THE LATER STONE AGE IN THE SOUTHERN CAPE SOUTH AFRICA

BY .

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The Later Stone Age in the southern Cape, South Africa

by

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NOTE ON PAGINATION

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ABSTRACT

Three cave sites, Nelson Bay Cave on the coast, Kangkara in an intermontane valley and Boomplaas some 80 km inland in the southern Cape Province, South Africa, were excavated between 1970 and 1979. Nearly 225 000 stone artefacts from the Later Stone Age sequence dating within the last 20 000 years are described from these three sites and are related to micro- and macroevolutionary changes at a regional and sub-continental level to provide a model for change in the Later Stone Age.

The classification scheme was designed to highlight inter- and intra-site variability through time and focused on analysis of the successive stages in the reduction sequence from raw material nodule to finished tool. Linear regression was used to test for interdependence and independence of variables and the significance of changes in size and shape of untrimmed flakes and scrapers was assessed. In the case of the scrapers, samples from the three southern Cape sites and from the eastern and northern Cape were compared and tested for significance with Mann Whitney and Kolmogorov-Smirnov two-sample non-parametric tests. The results indicate two levels of change through time, that involving the appearance of innovations that can be described as macroevolutionary, and that involving the subsequent modification of the frequency, size and shape of these innovations and other artefacts already part of the toolkit that can be described as microevolutionary change. By comparison with modern technological data, innovative changes represent the diffusion and acceptance of major advances in tool technology that are predictable from trends observed in modern technology. Post-innovative or micro-evolutionary changes, on the other hand, take the form of oscillations around a gradually changing mean that are similar to changes in style or fashion in the modern idiom.

The hypothesis that technological change was stimulated by environmental change was tested by comparing the timing of technological changes with those seen in oxygen isotope ratios in a Cango Cave stalagmite, charcoals from woody plants brought into Boomplaas Cave for firewood, small mammals caught by owls and eaten at Boomplaas and Nelson Bay Cave, and larger mammals hunted by people at all three sites. The results indicate that there is no consistent relationship between changes in the stone tool technology and environmental change. There is, however, a coincidence in the timing of changes in the larger mammals hunted and the stone tool technology that took place over a relatively short span of time between 12 000 and 11 000 B.P., post-dating major environmental adjustments at the end of the last glacial cycle by some 3000 years. Technological changes that took place between 8000 and 6000 B.P. were not coincident with a change in the animals hunted, nor with an equally sudden shift in environmental data, while a change in economy from hunting to herding within the last 2000 years was not accompanied by a change in the stone tool technology although pottery was added to the toolkit. There is thus a very complex relationship between economy, technology and environmental change that is not readily predictable.

The sequence in the southern Cape can be described in terms of punctuated equilibria, but the times of rapid change in technology, economy and climate do not always coincide. In the technological system periods of relative stasis have been labelled the Robberg, Albany and Wilton industries. The content, dating and evidence for subsistence during the Later Stone Age south of the Zambesi is reviewed from several hundred dated horizons at over 160 sites and although there is some spatial variability, the sequence of technological changes is much the same throughout the sub-continent. This confirms the long-held belief that the innovations that spread through the sub-continent were diffused over a very wide area of the Old World as the result of a well developed network of intercommunications during the Stone Age, while at times population migrations also took place. Microevolutionary changes, on the other hand, tend to be more regionally specific and may have been stimulated by different cues.

ACKNOWLEDGEMENTS

The study of archaeological materials is a labour intensive task that includes the selection of a suitable site which may take years to find, the excavation of the materials, which in the case of Boomplaas Cave took seven years, the analysis not only of the stone artefacts and other tools, but also of the faunal remains, charcoals, pollens, sediments, oxygen isotopes and the geological and ecological setting of the sites, as well as the final synthesis of the results. The artefact sequences described here are therefore only a part of the story and I am grateful to the following people for their co-operation and assistance at various stages in the project: Boy Adams, Margaret Avery, Johan Binneman, James Brink, David Daitz, H J Deacon, Vera Geleijnse, Richard Klein, Mary Leslie Brooker, Lawrence Posniak, Anton Scholtz, H C Taylor, J C Vogel, Lita Webley and M L Wilson.

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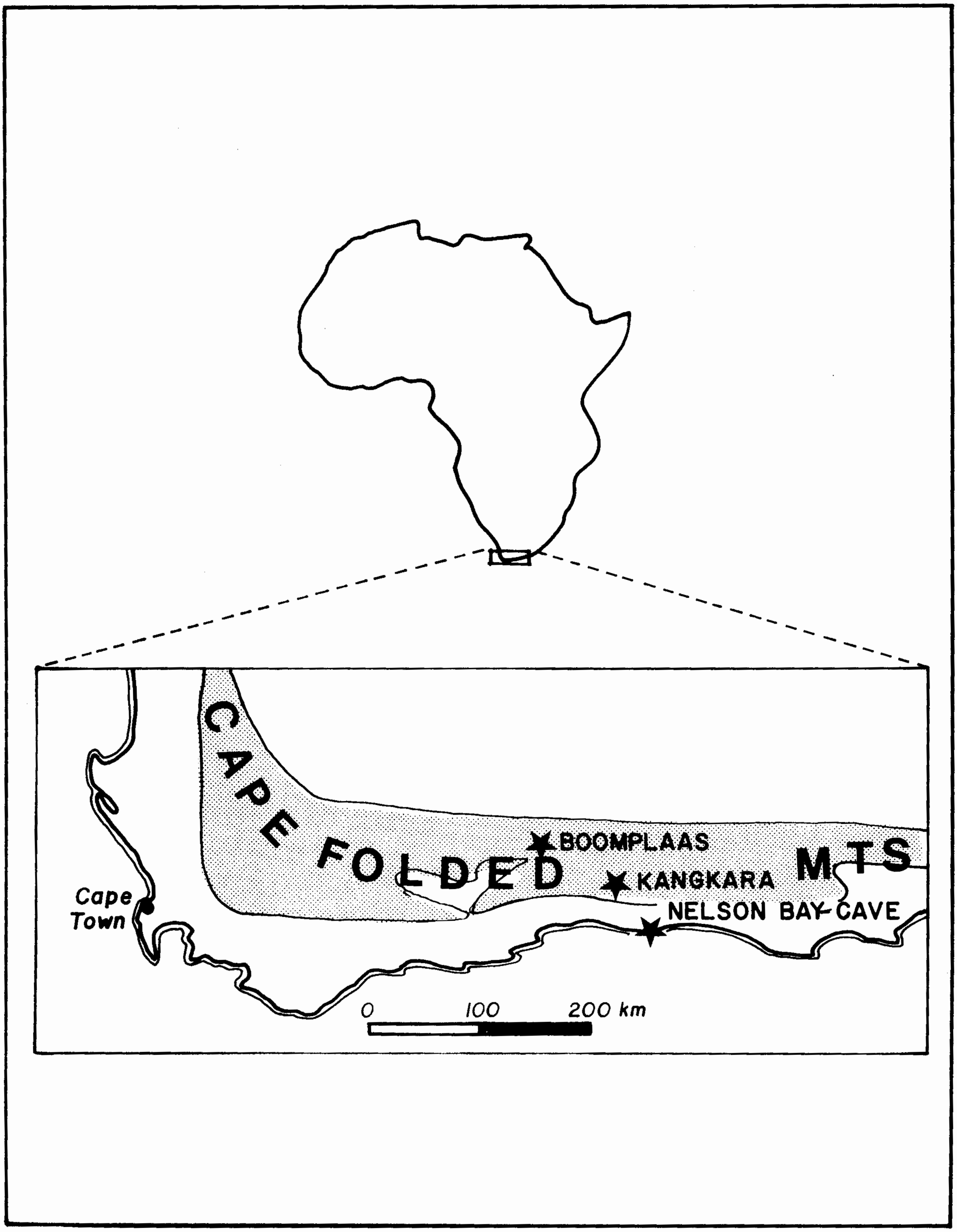
1
INTRODUCTION

FRONTISPIECE

ORIENTATION MAP SHOWING LOCATION OF THE THREE SITES IN RELATION TO AFRICA AND THE SOUTHERN CAPE



INTRODUCTION

The central theme of this thesis is the description, quantification and correlation of changes through time in the stone artefact sequences of the last 20 000 years at three southern Cape sites: Nelson Bay Cave (NBC) situated on the coast, Kangkara (KRA) situated in an intermontane valley some 40 km inland, and Boomplaas (BPA) on the southern slopes of the Swartberg range some 80 km inland (Frontispiece).

The choice of change through time (diachronic change) as the main focus for this research project was motivated by three considerations: firstly, it was considered essential to establish a temporal framework in the southern Cape region before attempting the integration of spatial variability and processual studies; secondly, too little emphasis has been placed on examining the details of diachronic changes in stone tool technology, despite the fact that archaeology is unique in providing a time dimension that is absent in most other disciplines. While ethnographic observations can give some insight into the way hunter-gatherer-fisher subsistence systems operate, only archaeology can contribute a long-term perspective on changes in technological, subsistence and demographic patterns. The third consideration is the assumption of many researchers that environmental changes, generated primarily by changes in climate during the Stone Age, were largely responsible for stimulating technological adjustments. We assume that technology represents one of the ways in which people have adapted to their environment and some aspects of technology are therefore expected to be influenced by external factors similar to those that control biological adaptations. The key concepts in the study of biological evolution are adaptation and selection and the questions of interest in the study of diachronic changes in stone tool technology are the significance of the selections made from the range of possibilities available, and the ways in which these selections helped people to adapt their behaviour to changing environmental and social conditions.

In the absence of ethnographic analogues for long-term changes in stone tool technology in southern Africa, archaeologists have traditionally attempted to interpret changes either as independently invented functional responses to habitat shifts induced by climatic change, or as the result of population migrations and the diffusion of new techniques invented and developed beyond the borders of southern Africa. What the data presented here will show is that the development of the technological tradition we have labelled 'Later Stone Age' is the result of the gradual accretion of traits and toolmaking techniques over a period of some 20 000 years in the southern Cape, and while some aspects of this tradition can be shown to coincide with environmental changes and subsistence strategies, others were more clearly the result of the borrowing of ideas and designs from neighbouring peoples. It is unlikely that one cause or 'prime mover' will be found for all the variability observed. The partial unravelling of the inter-relationships between the diffusion of technology, technological evolution and environmental variables is the concern of the research summarized here.

The excavation programmes, the classification scheme and the methods of analysis used here have been designed to characterize changes in the ways in which stone was flaked and in the range of formal and informal tools that were made, used and discarded at the three sites. These methods are not necessarily adaptable to the interpretation and analysis of other aspects of the Later Stone Age. The classification scheme has been designed to describe the method of flaking by observing the nature of the debris discarded at each stage of the reduction sequence from unflaked nodule to discarded formal tool. Variables that correlate are assumed to be linked to the same selection process and the adaptive advantages of the changes through time are considered by comparing the rate of change in stone tools with the timing of changes in environmental variables, faunal remains and non-lithic artefacts.

After a review of the methods and theories used in Later Stone Age studies during this century, the present-day environmental setting of the southern Cape and the three sites will be briefly described and will be compared with the evidence for past climatic and habitat conditions over the last 20 000 years to establish the timing and the magnitude of the changes which took place. Chapter 4 will describe the excavations and stratigraphic sequences of the three sites and this will be followed by the detailed stone artefact analyses and descriptions of the non-lithic material. In Chapter 6 some of the patterns of change observed will be described and interpreted for the southern Cape and further afield and Chapter 7 places the southern Cape data in perspective by describing the artefacts, dating and subsistence data characteristic of the Later Stone Age sequence in southern Africa. The significance of the observed patterns is discussed in the final chapter and two appendices describe the classification scheme employed for the stone artefacts and the methods of metrication and analysis used.

2

HISTORICAL REVIEW

HISTORICAL REVIEW OF THE METHODS AND THEORIES USED IN LATER STONE AGE STUDIES

The character of the Later Stone Age (LSA) was defined in 1926 by Goodwin and in 1929 by Goodwin and Van Riet Lowe as including assemblages with stone artefacts similar to those of the European Mesolithic (i.e. with a microlithic tradition) and the Neo-anthropic Cultures, meaning those relating to modern man (Goodwin & Van Riet Lowe 1929:7). It was accepted that microlithic tools had been made by the indigenous San (Bushmen) and their ancestors, as is implicit in the use of the term 'Bushman' in the nomenclature of some of the earlier classification schemes (e.g. Gooch 1881; Rickard 1881) and in the observations by Kannemeyer (1890) and Dunn (1931), who saw San making stone tools in the late nineteenth century. Many of the non-lithic items made by San (and pastoralist Khoi) were also found in LSA assemblages demonstrating the antiquity of shell and ostrich eggshell beads and pendants, leather clothing, tortoiseshell bowls, digging sticks and bows and arrows, thereby establishing continuity between the past and the present.

Two main 'cultures' were recognised in the LSA in 1929: the Smithfield and the Wilton. The term Wilton was proposed by Goodwin (1926) as an alternative to his early 'Pygmy' or 'Microlithic' culture to describe assemblages in which microlithic artefacts predominated and which included backed bladelets and, essentially, segments or crescents. Goodwin had seen the material excavated by Hewitt (1921) from the Wilton name site near Alicedale in the eastern Cape and was at pains to explain why the term Wilton was adopted in preference to Smithfield D which may have better described the apparent continuity from Smithfield A through B and C to Wilton. He reasoned that, because the Wilton was the only known LSA industry present in Zimbabwe (then Southern Rhodesia), and because it bore such a strong resemblance to the Capsian of North Africa where Smithfield-type assemblages were also absent, the local Wilton had its origins further north and therefore represented an intrusive element in the South African sequence, the Smithfield being a local development (Goodwin & Van Riet Lowe 1929: 255). Van Riet Lowe shared this view (1926:874).

