998) is from Burial 154, a 25-year-old female from MP1 who was also one of the tallest females in the group, but (unlike Burial 58) did not have strong muscular development. The next five highest $^{87}\text{Sr}/^{86}\text{Sr}$ values are from females, all of whom were of average height for their group.

Of the seven lowest $^{87}\text{Sr}/^{86}\text{Sr}$ values, six are from males. The three lowest male $^{87}\text{Sr}/^{86}\text{Sr}$ values are virtually the same (0.70921); one is from Burial 147, a 19-year-old from MP1 who was the tallest person of the entire sample but not muscular, another also from MP1 was from Burial 152, a 37-year-old male of average size for the group, also not muscular, and the third is from Burial 76, a 34-year-old male who was the second smallest in MP3, with a pattern of joint degeneration suggesting a different physical activity from other MP3 males. Of the three next lowest values, Burial 92 (18-year-old male, MP3) was shorter than average, and Burial 132 (34-year-old male, MP2) and Burial 29 (27-year-old male, MP4) were of average stature.

There were two anomalous values from children. The first is Burial 2 (0.70914), a nine-month-old infant from MP6 and found crushed and fragmented. The second is the deciduous tooth from Burial 96, a 4-year-old from MP2 whose $^{87}\text{Sr}/^{86}\text{Sr}$ value (0.70753) was vastly lower than any other sample. Burial 96 was heavily disturbed in prehistory.

EXCEPTIONAL BURIALS

The most prominent burial we analysed is Burial 15, the “Princess,” who with her 120,000 beads, an anvil and pottery from exotic clay (Vincent 2004) we expected might have been an immigrant. However, Burial 15 yielded an unremarkable $^{87}\text{Sr}/^{86}\text{Sr}$ value of 0.70939, which was repeated (0.70942) by a re-measurement of a separate piece of enamel from the same tooth (right P₁). Assuming ‘local’ is the null hypothesis, for now we must assume that the Princess was not an immigrant, although other isotopes measured in the future might suggest otherwise. Since the hand musculature of Burial 15 suggests she was a potter, we infer that she learned her trade locally. Burial 43, a 30-year-old male with over 56,000 beads and a turtle carapace among other items, also yielded practically the same $^{87}\text{Sr}/^{86}\text{Sr}$ value (0.70942) as Burial 15. The closeness of these two values (Fig. 92) suggests that this man and this woman had similar origins.

STRONTIUM ISOTOPE EVIDENCE AND THE KHOK PHANOM DI CHRONOLOGY

The first burials, in MP1, occur in layer 10 along with marine shell middens, wooden structures and hearths, with the addition of bone awls and clay netweights to the artefact assemblage, and changes in ceramics that might reflect immigration into the community (Vincent 2004). Of all phases, MP1 has the most non-local values. The two males we analysed from MP1, burials 147 and 152, have virtually the same $^{87}\text{Sr}/^{86}\text{Sr}$ value (0.70921) so that if they were immigrants, they came from the same place. The analysed female, Burial 154, had the highest $^{87}\text{Sr}/^{86}\text{Sr}$ value of the study, so while also non-local, her origin differs from the males. The younger of these non-locals were tall – the 19-year-old male (Burial 147) was the tallest person in the entire sample, and the 25-year-old female (Burial 154) was one of the tallest females in the group.

During MP2, burials occur in clusters, there is an increase in fishhooks and net weights, new artefacts include bone harpoons, while new faunal remains include the otter and dog. There were