Regional variants of the Wilton were recognized on the basis of the regional distribution of specialized formal tools. Thus the Free State Wilton (Van Riet Lowe 1947:96) included tanged arrowheads in low frequencies in the northern Cape, Orange Free State and Lesotho (Humphreys 1969) while the Western Cape Wilton included so-called 'double crescents' (Clark 1959:199).

The Smithfield was named after the town of the same name in the Orange Free State because it was here that collections of typical artefacts were made by early pioneers such as Kannemeyer, Van Riet Lowe and others. A three-phase subdivision in A, B and C was suggested because the Smithfield A had "every appearance of being the earliest" (Goodwin & Van Riet Lowe 1929:150). Smithfield B was seen as a development out of A (and therefore younger), with the Smithfield C a 'cave variant' influenced by the microlithic tradition of the Wilton. While the Wilton variants were recognized by the occurrence of specialized formal tools, the Smithfield variants were characterized by differences in the size and shape of one formal tool class, the scrapers. The Smithfield A had predominantly large circular or D-shaped scrapers, often concavo-convex in side view, the Smithfield B was characterized by duckbill endscrapers, thumbnail scrapers, side and notched scrapers, and the Smithfield C was dominated by the small thumbnail scrapers. An additional variable was raw material: hornfels (i.e. lydianite or indurated shale) being preferred for the Smithfield A and B, and chalcedonies, cherts, agates and quartz being used in the Smithfield C. The similarity between the Smithfield C and Wilton was noted by both Goodwin and Van Riet Lowe (1929:150, 187, 255), but it was only later that researchers urged that the terminology should acknowledge it (Willcox 1956; Clark 1959:211; Sampson 1972, 1974; Deacon, J. 1974; Humphreys 1979).

Further variants of the Smithfield were proposed outside of the type area. The Smithfield N was characterized by hollow or notched scrapers found in Natal (Goodwin 1930; Van Riet Lowe 1936), the Umlaas variant was found on the Natal coast and was characterized by flat bi-polar cores made in indurated shale (i.e. hornfels) (Schoute-Vanneck & Walsh 1961), while the Smithfield P was found on the Pondoland coast at Umgazana Cave where large circular scrapers, strangulated and hollow scrapers were made mostly in hornfels (Van Riet Lowe 1936). Finally, the coastal Smithfield, found along the southern and eastern Cape coast, had small scrapers and <u>outils</u>

écaillés made from small, flat water-worn pebbles (Van Riet Lowe 1946).

The theoretical framework within which Goodwin and Van Riet Lowe explained the Smithfield/Wilton dichotomy was clearly stated by Goodwin:

> "From the evidence presently available it seems as though we should adopt as our working hypothesis the assumption that the bearers of the Wilton Industry represent an off-shoot from the Capsian Group of North Africa, and that during the southward migration they moved in successive waves that probably diverged into two main channels - one down the central zone where the Smithfield variations are so well developed, and the other down the east coast where the industry remained fairly constant. A third possible channel is down the western desert route "(Goodwin & Van Riet Lowe 1929:150).

A similar hypothesis was favoured by Van Riet Lowe, but he was apparently content to place to origin of the South African LSA people no further north than the Zambesi River:

> "My personal leanings are toward the "successive wave" theory, i.e. successive waves of typically Neo-anthropic (Wilton) people moving southwards and there influencing the already "settled" communities. As far as Southern Africa is concerned, Rhodesia, in my opinion, is the real home of the Wilton Industry..." (Goodwin & Van Riet Lowe 1929:187-8).

Goodwin and Van Riet Lowe therefore saw the initiation of the LSA as the result of the southward migration of people with a new way of making stone tools and a new range of specialized artefacts, but the subsequent modification of this tradition was the result both of "successive waves" and the influence of such factors as local raw materials and geographic barriers which later isolated regional communities. The reasons for the 'invention' of LSA technology in the first instance, and secondly for the southward migration of Neo-anthropic people, were conveniently shifted north of the borders of southern Africa and were not considered.

The methodology adopted by Goodwin and Van Riet Lowe was designed to identify assemblages as LSA by noting the range of formal tools and cores, and then to plot the geographic distribution of variations upon this theme. The incidence of raw materials, particularly hornfels, the relative frequencies of scraper sub-types and the occurrence of certain key or marker tools were used to characterize regional variants and cultures. While some of the variability was interpreted as change through time, as for example the shift from Smithfield A to B, much of it was assigned to the influence of available raw materials or to the location of geographic features which may have acted as barriers to inter-group communication and the flow of ideas and people. The generalized consequences of the "successive wave" theory made it unnecessary to study details such as the unretouched component of assemblages or the associated faunal and floral remains, while the general lack of long sequence deposits throughout southern Africa and the absence of an absolute dating technique made it difficult to test the hypothesis in any convincing way.

The research strategy adopted by Goodwin and Van Riet Lowe combined a methodology designed to describe and classify assemblages with an explanation that interpreted the patterning through time and space. This combination has all the characteristics of what Binford (1981:83) has called a post hoc accommodative argument. It was necessary to adopt this strategy in the 1920s when relatively little was known about the Stone Age sequence, but it is undesirable to perpetuate it. Now that the general pattern of variability is known, we are in a position to set up hypotheses with test implications and to design methodologies and classification schemes to answer specific questions rather than offer untested 'explanations'. To merely offer new reasons for the variability is unsatisfactory because criteria chosen as important in the classification scheme are not necessarily related to the criteria important for the explanation.

The methodology pioneered by Goodwin and Van Riet Lowe was adopted by most prehistorians over the following 30 years. In the next major synthesis published by Clark in 1959 it is clear that although the data base had been extended, the methodology and the explanations for change were not very different. The Smithfield was still seen as an indigenous development influenced by contact with Wilton peoples:

> "...the periodic appearance of new elements in the material culture during the Later Stone Age also suggests that the cultures of the indigenous peoples were enriched from time to time by the introduction of new forms, new customs and new beliefs which probably found their way into the southern parts of the continent as a result of sporadic infiltration by new ethnic groups" (Clark 1959:215).

The fact that the Smithfield and Wilton cut across natural ecological boundaries encouraged Clark in the belief that "population movements were the underlying cause" of these distributions (Clark 1959:216).

Dissatisfaction with non-quantitative methods and the lack of a standardized typology was voiced in the 1960s (Clark et al 1966; Inskeep 1967), but the reason for wanting standardization was more to allow inter-site comparisons than to relate the methodology to a theoretical base or to test specific hypotheses. Two of the projects that were stimulated by a desire to generate and apply a standard typology produced somewhat different results. Sampson (1967a,b, 1972) was responsible for the analysis of materials from a series of open and rock shelter sites in the Middle Orange River basin of the northern Cape in the type area of the Smithfield and he set out to date the Smithfield and to describe it. The scheme he devised focused on formal tools and core sub-types that were defined on the basis of their size, shape and retouch. Inter-site comparisons assessed the relative frequencies of the types and sub-types in each assemblage with every other assemblage placed into the same culture-stratigraphic unit. Assemblages with similar frequencies of artefacts in certain classes were grouped together and, with the rock shelters providing some time control, a sequence was established. Explanations for the shifts through time were again essentially post hoc accommodative arguments that suggested both population movements and the influence of raw materials, particularly hornfels, which showed some significant and interesting patterns through time. Sampson specifically rejected environmental change as a prime mover in technological change (1974:289, 291, 320). The nature of the shifts were essentially the same as those noted by Van Riet Lowe in that the earliest assemblages were characterized by large scrapers which included concavo-convex forms (or Smithfield A), those in the middle of the sequence had small convex scrapers and backed microliths made in chalcedonies and agates (Smithfield C), while within the last 1000 years, long end-scrapers (Smithfield B) predominated, but Sampson was able, for the first time, to date these stages within the sequence.

Re-excavation of the Wilton large rock shelter, one of the original name sites, was undertaken in 1966/67 by H.J. and J. Deacon. The surprise in analysing the artefact sequence was that the assemblages were not, as Hewitt (1921) had stated, all essentially similar; there were clear, though gradual, changes through time both in the relative frequencies of the formal tools and in the size and shape of the scrapers and backed microliths. The artefact analysis was designed to assess both changes in function (by comparing the relative frequencies of formal tools) and changes in style (by comparing the metric attributes of scrapers) through time. The concept of using different aspects of the data to describe different processes of change which were not necessarily related was a methodological advance, but the explanation offered for the changes was still a post hoc one. Noting that the changes were more gradual than abrupt and that they could not, therefore, be ascribed to the occupation of the site by different people, it was suggested that the sequence in layers 1, 2 and 3 could be seen as an evolutionary development of a single technological theme. The shifts conformed to what might be expected in an ontogenetic model of change with phases of 'birth', 'maturity' and 'death' of the artefact manufacturing system (Deacon, J. 1969, 1972). The nature of the changes noted in this sequence were essentially similar to those noted in the Middle Orange River area by Sampson, but the method of analysis stressed continuity rather than cultural change.

During the 1960s and 1970s analysis of faunal and floral remains for information on subsistence systems was initiated. In terms of the explanations offered for change through time in the LSA, the most important by-product of these analyses was the observation that, in the southern Cape at least, there was a shift in the norms of artefact manufacture in the early Holocene that coincided broadly with a shift in the hunting pattern as reflected in the faunal remains (Deacon, H.J. 1972, 1976; Klein 1972a,b, 1974). The finding of a late Pleistocene set of assemblages that also fell within the range of variation of the LSA at Melkhoutboom and Nelson Bay Cave and the fact that these, too, were associated with a distinctive set of faunal remains, led to the naming of a three-stage sequence in the southern Cape Later Stone Age: the Robberg, Albany and Wilton industries. The explanation offered by H.J. Deacon (1976) rejected the 'successive wave' migration theory and favoured instead a model in which the microlithic toolmaking technique was diffused along linguistic pathways, but was adjusted to cope with changes in climate and habitat through time, and to a lesser extent with environmental conditions at an inter-regional level. This was incorporated into a model of homeostatic plateaux in which it was suggested that the Robberg, Albany and Wilton industries in the southern Cape each represented a period during which the adaptive response (as reflected in the faunal and floral remains) was relatively stable, with shifts in subsistence strategy necessitated at ca 12 000 and ca 8000 B.P. due to changing environmental conditions; these apparently stimulated shifts in the artefact tradition that were distinctive enough to warrant their description under different industrial terms. The fact that similar changes were seen in other ecozones where the same ecological shifts would not have taken place was seen as the result of social contact, with the corollary that where distinctive stylistic variants were geographically localized, this could indicate a lack of inter-group contact (Deacon, H.J. 1976).

A synchronic rather than a diachronic perspective was adopted in the south-western and western Cape by Parkington (1972, 1976, 1977a, b, 1981). Noting that the ages of dassies at death were restricted at the inland mountain site of De Hangen (Parkington & Poggenpoel 1971), Parkington suggested an hypothesis of seasonal mobility reasoning on the basis of historic and ethnographic records that LSA people in the region moved regularly from the mountains in summer to the coast in winter. Mortality profiles of seals at the coastal site of Elands Bay corroborated this by showing that the vast majority of the seals in the deposit died during the winter months and, together with observations on the availability of plant foods in the region, the hypothesis was essentially confirmed. Variability in the stone artefact assemblages was not initially correlated with the subsistence data, but when gross differences between the relative frequencies of scrapers, adzes and backed microliths were noted at mountain, sandveld and coastal sites respectively, it was reasoned that these could be explicable in synchronic functional terms, woodworking being more commonly undertaken at mountain sites, bow and arrow hunting at sandveld sites and generally little all-round maintenance at the coast (Mazel & Parkington 1978, 1981; Parkington 1980). An assumption essential to the functional explanation of this inter-site variability is that the assemblages, most of them from open sites, were all roughly contemporary. The interpretation of the variability did not make recourse to social explanations such as those favoured by Sampson and the methodology was designed to test for functional variability in the counting of only formal tools and the comparison of their relative frequencies.

To summarize, the methods and theories used in the description and explanation of changes in LSA technology in southern Africa favoured migration from the 1920s through the 1950s as a <u>post hoc</u> accommodative argument to account for the occurrence of different 'cultures' and industries. These were recognized as a result of the method of classification which stressed the <u>assemblage</u> as the unit of comparison. In regarding the LSA industries as 'packages' with characteristic artefact types and relative frequencies, the method of analysis involved the listing of the range of formal tools found, with the implication that new artefact types resulted from the influx of new people. Regional variants were recognized as resulting from the use of different raw materials or, later, as the result of the use of specialized tools to cope with tasks specific to the region. Woodworking was one of these.

In the 1960s and 1970s radiocarbon dating, a larger data base, an interest in subsistence, and a general dissatisfaction with the classification scheme led to some changes. The Burg Wartenstein conference in 1965 helped to make it clear that changes in stone artefacts do not necessarily indicate changes in 'culture' and that the terminology should acknowledge that it describes technological change only. With the introduction of quantitative methods it became clear that many assemblages and industries graded from one to the other, rather than providing sharp contrasts, and as the data base increased, so did the variability. With the availability of information on subsistence, the concept of systems and adaptive strategies was introduced offering correlates other than people to link to technological shifts, and stressing the functional role of technology and individual artefact types. The logical extension of this line of reasoning has been the explanation of spatial variability by linking this to differences in the local availability of resources. Thus, for some researchers, the relative frequencies of formal tools are seen as a direct reflection of the frequency with which particular tasks were performed at a site, and not as an indication of the cultural or social affinities of the people who made them.

Others, such as Sampson for example, were more circumspect. Sampson's methodology, designed for the classification of assemblages and the grouping of similar ones into Complexes and Industries, was essentially similar to that of Goodwin and Van Riet Lowe, with the advantage of a much larger sample and the availability of radiocarbon dates. The scheme, however, limited him to the application of post hoc accommodative arguments that drew from the paradigm in which either migration/diffusion or environmental change were the prime movers of technological change, but he was circumspect about choosing one or the other in explaining the origin of the Wilton tradition. On the one hand he proposed that "the possibility of human population movements during the period remains to be considered" (Sampson 1974:321), while also putting forward a more detailed scenario:

> "It now appears that the available field data may support the following hypothesis: the microlithic technology (which is only one stage in the composite hafting of stone armatures in arrow shafts) was favored by hunter-gatherers living in

> the northern Zambian woodland savanna during the period when all the (presently studied) territory to the south was being utilized by groups without any knowledge of these techniques. In archaeological terms this means that the Nachikufan Phase I and the Oakhurst Complex are broad contemporaries. After about 7000 B.C. there is evidence for interaction between these two areas and it is not unreasonable to assume that the appearance of abundant scrapers in the Nachikufan Phase IIA is at least partly the result of contact with Oakhurst technology. In return, the microliths, particularly backed crescents, were adopted by groups in southern Zambia and Rhodesia, and the new techniques were found alongside the Oakhurst tool kit on the southern Cape coast by 6000 B.C. Thus, the Early phase of the Wilton may represent a period of dispersal southwards of microlithic elements into the waning Oakhurst complex" (Sampson 1974:366-7).

As this quotation shows, Sampson sees the introduction of particular artefact types (scrapers, backed microliths) and their relative frequencies as linked to social group factors rather than to functional correlates and the explanations for their diffusion are therefore seen in social terms. The hypothesis does not attempt to explain how the microlithic technology came to be in Zambia in the first place, and is based on the premise (later shown to be faulty) that there were no microlithic assemblages contemporary with the Nachikufan I in South Africa.

In a total rejection of the migration hypothesis, Clark (1974) and Phillipson (1976, 1977) have argued that migration and diffusion played little part in the process of adoption of the microlithic method of toolmaking in southern Africa and they propose instead that this tradition developed independently in a number of different regions and at different times in the past in response to environmental changes. The fact that the change took on a similar direction in so many different regions is explained as due to factors inherent in the ancestral tradition. This solution is more realistic than that which assumes a mass migration from North Africa, but it is unrealistic in rejecting the likelihood that diffusion played a major role in establishing the extraordinary uniformity amongst LSA assemblages in Africa, particularly when modern historic and ethnographic studies have shown how rare independent invention is by comparison with borrowing (Kroeber 1952:60-1; Toynbee 1961:345; Trigger 1978:217). The fault probably lies in the assumption (made implicitly if not explicitly) by Phillipson and by Sampson that the LSA, or at least the microlithic technology that characterizes it, was a 'package deal'.

By seeing it rather as a changing constellation of attributes, amongst which is the tendency to make bladelets from bi-polar and single-platform bladelet cores, it is easier to accommodate hypotheses which include gradual evolution, diffusion and modification of innovations to suit regional requirements. Such a model is more flexible and fits better with the evidence which shows that the elements of LSA material culture are not all of equal antiquity and that shifts in toolmaking techniques and formal tool designs took place throughout the time period of the LSA.

Disenchantment with the migration hypothesis stemmed partly from the realization that no evidence for mass population movements has been forthcoming, although it must also be noted that no-one has set out to test the hypothesis against the data in any systematic way. Where migration is still entertained as a reasonable explanation for change, however, is in the spread of domestic stock and pottery to Stone Age people in southern Africa a little over 2000 years ago. The reasons for favouring this hypothesis lie in linguistic and ethnographic data rather than archaeological sources. Westphal (1963) has suggested that the languages spoken by herders at the Cape at the time of European contact were sufficiently different from their hunter-gatherer neighbours and sufficiently similar to present-day Tshu-Khwe-speakers in Botswana to warrant the hypothesis that Tshu-Khwe-speakers acquired sheep, cattle and pottery from neighbouring Iron Age people in Zambia and migrated southwards to the Cape coast, eventually occupying much of the Cape and Namibia. Despite this lead, it has been difficult to substantiate the theory with archaeological data. There is no apparent difference in the stone artefacts of some pre- and post-herder people at sites where both occur and the pottery styles of herders in the southern Cape bear no clear relationship to those in Botswana. It is therefore questionable whether we can indeed trace prehistoric migrations through stone artefacts and other technological items, and we need a re-assessment of the changes we could expect to find had migration indeed occurred.

The ingenuous acceptance of the theory that migrating peoples introduced the microlithic toolmaking technique to southern Africa is similar to the attitudes of British prehistorians who saw all inventions appearing in Britain as having originated in Europe. J.G.D. Clark (1966) suggested that the preoccupation with migration amongst British prehistorians amounted to an insular inferiority complex which would not allow them to credit ancient Britons with the ability to invent anything for themselves. In the same way, perhaps, southern African prehistorians have tended not to credit the indigenous LSA people with much creativity either.

The beginnings of doubt about the suitability of migration as a realistic explanation for the appearance of a microlithic technology in southern Africa can be seen in J. Desmond Clark's contribution to the Second Pan-African Congress on Prehistory in which he suggests that diffusion of ideas rather than migration of people would have been a more likely process and he cites the spread of smoking tobacco in Africa as an example of the rapidity with which a popular trait has diffused through the subcontinent in recent times (Clark 1955:363). He was also able to show that radiocarbon dating even then demonstrated that the Capsian and the Wilton were contemporary so that the latter could not have been derived from the former (Clark 1954:6-7).

The problem of the archaeological identification of an immigrant population has proved difficult even in circumstances where there is good historical evidence for the migration, especially where the two populations are of the same basic physical type and utilized the same food resources. Giles Clarke, in trying to trace the movements of people in Late Roman times in western Europe, considers that the major problem is in finding agreement on the criteria by which the immigrant population can be recognized (Clarke, G. 1975:46-7). The reason is that indices for change will vary according to the time, place and environment. For example, while Clarke argues that burial practices are the best criterion for identifying intrusive populations in western Europe during the Late Roman period, Adams (1968:209) demonstrates that they do not reflect populations movements in Nubia. Furthermore, archaeologists' ideas have changed and traits that were at one time taken to indicate migration are now seen as evidence for diffusion in the Bronze and Iron Ages in Britain (compare Clark, J.G.D. 1966 and Renfrew 1969). Thus, while it may be desirable to set up test implications for Stone Age migrations in southern Africa, without ethnographic evidence we cannot guess yet at the criteria which will be the most relevant.

Given the difficulties of recognizing migrant populations in the LSA record, it may be more realistic to view migrations as events within the continuum of diffusion. This would recognize that migrations can occur, but because of the difficulty of recognizing either migration <u>or</u> diffusion archaeologically, we are most unlikely to find unequivocal evidence for either without some clues from historic or ethnographic records. Thus to stress one or the other is to overlook the more important issue of understanding the reasons for the acceptance of the innovation in the first place;

in trying to decide whether the bow and arrow was introduced to southern Africa by a progressive son-in-law, by an invading horde of migrant Ugandans, or by a yachtload of Egyptian tourists, the very fact that they were accepted, adopted and adapted has sometimes been overlooked.

As an alternative to the rather worn term 'diffusion', Trigger (1978: 218) suggests 'cultural borrowing' and it would seem to be a more flexible and useful concept. The word 'borrowing' helps to shift the emphasis, placing the onus on the recipient rather than the donor in passing on the ideas and new traits, stressing the selective role played by the recipient in the transaction and overcoming the passive role of both donor and receiver implicit in the diffusion model.

The criteria for recognizing change stimulated by environmental and subsistence strategy shifts are no more explicit. They require that there should be changes in the artefact record that coincide with changes in the range of animals hunted as evident from the faunal remains and other climatic indicators. We have no precedents from ethnographic data, however, to indicate whether we should expect a time lag between subsistence shifts and technological change, nor whether the same climatic change will have similar or different effects in different ecozones. There are precedents in the present day for technology changing well before adjustments in subsistence (the present day Kalahari San, for example, still subsist largely by hunting and gathering, but they have not made stone tools for over 100 years), and for the technology remaining stable during fundamental changes to the subsistence system (sites in southern Africa often show no change in the stone toolkit after the introduction of domestic stock). It is only by careful documentation of archaeological data that show coincidental changes in technology and other parts of the system that we shall be able to build up a data base from which pertinent criteria can be tested. For the moment the data we have for climatic and habitat changes are sparse and often contradictory, but there is no reason why we should not be able to set up testable hypotheses in the future, particularly in view of the excellent data from Boomplaas presented in this thesis.

We find patterns because we look for them, but we will only find meaningful patterns if we know what to look for and how to look. This somewhat circular dilemma underlines the difficulties experienced by archaeologists in interpreting prehistoric behaviour from the patchy archaeological record. Our decisions on what to look at are also determined by the paradigm within which we are working at any particular time and place.

Many of the disagreements that have arisen between archaeologists over the last century have centred on the relevance of the organizational or classification schemes that have been proposed, but the dissatisfaction that arises, particularly between successive generations of archaeologists, is the result not so much of faulty logic, but of shifts in our concepts of what aspects of prehistoric life are reflected in the archaeological remains and which of these are 'relevant'. Over the last 60 years there has been a shift away from the belief that constellations of artefacts represent the material culture of prehistoric ethnic groups and that changes in the elements of this constellation represent changes in the identities of the makers, towards the belief that constellations of artefacts tell us more about what the people did than about who they were. Almost all the explanations offered, however, remain post hoc accommodative ones that provide a 'reasonable' interpretation within a relevant paradigm. Archaeology in general has been unsuccessful in offering explanations except where homologous ethnographic parallels can be drawn so that where these are absent the life expectancy of an explanation may be less than that of the person who suggested it. As in palaeontology, it is not a simple matter to test these interpretations within the hypothetico-deductive framework and, as expressed by Eldredge (1979:17):

> "Many of the controversies in contemporary evolutionary biology stem not so much from the relative merits of the logic or data used in arguing a particular point of view, but rather from fundamentally different approaches taken by the investigators... The argument is, in the end, over which approach to evolutionary theory is the most appropriate."

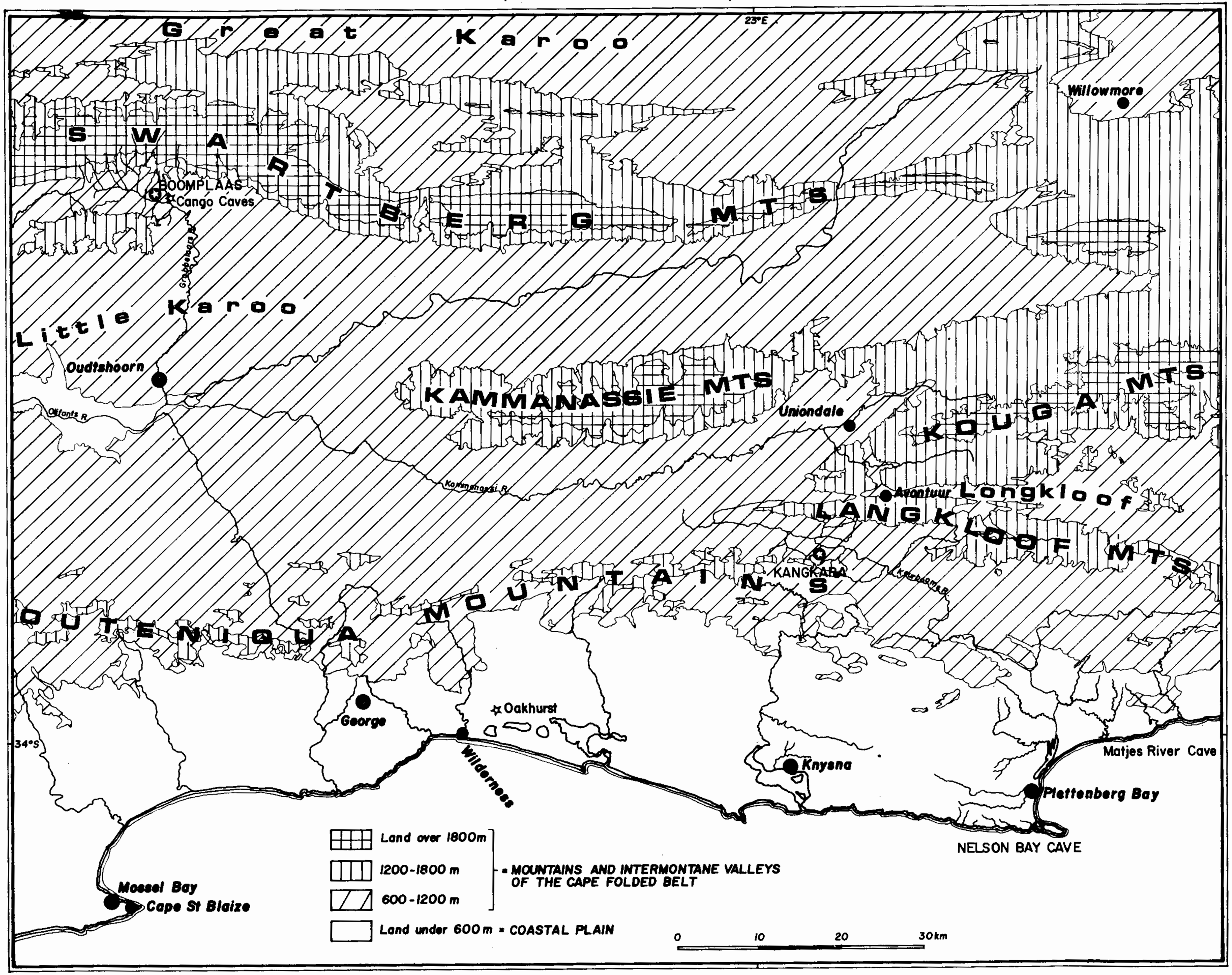
It is easy enough to criticize the explanations offered by other researchers, but it is less easy to propose an alternative that will be universally acceptable.