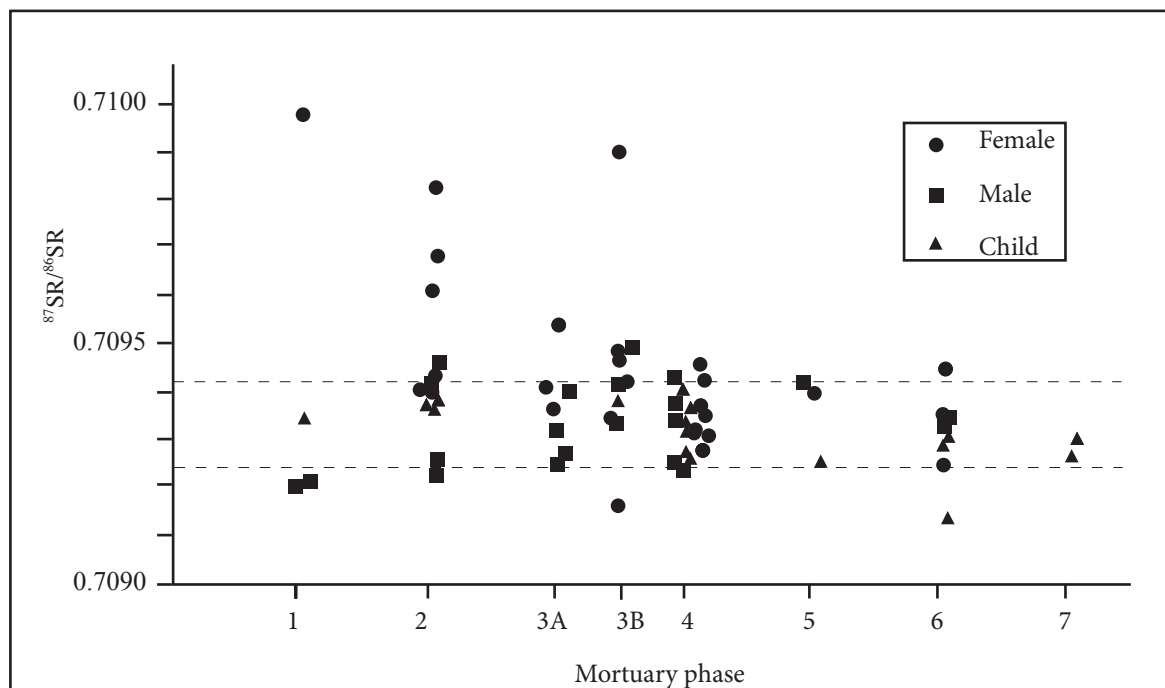


FIG. 92. $^{87}\text{Sr}/^{86}\text{Sr}$ in human enamel from Khok Phanom Di, by chronological phase. Horizontal lines indicate local $^{87}\text{Sr}/^{86}\text{Sr}$ range, defined as within two standard deviations of the mean value in children's teeth (0.70924 - 0.70942)

no discernable differences in grave goods included with men and women burials in MP2, which included red ochre, fine pottery, shell beads, cowrie shells and animal teeth. Surprisingly, MP2 is when the difference in $^{87}\text{Sr}/^{86}\text{Sr}$ between sexes is the most significant ($p < 0.07$), with the mean value for females (0.70956 ± 0.00018) higher than for males (0.70935 ± 0.00012).

Mortuary phases 3B and 4 suggest a period of freshwater conditions during which rice was cultivated locally and society was more sexually divided, with items such as pot-making anvils with women and turtle carapace ornaments with men. The $^{87}\text{Sr}/^{86}\text{Sr}$ for females during early MP3 (0.70942 ± 0.00009) decrease slightly by MP4 (0.70937 ± 0.00006) such that they are the same as the mean for males in MP3 and MP4 (0.70935 ± 0.00009). Two MP3 burials in which domesticated rice was present as the food residue yielded slightly higher $^{87}\text{Sr}/^{86}\text{Sr}$ values, 0.70943 from B67 and 0.70947 from B56.

In between these two phases, however, there appears to have been an influx of immigrants. During MP3B, a transition occurred such that rich burials with shell disc beads declined, and new ceramic decorations were applied, with different sources of clay and temper. The artefactual evidence suggests that immigrant women brought in these new potting traditions. Indeed, the samples analysed from MP3B (Burials 56, 58 and 64) showed a wide spread of $^{87}\text{Sr}/^{86}\text{Sr}$ values, including the lowest overall value from Burial 58, as mentioned above, and the second-highest value (0.70990) from Burial 64, a female in her early twenties. This variation in MP3B is all the more striking when compared with the considerable compression of variation in MP4 (Fig. 1).