The patterns that will be sought in this study of the sequence of changes in the LSA of the southern Cape are those that we assume will tell us how people were making stone artefacts and in what ways their methods and goals changed through the last 20 000 years. The patterns through time will be compared with those observed in modern technological change to identify traits common to all technological systems and to find those that are unique to the LSA. In reviewing the evidence for correlations between language, physical type and culture, Hodder (1978a:12) concludes that "we cannot be confident that archaeological cultures relate in any straightforward way to other aspects of social and cultural life", but he claims that the reason for this failure to find correlations is that our usual approaches have been too crude because they consider "archaeological cultures as mass, composite and unitary phenomena" (ibid:24). Acknowledging that this is a bias that needs adjustment, the artefact analyses of the NBC, KRA and BPA sequences will explore the interrelationships of the components of the assemblages rather than the assemblages as a whole. The problem arises, however, in the interpretation of the results. Although ethnographic analogues will be applied wherever possible, we shall never be able to obtain sufficient ethnographic evidence for the construction of middle range theory for stone artefact studies specific to southern Africa. It is, quite simply, too late and explanations are for the most part post hoc accommodative arguments that rely on common sense and an appropriate approach.

3

ENVIRONMENTS PAST AND PRESENT

Fig. 1
Map of the southern Cape



ENVIRONMENTS PAST AND PRESENT

The southern Cape, as defined for the purposes of a recent study of the Cape coastal regions (Heydorn & Tinley 1980), extends from Cape Agulhas in the west to Cape Padrone in the east and from the coast in the south to the interior margin of the Cape Folded Mountain Belt in the north, an area of approximately 650 km from west to east and about 100 km from north to south. In this thesis, however, only that portion of the southern Cape in the vicinity of the three sites excavated will be considered in detail (Fig. 1). The southern Cape has been subdivided into three habitat zones: the coast and coastal lowlands to about 600 m above sea level, the intermontane valleys of the Cape Folded Mountains, and the mountain chains themselves. Nelson Bay Cave is situated on the coast, Kangkara is in one of the major east/west intermontane valleys, and Boomplaas is on the southern slopes of the highest of the mountain chains, the Swartberg (Fig. 1). No site from the coastal forelands is included, but the Oakhurst Cave, excavated by Goodwin in the 1930s (Goodwin 1938), would fill this gap in the sampling programme. The major geographic features of the zones will be described below, together with the more detailed setting of each site. In the second part of the chapter the evidence for past environments will be reviewed, with particular emphasis on evidence for climatic changes over the last 20 000 years in the southern Cape.

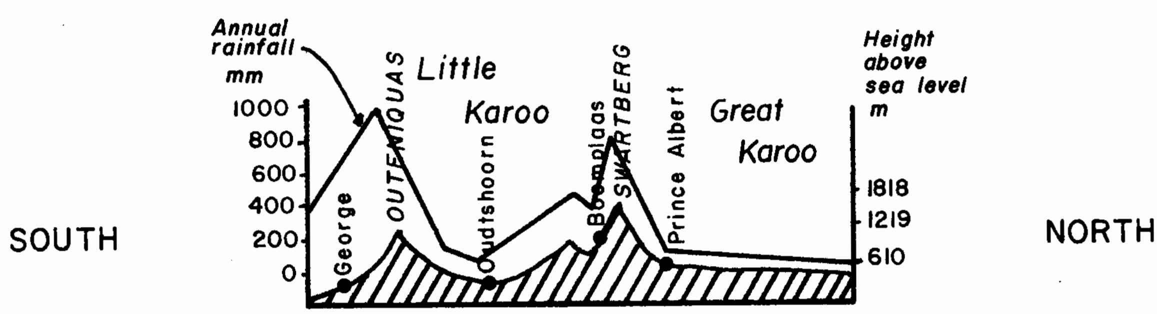
PRESENT DAY ENVIRONMENTS

The coast and coastal lowlands

The southern Cape coastline is marked by a series of westward-facing half-heart bays formed by the presence of resistant arms of the Cape Folded Mountains which extend into the sea as capes, and the clock-wise Return Agulhas Current which scours the capes clean and deposits the sand load along sandy beaches between them. The sandy beaches are interrupted by blocked river mouths and by rock cliffs where the mountains come close to the shore (Taljaard 1949:102; Heydorn & Tinley 1980).

Immediately inland from the coast the gently undulating plain of the coastal lowlands is about 20 km wide in the west, narrowing to a few km in the east where mountains come closer to the coast. On the coastal lowlands, basement rocks of the Table Mountain Group are overlain in parts by surficial deposits of both continental and marine origin, particularly windblown sands and Cretaceous estuarine conglomerates of the Enon Series or their re-worked derivatives. The lowland is elevated to about 600 m above sea level, shelving slightly to the sea. It is deeply dissected by a number of short rivers and several longer ones which drain the Cape Folded Mountains and have cut deep gorges at times of low sea level but have drowned estuaries at present. This deep dissection inhibited development of the region in the vicinity of Nelson Bay Cave after European contact and the first road along the coast between Plettenberg Bay and the Gamtoos River mouth was constructed as late as the 1890s (Skead 1980:813).

The climate of the coast and coastal lowlands has been described in a simplified Köppen classification as Cfb (Schulze & McGee 1978:38-9), i.e. a warm temperate climate without frost, sufficient precipitation during all months, and with the warmest month below 22°C, but at least four months above 10°C. The southern Cape east of Mossel Bay is situated between the summer and winter rainfall regions of South Africa and thus receives rain from both weather systems throughout the year, but with peaks in spring and autumn. Relief exerts a marked influence on rainfall of the region, much of which is orographic. This can be seen clearly in the diagram below which shows that sites on the windward slopes (south facing), as for example George, receive much more rain than those in the rain shadow, for example, Oudtshoorn.



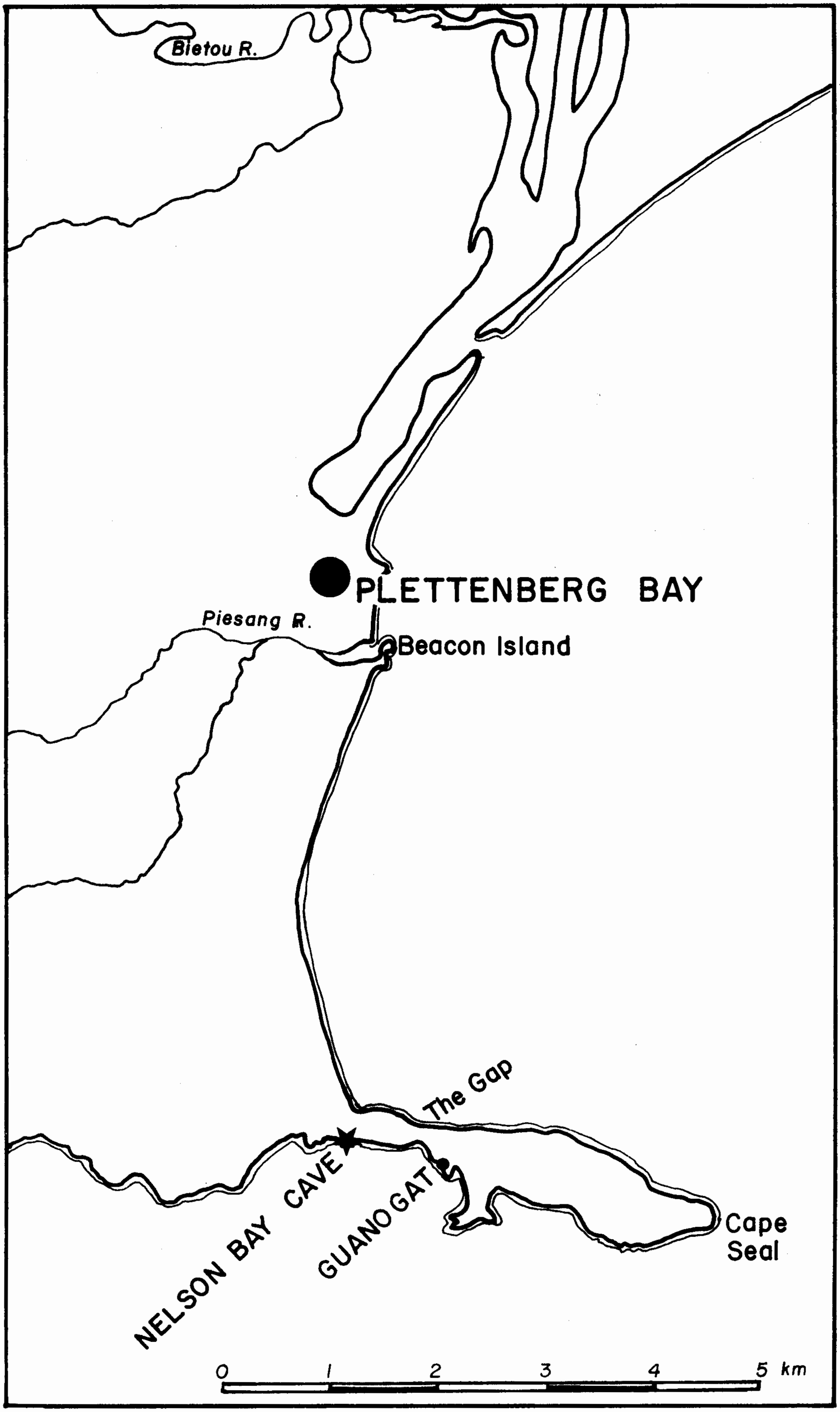
The vegetation on the coast and coastal lowland ranges from Coastal Cliff Fynbos on the rocky coastal areas from Knysna to Nature's Valley (east of Matjes River on Fig. 1), through Afromontane temperate forest on the coastal plain and wetter slopes, to Mountain Fynbos on the mountain slopes. The Coastal Cliff Fynbos is characterized by a general lack of proteoid species and is more akin to Mountain Fynbos than to the Coastal Fynbos found further west because it occurs on a similar quartzite substrate (Taylor 1970). The Afromontane forest, known locally as Knysna forest, has a distinctive plant community for although several species are common to the montane forests of tropical Africa, several others are subtropical species and the two yellowwoods, Podocarpus latifolius and P. falcatus in particular, are relicts of the older southern Cape flora which is not found further north (Von Breitenbach 1974:12).

The amount of plant food available to herbivores is less in the forest than in more open areas, but in early historic times (17th - 19th centuries) there were open glades with coarse grasses used by buffalo and red hartebeest (Skead 1980). Other larger mammals noted by early travellers in this area include eland, blue antelope (now extinct), bushbuck, blue duiker, elephant, hippopotamus, Cape lion, caracal, lynx, spotted hyaena, bushpig, vervet monkey and baboon (Skead 1980). Thunberg (1795:190) noted many seals basking on the rocks of the Robberg Peninsula near Nelson Bay Cave.

The marine environment from Plettenberg Bay to Cape St Francis is classified within the warm-temperate south coast of Brown & Jarman (1978: 1257 ff). South of 30°S latitude the warm Mozambique current is joined by the southern stream of the South Equatorial current and becomes what is known as the Agulhas current off the south-east and south Cape coast. It is relatively fast-flowing and closely follows the edge of the continental shelf, here some 90 km south of Plettenberg Bay and widening to the south and west, but narrowing to the north and east. Although the temperature of the current drops as it moves south, the core remains at some 25°C south of Plettenberg Bay. The influence of local wind patterns and the lifting of cold Intermediate and Central Antarctic water onto the continental shelf in summer, however, can cause rapid and extreme temperature fluctuations so that the lowest and highest temperatures limit the distribution of species invading from the warmer east coast shores and the cooler west coast (Brown & Jarman 1978:1257).