As just mentioned, the $^{87}\text{Sr}/^{86}\text{Sr}$ values during MP4 fall within a narrow range for both sexes (mean 0.70936 ± 0.00007), presumably clustered around the local value. During MP4, burials became more individually spaced and with a stronger association of turtle carapaces with male burials and anvils for females. Skeletal evidence points to intensified rice subsistence as, compared with previous phases, tooth wear declined, caries were more frequent, infant mortality was lower (suggesting a greater investment in child rearing), and men were less muscular. It is notable that the mean $^{87}\text{Sr}/^{86}\text{Sr}$ value during MP4 is very close to the mean value from children (0.70933) but slightly lower than the two MP3 burials with domesticated rice residue (0.70943–0.70947).

During MP5 and MP6, the $^{87}\text{Sr}/^{86}\text{Sr}$ values appear within the local range for the most part (Fig. 92). Conditions reverted back to a coastal mangrove during MP5. If anything, social conditions became more complex during the return to hunting and gathering during this phase, as exotic ivory and shale appeared, women were buried with specialist potting equipment, probably even as girls. The similarity in $^{87}\text{Sr}/^{86}\text{Sr}$ values of the two rich burials (15 and 43) suggest similar origins for this elite man and woman. Mortuary practices continued to elaborate during MP6, with substantial mortuary structures, one of which contained substantially poorer burials than the other. As with MP5, elaborate burials during MP6 seem to correlate with local $^{87}\text{Sr}/^{86}\text{Sr}$ values (Fig. 92).

CONCLUSION

Concerning the human tooth enamel values, three significant patterns emerge from the isotope values: (1) Before MP4, the variance in female $^{87}\text{Sr}/^{86}\text{Sr}$ values is significantly larger than it is for males; and (2) Immediately after a period of high variation in MP3B, the variance in both the male and female $^{87}\text{Sr}/^{86}\text{Sr}$ values is significantly reduced during and after MP4, and (3) The highest variance in $^{87}\text{Sr}/^{86}\text{Sr}$ values occurs during MP1 and MP3B, the two phases for which the archaeology is most suggestive of immigration. These results from Khok Phanom Di are strikingly similar to recent isotope results from Ban Chiang, Northeast Thailand. During and after EPV at Ban Chiang, the range of $^{87}\text{Sr}/^{86}\text{Sr}$ among females is considerably reduced, just as they are in MP4 at Khok Phanom Di. At Ban Chiang however, a notable difference from the Khok Phanom Di results is that among males the isotope signatures are highly variable throughout the sequence, whereas the male values are highly invariable throughout the Khok Phanom Di sequence. At Ban Chiang, Bentley *et al.* (2004) suggest that the change that occurred in EPV involved either (a) a sexual division of labour, such that males ranged over a wide area while hunting and gathering and females remained closer to the settlement, perhaps gathering and making pottery and/or (b) a cultural pattern of matrilocality, by which the man immigrates to the woman's birthplace after marriage. At Khok Phanom Di however, it seems likely that the change during and after MP4 involved more local cultivation and living by both sexes, with artefacts and hand musculature suggestive of female potters.

Acknowledgements

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Table 21 *The results of strontium analysis of KPD human tooth enamel*

Burial	UCL lab no.	Tooth	MP	Sex	Age (yrs)	$^{87}\text{SR}/^{86}\text{SR}$	$\pm\sigma$	Comments
1	KPD 59	55	7	child	9	0.70927	0.00001	
2	KPD 69	crown frags	6	child	0.75	0.70914	0.00001	
4	KPD 06	25	6	female	25	0.70939	.000001	one of the smallest adults
6	KPD 60	84	6	child	0.75	0.70929	0.00001	
8	KPD 29	34	6	male	Immat.	0.70935	0.00001	
9	KPD 07	14	6	male	30	0.70933	0.00001	
11	KPD 64	25	6	child	12	0.70931	0.00001	
12.1	KPD 65	35	7	child	12	0.70931	0.00001	
13	KPD 30	45	6	female	35	0.70925	0.00001	
14	KPD 70	64	5	child	1.25	0.70926	0.00001	
15	KPD 08a	15	5	female	35	0.70939	0.00001	The Princess
15	KPD 08b	15	5	female	35	0.70942	0.00001	Princess, repeat measurement
17	KPD 66	frags	4	child	12	0.70927	0.00001	
18	KPD 09	34	6	female	42	0.70936	0.00001	vertebral degeneration
19	KPD 10	16	6	female	25	0.70945	0.00003	
20	KPD 67	14	4	child	12	0.70937	0.00001	
21	KPD 61	17	4	child	8	0.70941	0.00001	
23	KPD 31	14	4	male	30	0.70926	0.00001	
24	KPD 32	34	4	male	25	0.70948	0.00001	
25	KPD 33	28	4	female	19	0.70946	0.00001	
26	KPD 34	24	4	female	35	0.70939	0.00001	
27	KPD 35	36 (or 46?)	4	female	40	0.70932	0.00001	
29	KPD 36	crown frags	4	male	27	0.70924	0.00001	
30	KPD 37	crown frags	4	male	34	0.70937	0.00001	
32	KPD 62	65	4	child	x	0.70928	0.00001	
33	KPD 71	62	4	child	3	0.70934	0.00001	
35	KPD 38	36	4	female	21	0.70943	0.00001	
37	KPD 68	42	4	child	9	0.70932	0.00001	
38	KPD 39	crown frags	4	male	32	0.70935	0.00001	
40	KPD 41	35	4	female	38	0.70938	0.00001	
42	KPD 42	16	4	male	32	0.70938	0.00001	
43	KPD 04	25	5	male	30	0.70942	0.00001	healthy and very rich
44	KPD 12	27	4	male	18	0.70938	0.00001	dental calcification
45	KPD 13	(pre?) molar frags	4	female	45	0.70932	0.00001	short skull
47	KPD 14	premolar	4	female	22	0.70928	0.00001	

Table 21 *The results of strontium analysis of KPD human tooth enamel (cont).*

Burial	UCL lab. no,	Tooth	MP	Sex	Age yrs.	⁸⁷ SR/ ⁸⁶ SR	±σ	
56	KPD 15	25	3B	female	45	0.70947	0.00001	Anaemia
57	KPD 16	15	3	male	26	0.70931	0.00001	turtle carapace, pottery shell beads
58	KPD 17	34	3B	female	35	0.70917	0.00001	
60	KPD 43	24	3B	female	19	0.70947	0.00001	
61	KPD 18	28	3A	female	48	0.70955	0.00001	repeat = 0.70955
63	KPD 72	72	3B	child	1.75	0.70934	0.00001	
64	KPD 19	25	3B	female	21	0.70990	0.00001	protruding maxilla, dental calc.
67	KPD 20	38	3B	male	35	0.70943	0.00001	
73	KPD 44	27	3A	female	25	0.70940	0.00001	
74	KPD 45	14	3B	male	40	0.70948	0.00001	
76	KPD 46	27	3A	male	34	0.70921	0.00001	
77	KPD 47	16	3B	female	25	0.70934	0.00001	
79	KPD 48	crown frags	3B	female	47	0.70941	0.00001	
83	KPD 21	15	3A	female	30	0.70933	0.00001	
90	KPD 22	46	3A	male	27	0.70933	0.00001	
91	KPD 49	27	2	male	45	0.70926	0.00001	
92	KPD 23	25	3A	male	18	0.70923	0.00001	vertebral degeneration, repeat = 0.70922
96	KPD 73	62	2	child	4	0.70758	0.00001	
101	KPD 74	52	2	child	1.5	0.70937	0.00001	
103	KPD 24	25	3A	male	26	0.70939	0.00001	vertebral degeneration
107	KPD 51	crown frags	2	female	40	0.70941	0.00001	
109	KPD 25	17	2	female	31	0.70983	0.00001	
110	KPD 52	crown frags	2	female	36	0.70969	0.00001	
115	KPD 26	premolar	2	male	38	0.70945	0.00001	vertebral degeneration
120	KPD 55	34	2	male	21	0.70946	0.00001	
121	KPD 75	53	2	child	1.25	0.70939	0.00001	
122	KPD 56	43	2	female	52	0.70962	0.00001	
123	KPD 76	53	2	child	2	0.70938	0.00001	
132	KPD 57	26	2	male	34	0.70923	0.00001	
147	KPD 27	43	1	male	19	0.70921	0.00001	
150	KPD 77	53	1	child	2.5	0.70935	0.00001	
152	KPD 58	25	1	male	37	0.70921	0.00001	
154	KPD 28	35	1	female	25	0.70998	0.00001	

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Abbreviations

HAI: Hunan Archaeological Institute

YPM: Yunnan Provincial Museum

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