Fig. 2

Nelson Bay Cave and the Robberg Peninsula



The setting of Nelson Bay Cave

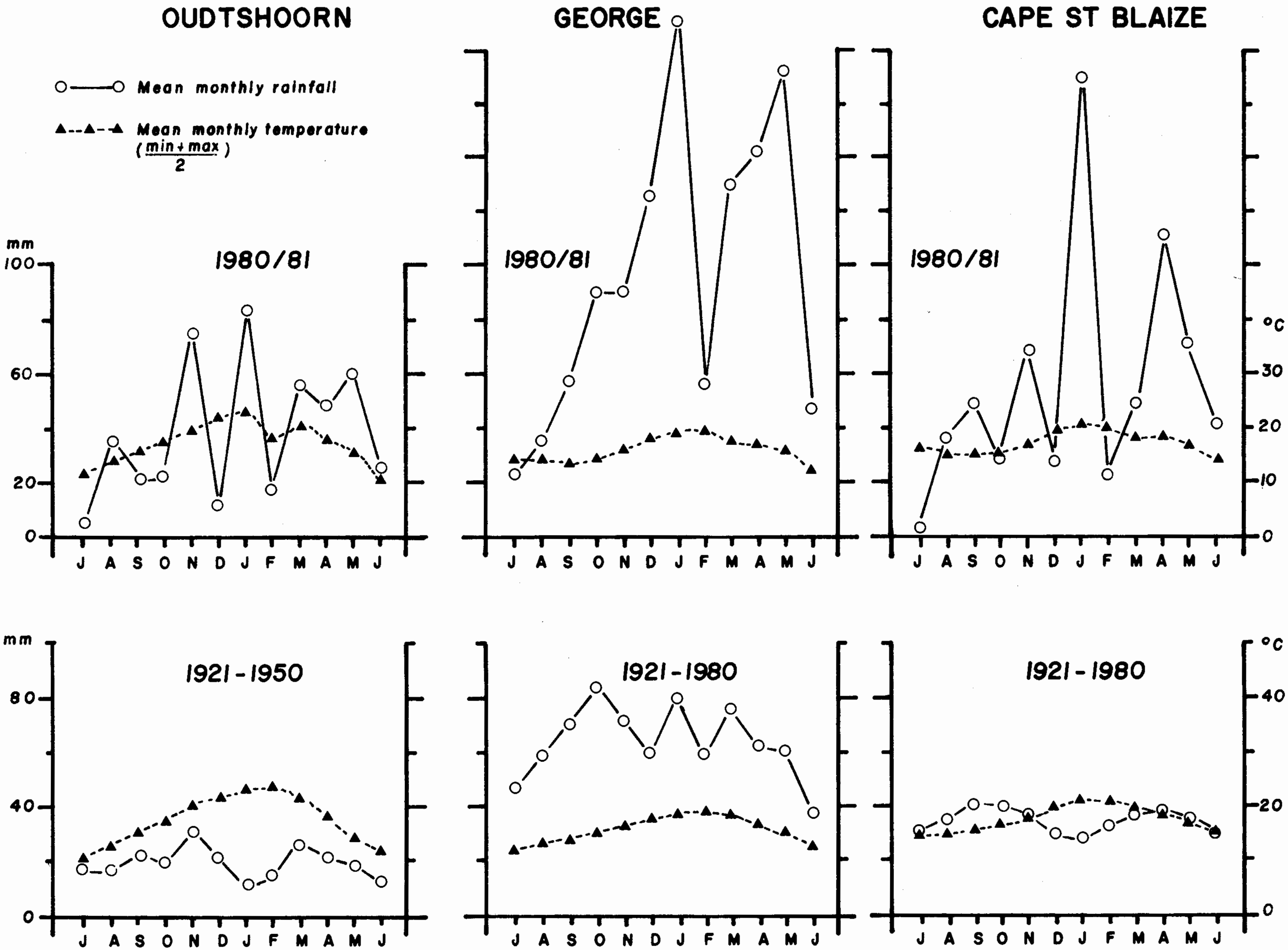
Nelson Bay Cave (34.6.10S; 23.22.30E) is situated on the southward side of the east-west-trending Robberg Peninsula, near the junction of the peninsula with the mainland and about six km south of the village of Plettenberg Bay (Fig. 2). Rocks of the Table Mountain Group and Cretaceous Enon conglomerate form the foundations of the peninsula and as they dip away from the sea on the northern side, precipitous cliffs result. On the south side, sloping surf runs leave sandy patches between rocky shores (Rogers 1966:5-6). The prevailing south-westerly winds have formed dune sands on the south-east side of the peninsula and on the top of the cliffs in places. On the landward (western) side, the peninsula reaches a height of 73 m a.s.l., rising to 153 m east of the Gap. West of the Cape Seal lighthouse on the eastern end it is still high at 145 m, but drops rapidly to sea level at the point.

The rocky shores of the Robberg Peninsula are inhabited by the typical south coast fauna listed in Table 1, the dominant mussel being *Perna perna* (the brown mussel) and the most common limpets being *Patella cochlear*, *P. granularis* and *P. oculus*. Those species that have been identified in the NBC deposits are marked in the table. Fish abound on the sheltered northern side of the peninsula and line fishing is still popular on both sides of the peninsula today. Whales and dolphins are regularly seen in Plettenberg Bay, but the seals noted by Thunberg and apparently hunted or collected by the Stone Age inhabitants of the cave are no longer present.

Detailed weather data are not available for a site in the immediate vicinity of Plettenberg Bay, but climographs for George and Cape St Blaize are presented in Fig. 3 to demonstrate the equability of temperature in similarly situated sites. The difference in rainfall between Cape St Blaize and George is due to the fact that George is closer to the mountains and therefore receives more rain. Nelson Bay Cave is in a situation more similar to that of Cape St Blaize with a mean annual rainfall of between 600 and 700 mm and a mean annual temperature of about 17°C (Fuggle & Ashton 1979).

Vegetation on the peninsula and surrounds varies according to substrate and aspect. Taylor (1970) conducted a survey of the vegetation for the International Biological Programme and recognized five plant communities on the peninsula:

Fig. 3
Climographs for selected stations in the southern Cape



a. _Erica-Phylica_ microphyllous evergreen steppe fynbos
b. _Phylica-Passerina_ microphyllous evergreen steppe coast fynbos
c. _Metalasia-Restio_ grey evergreen microphyllous shrub pseudo-savanna
d. _Eriocephalus_ open microphyllous evergreen scrub
e. Mesophyllous open microphyllous evergreen scrub.

Nelson Bay Cave itself is surrounded by plants of community (e) with woody shrubs and climbers that are absent on the rockier northern coast of the peninsula. All five communities are grouped under the general heading of Coastal Cliff Fynbos which Taylor (1978) describes as occurring along the entire length of the rocky coast between Knysna and Nature's Valley. A full list of the edible and medicinal plants found on the Robberg Peninsula is given in Table 2. In general it is clear that, today at least, the vegetation on the peninsula would not provide plant food staples in any quantity and those berries and fruits that are present are highly seasonal and not abundant. They are most plentiful in spring and summer.

On the windblown sands north and east of the peninsula and inland from the beach the vegetation is invaded by aliens today, but would probably have been similar to Taylor's South Coast Scrub (Taylor 1978: 213) which is dominated by the melkhoutboom, _Sideroxylon inerme_, which has edible berries (Smith, C.A. 1966).

Where the substrate provides better soils, as in the valleys of the Piesang and Bitou Rivers and a few km inland from the coast, the Afromontane Knysna forest is prominent. It is at present greatly depleted and the transition from fynbos/South Coast scrub to forest could have been closer to the coast in former times. However, the distribution of soils makes it unlikely that forest was ever much closer to NBC than the valley of the Piesang River about 5 km to the north.

The first written description of Plettenberg Bay is that of Duarte Pecheco Pereira who accompanied Bartholomeu Diaz on part of his return journey from the southernmost tip of Africa in 1488. He makes particular mention of the Beacon Island at Plettenberg Bay and the numerous seals and sea birds there (Storrar 1978). In 1630 the survivors of the San Gonzales, who had been shipwrecked off Robberg beach, built a house, a church and two small vessels in which they eventually sailed away. They stayed about eight months from late August and their account is of particular interest because they met and bartered with a group of Khoi

Table 1

SHELLFISH SPECIES FOUND ON A ROCKY SHORE TRANSECT IN THE WARM TEMPERATE SOUTH COAST PROVINCE . Species identified in levels at Nelson Bay Cave are noted. Species not normally eaten are marked with an asterisk.* Modern data after Brown & Jarman (1978:fig. 8). NBC data after Klein (1972a). *x* = present, *xx* = moderately abundant, *xxx* = abundant.

LITTORAL ZONE		SPECIES	NBC UNITS							
			IC	BSC	RA	RB	J	BSBJ	CS	GSL
Supra Littoral		*Littorina knysnaensis*								
		Patella granularis								
Supra Littoral Fringe	*	*Chthamalus dentatus*								
	*	*Tetraclita serrata*								
	*	*Octomeris angulosa*								
		Patella granularis								
		P. oculus								
		Thais dubia								
		Oxystele variegata	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
	*	*Acanthochiton garmoti*								
	*	*Actinia equina*								
Upper Mid Littoral	*	*Balanus trigonus*								
	*	*B. algicola*								
	*	*Octomeris angulosa*								
		Cyclograpsus punctatus								
		Patella oculus								
		P. granularis								
		Chiton tulipa	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
		Thais dubia								
		T. squamosa								
Lower Mid Littoral		*Patella barbara*	*x*		*x*	*x*	*x*	*x*	*x*	*x*
		P. longicosta	*x*	*x*	*x*	*xx*	*xx*	*xx*	*x*	
	*	*Pseudactinia ssp.*								
	*	*Parechinus angulosus*								
	*	*Henricia ornata*								
	*	*Patiriella exigua*								
	*	*Amphiura capensis*								
		Plagusia chabrus								
		Burnupena cincta	*x*			*x*	*x*	*xxx*	*xx*	*xx*
		Oxystele sinensis	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
		Oxystele tigrina								
		O. variegata								
	*	*Gibbula rosea*								
		Dehaanius dentatus								
	*	*Balanus algicola*								
	*	*Octomaris amgulosa*								
	*	*Balanus maxillaris*								
		Patella barbara	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
		P. longicosta	*x*	*x*	*xx*	*xx*	*xx*	*x*	*x*	
		P. granularis								

Table 1 contd.

LITTORAL ZONE	SPECIES	IC	BSC	RA	RB	J	BSB.1	CS	GSL
Lower Mid-Littoral contd.	*Patella oculus*								
	Perna perna	xxx	xxx	xx	xx	xx	x	x	x
	* *Dinoplax gigas*								
	Thais dubia								
	T. squamosa								
	Crassostrea								
	* *Margaritacea*								
	* *Gunnarea capensis*								
	* *Pomatoleios crosslandi*								
Sub Littoral Fringe	* *Aulacomya ater*								
	* *Bunodactis reynandi*								
	* *Bunodosoma capensis*								
	Pyura stolonifera								
	Patella cochlear	x	x	x	x		x	x	x
	P. barbara	x		x	x	x	x	x	x
	P. longicosta	x	x	xx	xx	xx	x	x	
	P. miniata								
	P. argenvillei	x	x	x	x	x	x	x	x
	Perna perna	xxx	xxx	xx	xx	xx	x	x	x
	Dinoplax gigas								
	Oxystele sinensis	x	x	x	x	x	x	x	x
	O. tigrina								
	O. variegata								
	Thais dubia								
	T. squamosa								
	Turbo cidaris								
	* *Marthasterias glacialis*								
	* *Patiria granifera*								
	* *Gunnarea capensis*								
	Burnupena cincta	x			x	x	xxx	xx	xx
	* *Pseudonereis variegata*								
Sub Littoral	* *Aulacomya ater*								
	* *Balanus maxillarus*								
	Haliotis midae		x	x	x	x	x	x	x
	H. sanguinea	x	x	x	x	x	x	x	x
	Patella tabularis	xx	x	x	x	x	x	x	x
	P. argenvillei	x	x	x	x	x	x	x	x
	* *Parechinus angulosus*								
	* *Henricia ornata*								
	* *Patiriella exigua*								
	* *Marthasterias glacialis*								
	* *Ophiothrix triclochis*								
	* *Gunnarea capensis*								
	Burnupena cincta	x			x	x	xxx	xx	xx
	Thais squamosa								
	Plagusia chabrus								
	Turbo samarticus	x	x	xx	xx	xx	x	x	xx

Table 2

EDIBLE AND MEDICINAL PLANTS RECORDED ON THE ROBBERG PENINSULA (after Taylor 1970)

ASSOCIATION	DESCRIPTION	SPECIES	COMMON NAME	KNOWN USE
1	*Erica-Phylica* Microphyllous Evergreen Steppe Fynbos	*Agathosma ovata*	Wilde boegoe	Medicinal
		Virgilia oroboides	Keurboom	Gum used as starch
2	*Phylica-Passerina* Microphyllous Evergreen Steppe Coast Fynbos	*Eriocephalus umbellatus*	Wilderoos-maryn	Kapok/leaves
		Euclea racemosa	Bosghwarrie	Edible fruit
		Rhus crenata	Korentebessie	Edible fruit
		Rhus glauca	Korentebessie	Edible fruit
		Sideroxylon inerme	Melkhoutboom	Edible berry
		Zygophyllum morgsana	Vetbos	Stock food
		Agathosma apiculata	Knoffelboegoe	Medicinal infusion
		Astephanus neglectus	Bokhoring	Edible buds Oct/Nov
3	*Metalasia-Restio* Gray Evergreen Microphyllous Shrub Pseudo-Savanna	*Olea exasperata*	Slanghout	Anti-snakebite
		Chironia baccifera	Aambeibessie	Remedy for piles
		Carpobrotus acinaciformis	Sour fig	Edible and medicinal
		Euclea racemosa	Bosghwarrie	Edible fruit
		Rhus mucronata	Korentebessie	Edible fruit
4	*Eriocephalus* Open Micro-phyllous Ever-green Scrub	*Chironia baccifera*	Aambeibessie	Remedy for piles
		Pelargonium cf inquinans/zonale	Malva	Medicinal
		Rhoicissus digitata	Boesmansdruif	Edible fruit Dec-March
		Capparis sepiaria	Cape caper	Edible buds
		Zygophyllum morgsana	Vetbos	Stock food
		Carissa bispinosa	Num-numbos	Edible fruit
		Grewia occidentalis	Kruisbessie	Edible drupes Wood for bows
		Cassine tetragona	Droëlewer	Astringent edible fruit
		Kedrostis nana	Ystervark-patats	Tuberous edible rootstock eaten by animals

Table 2 contd.

ASSOCIATION	DESCRIPTION	SPECIES	COMMON NAME	KNOWN USE
5	Mesophyllous Evergreen Broad Sclerophyll Mixed Coastal Scrub	*Sideroxylon inerme*	Melkhoutboom	Edible berry
		Rhoicissus digitata	Boesmansdruif	Edible fruit Dec-March
		Capparis sepiaria	Cape caper	Edible buds
		Lycium campanulatum	Slangbessie	? Edible fruits
		Kedrostis nana	Ystervark patat	? Edible
		Cassine tetragona	Droëlewer	Astringent edible fruit
		Carissa bispinosa	Num-numbos	Edible berry
		Rhus crenata	Korentebessie	Edible fruit
		Zygophyllum morgsana	Vetbos	Stock food
		Euclea racemosa	Bosghwarrie	Edible fruit
		Chrysanthemoides monilifera	Bietou	Juicy edible fruit Oct-May
		Carpobrotus edulis	Hotnotsvy	Edible fruit

Note: Information on common names and known usage from Smith, C.A. (1966).

herders who had both cattle and sheep:

> "These savages are not quite black, they go about naked, with a small piece of skin around their loins; in winter they add to this capes of the same. They wear copper bracelets on their arms, and around their necks the sinews of oxen... They have no towns, but wander about in bands with their flocks, after the manner of the Arabs. Some, but not all, carry portable tents made of stakes and mats... They invited our men to partake of cake, which appeared to be made of the flour of roots and oxen's dung kneaded together. They also eat the flesh of the oxen, but almost raw, as no sooner is it put on the fire, which is made by rubbing two sticks together, than they take it off again... Their arms are assegaais and bows" (quoted *in* Storrar 1978:16).

The presence of people with cattle and sheep along this coast would suggest that there were areas which included suitable grazing and that movement was possible inland through the forest. One of the plants identified by Taylor (1970) at the southern end of the peninsula is *Zygophyllum morgsana,* the vetbos. C.A. Smith (1966:483) describes it as a robust shrub of up to 1,2 m high which was taken to Holland about A.D. 1700 to be cultivated as a stock food. This would presumably have provided suitable cattle feed in the Coastal Cliff Fynbos where the grass element is reduced. The fact that the Khoi were eating 'cakes' of what was very likely ground corms rather than roots suggests, too, that geophytes were readily available in the vicinity.

Intermontane valleys of the Cape Folded Mountains

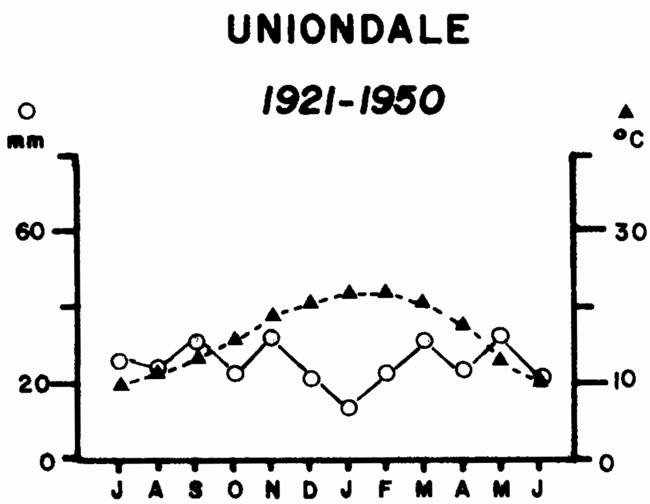
The Cape Folded Mountains in the southern Cape are composed of rocks of the Cape Supergroup with east-west-trending ranges of predominantly Table Mountain Sandstone. Each of the ranges is composed of multiple anticlines overfolded to the north and bounded on the south by prominent faults forming a series of intermontane valleys parallel with the coast and the mountain ranges. Bokkeveld shales are often exposed on the valley floors. The most persistent ranges in the southern Cape are the Swartberg to the north along the southern boundary of the Great Karoo, and the Outeniqua to the south just inland of the coastal lowlands. Between them the folded chain is broken and impersistent, but the Kammanassie, Kouga and Baviaanskloof ranges are prominent in the region discussed here (Fig. 1). The Swartberg reach a maximum elevation of about 2100 m, but the

Outeniquas are lower with a maximum height of 1600 m to the east of Kangkara Cave.

The most prominent of the intermontane valleys is known as the Langkloof. It is formed between the Outeniqua and Tsitsikama mountains to the south and the Kouga and Baviaanskloof ranges to the north, and is drained mostly by the Krom River which flows eastwards and empties into the sea near Cape St Francis. From Avontuur in the west to Kareedouw in the east the Langkloof is some 125 km long and, at its widest point, about 5 km across at the 900 m contour.

With annual precipitation at Avontuur about 450 mm, the climate of the Langkloof and vicinity is semi-arid (BsK in the Köppen classification used by Schulze & McGee (1978:39)), although the Krom and other rivers and streams provide a permanent water supply in the valley itself. A climograph for Uniondale, the weather station nearest to Kangkara, is given below (Fig. 4) to illustrate a dry summer and shallow rainfall peaks in spring and autumn.

Fig. 4



The vegetation on the quartzitic mountain slopes surrounding Kangkara and through the Langkloof is Mountain Fynbos in a variety of forms depending on soils, aspect and rainfall (Taylor 1978; Kruger 1979) with ericoid, proteoid and restioid species predominating. Grasses increase with soil fertility and summer rainfall to the east (Kruger 1979 :96) and trees are rare and generally confined to well-watered kloofs. The vegetation on the valley floors prior to the settlement of European farmers is likely, from the Bokkeveld substrate and the remarks of early travellers such as Schrijver (Mossop 1931), to have been renosterveld. Larger mammals noted by Sparrman (1785:269ff) include buffalo and hartebeest, as well as elephant and smaller browsers such as bushbuck and grysbok. Thunberg (1795:53, 58) added eland and oribi to this list and remarks that their oxen were attacked by hyaena in the Langkloof.

The flat topography, permanent water supply and soils derived from Bokkeveld shales made the Langkloof an ideal route for travellers who wished to avoid the dense vegetation and steep valleys of the coastal forelands to the south and the dry Karoo to the north. The majority of the European travellers of the 17th-19th centuries were led this way by Khoi guides who knew the route to be reliable and relatively easy for ox waggons and horses. The first of these travellers to have recorded his impressions in print was Ensign Schrijver who was commissioned to take a party to the eastern Cape by land in 1689 (Mossop 1931). Having passed to the north of Mossel Bay on 25 January, they were shown a way through the mountains inland by a 'Gauris Hottentot' (Mossop 1931:219) who led them across the Attaquaskloof, still used today as a pass through the Outeniqua mountains from the coast. The vegetation was so thick that in order to get the ox waggons through, they burned the bush. On entering the Langkloof he remarked on the 'Rhenocers Bosjes' and the good supply of water and pasturage. He was told of a kraal of Attaquas Hottentots south of the Outeniqua mountains, but decided not to visit them (op. cit: 222). Once they moved north and out of the Langkloof into the Karoo they met more than 150 members of Heijkon's kraal between the present-day towns of Willowmore and Aberdeen and traded with them obtaining more than 500 head of cattle and a flock of sheep (op. cit: 236). Two other groups were also seen in the area: the Sonquase who had been in battle against the Attaquas having attacked them during the night (op. cit: 239), and the Hongliquase who, having tried to steal cattle from Schrijver's party, were shot at; about 30 were killed (op. cit: 241).

The presence of Khoi in the Langkloof itself is attested by several of the later travellers. Sparrman, for example, says that in October 1775 he met:

> "large numbers of fugitive Hottentots of both sexes...
> Most of these fugitives carried a thick stout staff,

> generally headed with a heavy gritstone of two pounds weight or more, rounded off, and with a hole bored through the middle of it, in order to increase the force of the stick for the purpose of digging up roots and bulbs out of the ground; and at the same time for piercing the hard clay hillocks, which are formed...by a kind of ants...of which the Boshies-men's food in a great measure consists" (Sparrman 1785:306).

The fugitive aspect is also stressed by Thunberg (1795:59) who was in the Langkloof in November 1773 and saw 'Hottentots' being "obliged to give way" to the Dutch colonists and "quit their native plains."

The setting of Kangkara Cave

Kangkara, named after a stream of the same name, is situated at 33.47.40S; 23.05E on the farm Oshoek (formerly Apoolskraal) in the George District, a few km to the south and west of the western end of the Langkloof and some 45 km NNW of Nelson Bay Cave. The Kangkara stream flows intermittently about 30 m from the cave mouth, joining the Keurbooms River which empties into the sea a few km east of Plettenberg Bay and Nelson Bay Cave. The cave is formed in a fold of Table Mountain Sandstone at an elevation of about 450 m above sea level and is surrounded by Mountain Fynbos. Being on the lee slopes of the Outeniqua range, the surrounds are relatively dry. Its situation inland makes it hotter and drier in summer than coastal stations (compare climographs from Cape St Blaize and Uniondale in Figs. 3 & 4).

The Cape Folded Mountain Belt

The elevation and aspect of the mountain slopes in the southern Cape is so varied that it would be of little relevance to describe them in detail here. They are, as has been mentioned, characterized by higher rainfall on the southward-facing slopes and Mountain Fynbos species on these slopes therefore differ from those on the northern lee slopes. The highest peaks in the Swartberg rise to over 2000 m. Snow falls only occasionally in the winter and is rare on ranges other than the Swartberg. Frost, however, is more common and is a limiting factor for some fynbos species.

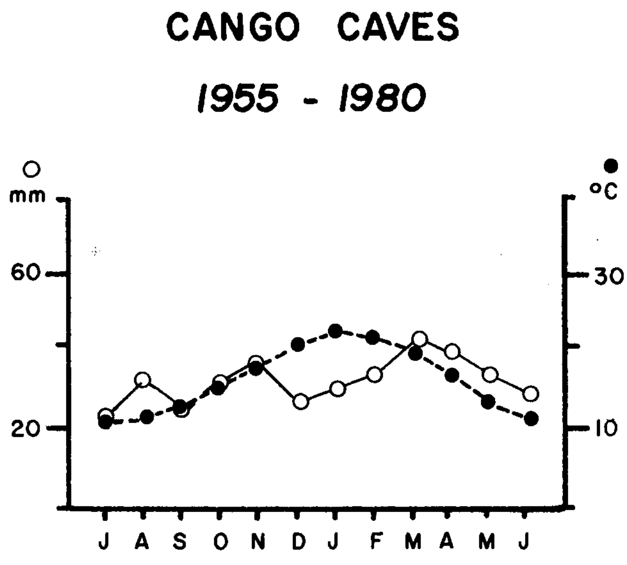
The setting of Boomplaas Cave

Boomplaas (33.23S; 22.11E) is located some 70-80 km from the coast on the southern (windward) slopes of the foothills of the Swartberg mountain range, but rainfall is not much higher than at Kangkara because of the increased distance inland (ca 400 mm p.a. at Cango Caves near BPA vs 450 mm p.a. at Uniondale near Kangkara). The climate is classified as Bsk (Schulze & McGee 1978:39) with a mean annual temperature of 16,4°C. A climograph for the Cango Caves is presented below and can be compared with that for the drier and hotter station of Oudtshoorn in the lee of the Outeniquas to the south (Figs. 3 and 5). A feature of the Cango Valley below Boomplaas Cave is the permanent Grobbelaar's River which draws water all year round from the higher slopes of the Swartberg.

Vegetation in the environs of BPA is modified by the relatively unusual presence of a limestone substrate, as is described in detail in Moffett & Deacon (1977). The detailed geology of the Cango Valley (a local term for the valleys of the Grobbelaar's and Matjes rivers which drain east and westwards respectively and empty into the Olifants River to the south) has been mapped and described by Roussouw et al (1964) and more recently by Le Roux (1977). The rocks of the Cango Group, which include the karstic limestones in which Cango, Boomplaas and some ten other cave systems have formed, underlie those of the Cape Supergroup which form the Cape Folded mountains, having been exposed here due to upfaulting on the southern margin of the Swartberg. This upfaulting has also exposed a variety of other rocks such as hornfels, greywackes and quartz veins which have been used for stone artefacts by the cave inhabitants.

The flora is marked by a high species diversity and a large number of monotypic families represented in seven vegetation types recognized from 13 plots across the valley. The vegetation types range from Closed Woodland, at present restricted to limited areas of alluvium in water courses on the eastern side of the valley, through Bush-Shrub-Grass-Herbland on the limestone substrate, to several forms of Dense Shrubland; they are described in detail in Moffett & Deacon (1977). The floristic survey has been instructive in demonstrating that there are very few plant foods in the vicinity of the cave today, and none of these would provide a plant food staple for any length of time. This is largely because the geophytes are under-represented here, although they may be more common in plant communities on the higher and better watered Swartberg slopes. Only Hypoxis villosa, which is plentiful under renosterbos, would provide suitable sustenance. The limestone substrate is important

Fig. 5



in providing an environment more suitable for grass than is present on surrounding substrates and this may have been a reason for the persistence of grazers in the fauna at the site.

The Cango area has been known historically since the mid-18th century and the first European farmers settled in the Matjes River valley to the west of BPA in 1756 (Green 1955:118). Thunberg (1795:53) wrote of the 'Kankou' area, ascribing the name to the local Khoi people. In 1797 Barrow (1801:364) described the Cango Valley as a Karoo plain "situated between the first and second chain of mountains, but being well watered by the mountain streams...On these plains are an abundance of ostriches, herds of Quachas, Zebras and Hartebeests." In the early 19th century, Khoisan pleople were still present in the Cango area in small numbers as is suggested by Green's account (1955:120) of Commandant L J Botha who built the Boomplaas farm house in 1810 and used the Boomplaas Cave as a sheep kraal to protect his animals from San raiders. Evidence for the presence of these sheep can be seen in the cave in the form of a thick layer of burnt sheep dung overlying the Stone Age occupation horizons. The permanent water supply in the valley meant that it was a useful refuge for stock at times of drought, particularly in summer (Forbes 1967:134; Grill 1968:114; Spöhr 1973:35). Today local farmers consider the natural grazing to be at its best in spring and autumn.

SOUTHERN CAPE PALAEOENVIRONMENTS OF THE LAST 20 000 YEARS

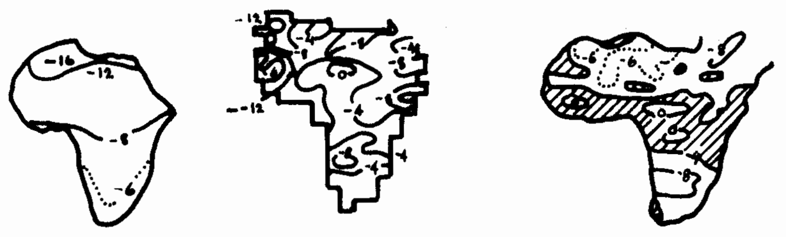
Over the last 20 000 years the climate throughout the world has undergone dramatic changes from the last glacial maximum about 18 000 years ago when temperatures were between 5° and 10°C lower than at present, to conditions approaching those of the present day about 10 000 years ago, with fluctuations around this standard over the following millennia of the Holocene. These climatic shifts have long been recognized, but it is only within the last decade, particularly with the impetus given to palaeoclimatic studies by the CLIMAP programme established in 1971, that detailed information on the dating, nature and geographical variation of these worldwide changes has become available. Much of this research, however, has been directed at the reconstruction of the world's climates at the glacial maximum and there is relatively little information available on conditions that may have pertained before and after this maximum and during the Holocene.

In the context of this thesis it is of interest not only to model the ice age climate, but to obtain data on the nature and timing of post-glacial changes to facilitate the testing of hypotheses which suggest that artefact manufacturing changes coincided with environmental shifts because they directly reflect changes in adaptation to the habitat. The emphasis will therefore fall again on the sequence of events rather than on the nature of environmental conditions at any particular point in time, and comparisons will be made between expected and observed conditions.

Modelling the Ice Age climate and comparisons with palaeoecological data

The concern of the CLIMAP programme was to reconstruct from quantitative geological evidence the average state of climatic boundary conditions (sea-surface temperature, ice extent, ice elevation, continental albedo, wind velocity, rainfall/precipitation, land surface temperature) for the last glacial maximum at 18 000 B.P. (CLIMAP 1976). To date mainly data for July have been published. In addition, general circulation models (GCMs)

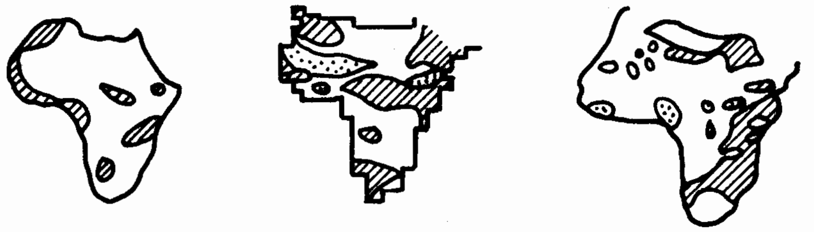
Temperature



NCAR RAND GFDL

Difference in July surface temperature (°C) between 18 000 years ago and today. Shading: less than 4° cooling.

Precipitation



NCAR RAND GFDL

Differences between July precipitation 18 000 years ago and today. Diagonal shading: more ice age precipitation; unshaded: less ice age precipitation; stippling: ice age precipitation lower by more than 5 mm/day.

NCAR: after Williams et al (1974). RAND: after Gates (1976. GFDL: after Manabe & Hahn (1977).

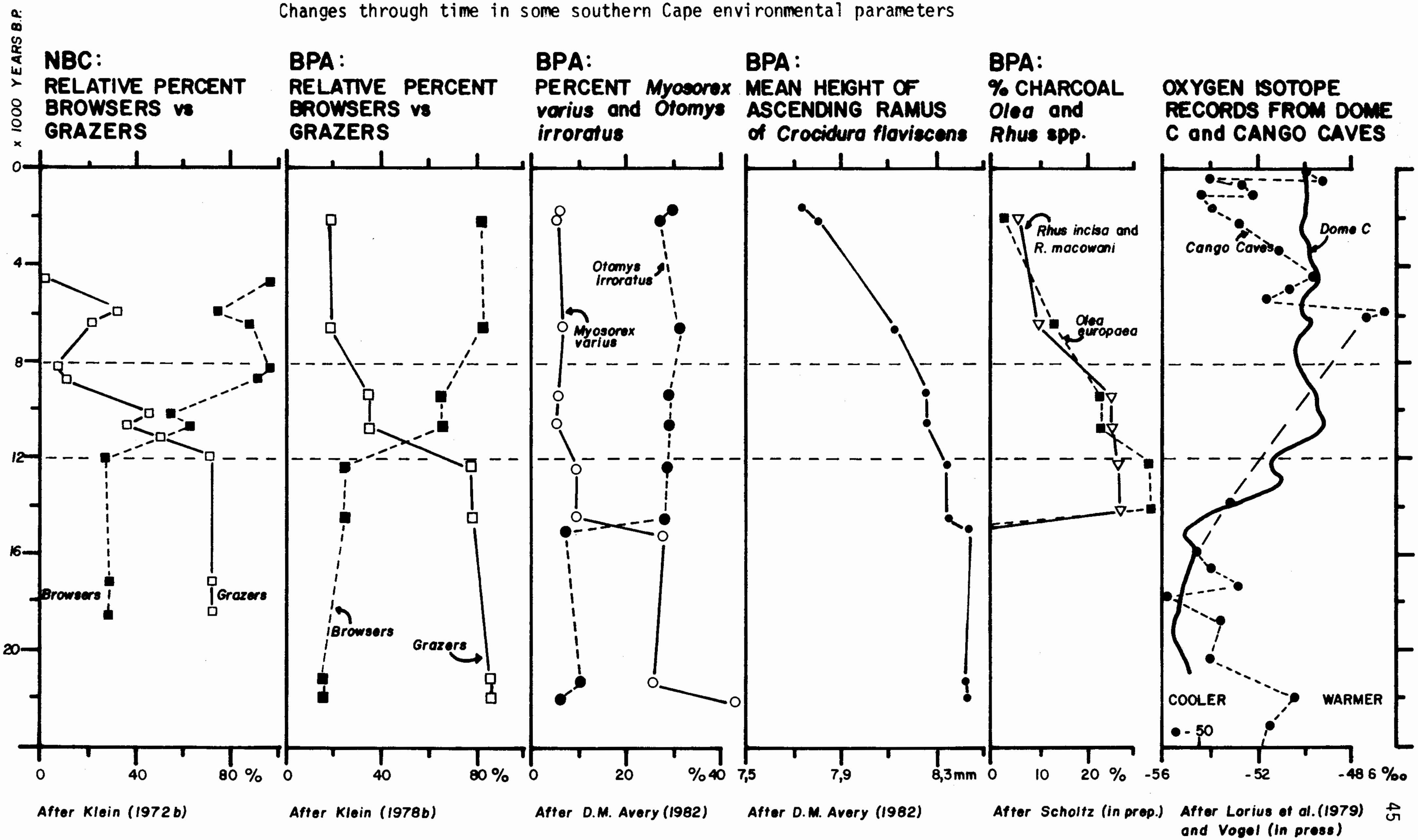
Comparisons between three Global Circulation Models for Africa illustrating differences between temperature and precipitation today and 18 000 years ago have been computed to simulate mathematically ice age climatic conditions from equations governing the transfer of heat and momentum in the atmosphere based on specifications for individual locations of incoming solar radiation, land topography, sea surface temperature, surface albedo and ice sheet extents and elevations. The general acceptability of the results of such simulations has been shown by Barry & Williams (1975) and Heath (1979:fig. 1) who contrast simulated models against actual data for modern conditions. The fit is not absolute (Barry & Williams, for example, show consistently higher precipitation estimates than actually occur), but it is a reasonable basis for discussion. Simulated models are now available for global sea surface temperature (CLIMAP 1976), land surface temperature, surface heat balance, sea level pressure (Gates 1976; Manabe & Hahn 1977), precipitation (Heath 1979), relative humidity, cloudiness, evaporation rate and wind velocities (Gates 1976; Sarnthein 1978). In a comparison of five simulation models, Williams (1978) found considerable variation in temperature estimates for particular locations, but general agreement that the last glacial maximum was cooler and distinctly drier worldwide (Fig. 6). These generalized maps provide a useful standard against which field observations can be tested and compared.

Estimates from the GCMs indicate a temperature depression of between 4° and 6°C in the southern Cape 18 000 years ago. Amelioration of the southern hemisphere temperatures can be seen from 14 000 B.P. in the ^{18}O record from the Dome C core from Antarctica (Lorius et al 1979) and in deep-sea cores (Shackleton & Opdyke 1976; Morley & Hays 1979). The scale and timing of these temperature changes can also be seen in an oxygen isotope record from a stalagmite collected in an underground cavern, Cango II, recently discovered beyond the well-known Cango Caves a few km east of Boomplaas. Vogel (in press) has dated the sections of the core from which the oxygen isotope samples have been drawn and, although there is a break in deposition between about 16 000 and about 6000 B.P. that prevents complete documentation of the record, there is some similarity between this curve and that from Antarctica in the timing of major shifts in temperature (Fig. 7).

The Cango curve, combined with data on palaeotemperatures from ground water aquifers in the Uitenhage District, some 200 km east of Cango, indicate a decrease of the order of 5° - 5,5° C for temperatures at the last glacial maximum (Vogel, in press). The break in deposition in the

Fig. 7

Changes through time in some southern Cape environmental parameters



Cango II stalagmite may have some significance in interpreting changes in precipitation because the stalagmite in the BPA cave also ceased growing soon after 15 000 B.P. The growth of stalagmites is dependent on a delicate balance between temperature and humidity and it is clear that this balance was upset by changes in one or both of these factors ca 16 - 15 000 years ago. That this occurred both in the sealed underground cavern and in the exposed situation at BPA suggests that it was not the result of localized site-specific changes, but that it was due to more profound shifts in the humidity/temperature balance in the Cango Valley (and probably the southern Cape) as a whole. If the temperature in a cave is kept constant, then a given volume of water dissolves more carbon dioxide and more stalagmite is formed the higher the pressure of the gas; however, if the partial pressure of the gas is kept constant, then its solubility falls (i.e. less stalagmite is formed) if the temperature is raised (Du Plessis 1958:60). The partial pressure of the gas is in turn affected by humidity so that stalagmite formation may be halted with a rise in both temperature and humidity, but may be renewed if humidity drops and temperature does not. It is therefore of interest to examine the evidence we have for rainfall/precipitation at the last glacial maximum in the southern Cape and further afield.

Peterson et al (1979:62-3) in reviewing worldwide evidence for continental environmental conditions at 18 000 B.P. point out that while deep-sea core data indicate a relatively stable, though cool, period between about 24 000 and 14 000 B.P., continental evidence suggests major precipitation changes between 21 000 and 15 000 B.P. on most continents. Southern Africa is no exception. For the summer rainfall region including Zimbabwe, Botswana, Namibia, the Transvaal, Orange Free State and northern Cape, claims have been made for higher rainfall during the last glacial maximum and for the 10 000-odd years preceding it (Coetzee 1967; Brain 1969:129; Butzer et al 1973, 1978; Street & Grove 1976; Van Zinderen Bakker 1976:193; Heine 1978; Lancaster 1979; Scott 1979). In a recent paper, however, Lancaster (1981) has reviewed the data for Botswana and Namibia and has concluded that good evidence for higher rainfall in these areas dates only between 30 000 and 20 000 B.P. and that thereafter lake levels were maintained locally by a high water-table rather than by increased precipitation. Elsewhere, in the Transvaal, Orange Free State and northern Cape, the evidence for increased ice age precipitation is either questionable geomorphologically or it is poorly dated and in all cases needs corroboration with more data. In the southern Cape, however, which is influenced by both the winter and summer rainfall regimes, the evidence to be summarized here all seems to point to drier conditions during the glacial maximum with higher precipitation immediately after.

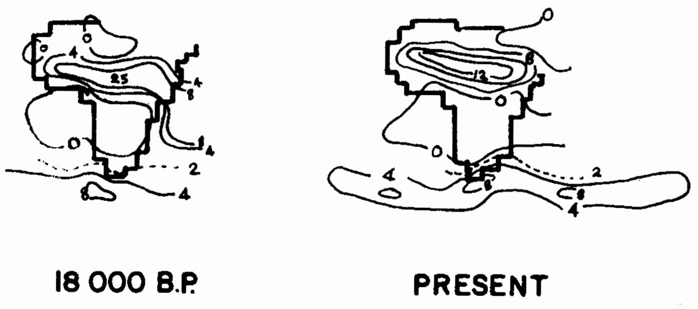
While unequivocal evidence for wetter conditions at 18 000 B.P. is lacking in the summer rainfall region, all three GCMs in Fig. 6 suggest that higher precipitation could be expected there and Butzer et al (1978: 335-6) have put forward a scenario that would accommodate it. It breaks from the generalized hypothesis of Van Zinderen Bakker (1976) and others (Tankard 1976; Coetzee 1978; Eriksson 1978; Heine 1978) which suggested a straightforward northward displacement of the westerlies which bring a succession of cold fronts to the southern and western Cape during winter, and proposes instead that higher rainfall in the summer rainfall region would be the result of the southward penetration of maritime tropical air from the Indian Ocean and Mozambique Channel. In the southern and south-eastern Cape, however, cooler ocean temperatures would reduce evaporation and the amount of precipitable water, leading to significantly lower rainfall. Climatic modelling has made it clear that the future of palaeoclimatic studies lies in examination of synoptic weather features rather than in simple shifts of the general circulation (Nicholson & Flohn 1980; Nicholson 1980:197-8), although Lancaster (1981) suggests that such zonal shifts have played their part, particularly in times of increased wind speeds when dune sands were mobilized north-wards of active dune formation in the present. Just as botanists have noted that plant communities do not change as communities, but that each species reacts differently to change, so have climatologists come to appreciate that a worldwide drop in temperature will have a far more complex effect on synoptic weather patterns than a simple equator-ward shift of climatic belts.

Simulations for the ice age sea surface temperature and precipitation rates (Fig. 8) indicate a southward depression of the 4mm/day^{-1} isohyet implying a reduction in rainfall in the southern Cape of between 30 and 50% in winter. Lower sea surface temperatures are confirmed from deep sea data (Hutson 1978; Prell et al 1979; Martin, A.K. 1981:552-3) which agree that not only were ocean temperatures cooler, but that the Agulhas current was considerably weaker than at present. Although the weather of the

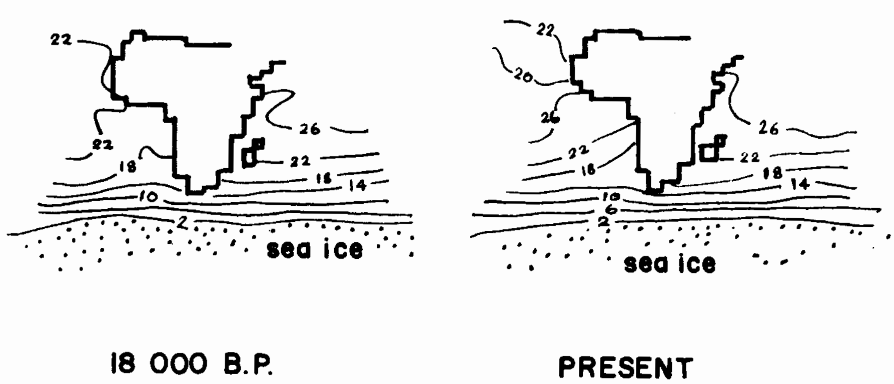
Fig. 8

Estimated differences in precipitation rate, sea surface temperature and surface air temperature for Africa between 18 000 B.P. and today

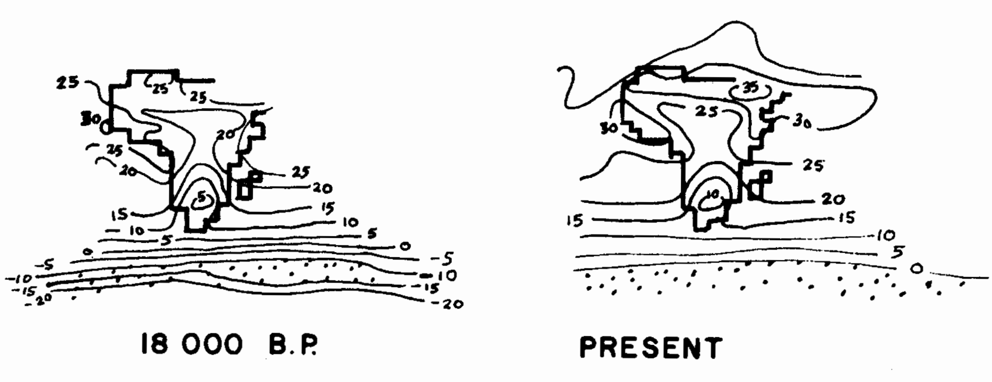
(a) The precipitation rate (mm/day^{-1}) simulated for the ice age July and present July. Isopleths are drawn every 2 mm/day except in regions of intense precipitation where only the local maximum is given. After Gates (1976:1862, fig. 23).



(b) The sea-surface temperature (^{0}C) for the ice age July and present July. Present day and ice age data after Gates (1976:1848, fig. 4).



(c) The surface air temperature (^{0}C) simulated for the ice age July and present July. After Gates (1976:1850, fig. 7).



southern Cape today is largely controlled by the passage of cold fronts which originate in the south Atlantic to the south and west of Cape Town, the rainfall maxima are in spring and autumn rather than winter which is, in fact, the season of lowest rainfall at some stations (Fig. 3). Tyson points out that land and sea breezes generated by the differential heating of land and sea and by the presence of the Agulhas current offshore, are responsible for a proportion of the summer rains today which are enhanced by the presence of the Outeniquas and other ranges close to the coast. We would thus expect that a weakening of the Agulhas current, cooler land and sea temperatures and an exposed continental shelf placing the mountains 70 - 90 km inland during the glacial maximum would all have contributed to the reduced effectiveness of sea breezes in promoting orographic precipitation in the southern Cape. In addition, cooler ocean temperatures would have reduced the amount of moisture carried by the westerly winds and generated by cold fronts from the west, although wind strengths may have been higher (Barry & Williams 1975). The effect of lower temperatures on the amount of precipitable water for condensation as rain is illustrated in Fig. 9 to show that a lowering of the mean annual temperature at Plettenberg Bay by 6°C could have decreased the amount of precipitable water by between 30 and 50%.

Palaeoenvironmental data from BPA support the contention that the last glacial maximum was both cooler and drier than the present. Scholtz, Deacon & Daitz (in prep.) have studied charcoal samples from the BPA sequence (Figs. 7, 10; Table 3) and have demonstrated that in the deposits from LPC, dated to 22-21 000 B.P., through LP to GWA which immediately underlies the CL member for which there is a basal date of 14 200 B.P., the charcoals generated from burnt firewood brought into the cave from the surrounding hillside and valley floor are dominated by Compositae and Leucadendron species which grow today in drier situations on lee and higher slopes of the Swartberg. Pollens are not evenly preserved in the BPA sequence (Fig. 11), but a sample from LPC confirms the presence of abundant Compositae and the pollen spectrum is interpreted by Scholtz (in prep.) as indicating the close proximity of renosterveld, again indicative of cooler and drier conditions.

Further lines of evidence point to the LP unit having been accumulated during the coldest period of the last glacial cycle. The

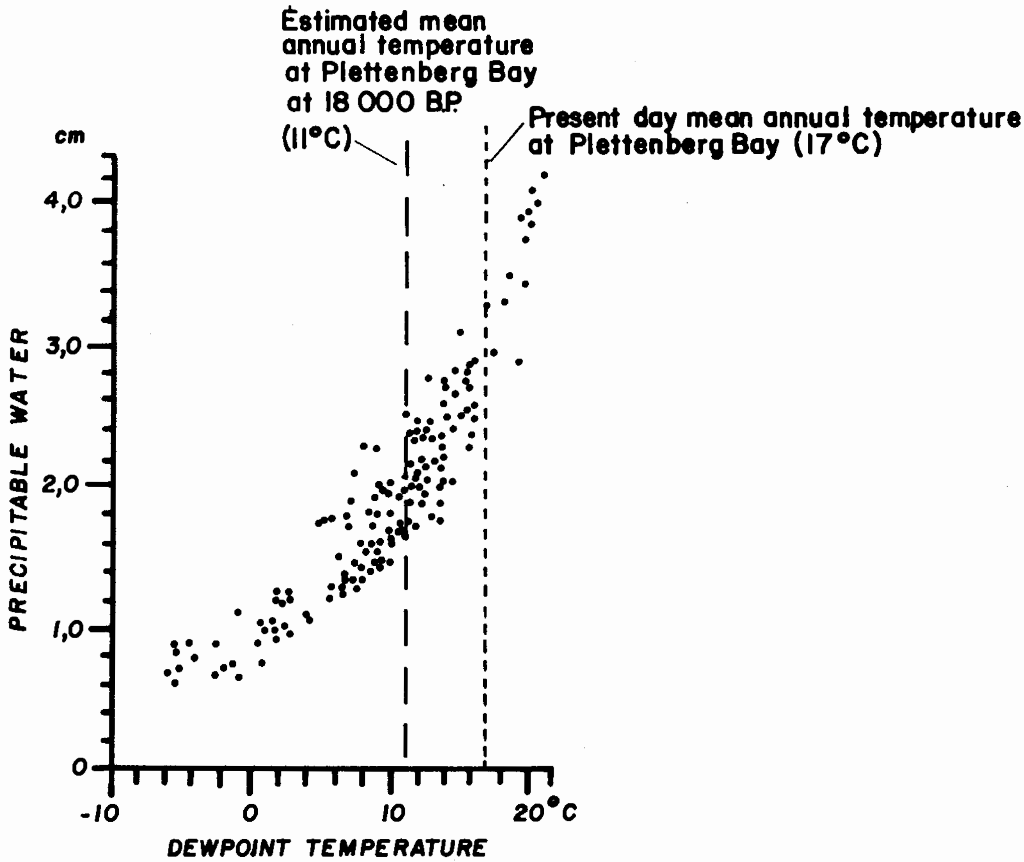


Fig. 9. The relationship between mean monthly precipitable water and dewpoint values at South African stations during 1967 and 1968. The moisture parameter known as precipitable water vapour measures the depth of the water column which would form if the water vapour in an atmospheric column above a unit area were to condense. Values were determined from some 5000 radiosonde ascents at 50 mb intervals between 1000 and 800 mb and 100 mb intervals between 800 and 300 mb at which level (10 000 m) it is assumed that no more water is present in the atmosphere. After McGee 1974.
The present day temperature at Plettenberg Bay is compared with the estimated mean annual temperature at 18 000 B.P. to demonstrate that lower temperatures correlate with a smaller amount of precipitable water.

analysis of quartz grain textures and the increase in roof spalls in LP at Boomplaas (Webley (1978) has shown that although true éboulis sec were not forming, there was a greater incidence of frost weathering and spalling at this time than at any other. In the vicinity of BPA on the higher slopes of the Swartberg, Goede (pers. comm.) was unable to locate any evidence for frost weathering that could be attributed to colder glacial conditions. He suggests that a possible explanation may be that the season of maximum precipitation during the glacial maximum did not coincide with the season of maximum cold as moisture is as necessary as cold for frost weathering to take place on a large scale. This would also account for the absence of marked frost weathering inside the cave during the accumulation of the LP deposit.

Results from the analysis of micromammalian faunal remains which built up on the cave floor during times that the site was occupied by owls again confirm that the coldest conditions pertained during the build-up of LPC and the mix of species and their low diversity suggest open and relatively arid vegetation with the reed component on the river banks reduced and the grassy component increased (Avery, D.M. 1979: 171, 1982. The operation of Bergman's Rule, which states that body size may increase as temperature decreases, can be seen in changes in the length of the ascending ramus of the red musk shrew, Crocidura flaviscens (Avery, D.M. 1979, 1982), that are summarized in Fig. 7. These again demonstrate that the coldest conditions pertained between LPC and GWA.

The large mammal fauna at BPA provides a different perspective from that given by the micromammals because it was partly influenced by the preferences and choices of the people who hunted the animals, whereas the micromammals were not subject to this bias. Nevertheless, the fact that the hunted fauna brought to the site by people is dominated by large grazers is clearly indicative of the existence of grassland in the vicinity of the cave (Klein 1978b), as has also been suggested from the micromammals and as would be expected if climatic conditions were cooler and drier. Here and at other sites in the southern Cape a number of 'giant' bovids and the large equid, the Cape horse Equus capensis, were present during the glacial cycle but became extinct between 12 000 and 8000 B.P. (Klein 1978c).

At Nelson Bay Cave, as at BPA, the small and large mammal faunas again indicate the presence of grassland at the glacial maximum rather

Table 3. Boomplaas Cave: Percentage frequencies of identified charcoals (after Daitz, Deacon & Scholtz, in prep.).

TAXON	BLD	BLA	BRL	CL	GWA*	LP/LPC
Acacia karoo	36,0	4,0	5,0	-	-	-
Anisodontea	-	7,0	-	-	-	-
Rhus undulata	5,0	1,5	1,5	1,0	-	0,5
Rhus incisa	1,5	3,0	12,0	14,0	-	-
Rhus macowani	4,0	7,0	12,0	12,0	-	-
Olea europaea	2,0	12,0	23,0	33,0	-	-
Hermania/Grewia	1,0	3,0	6,0	2,0	-	-
Euclea	1,5	10,0	-	-	-	-
Diospyros	-	1,0	-	-	-	-
Maytenus/Pterocelastrus	3,0	13,0	3,0	-	-	-
Buddleia glomerata	2,0	6,0	3,0	-	-	5,0
Buddleia salviifolia	4,0	-	5,0	-	-	-
Nymania	8,0	4,0	-	-	-	-
Passerina	2,0	-	-	2,0	-	-
Lycium	-	-	1,5	-	-	2,0
Salix mucronata	0,5	-	5,0	13,0	-	4,5
Proteaceae:						
Protea arborea	12,0	1,5	1,5	4,0	-	2,5
Leucadendron tinctum	-	-	1,5	4,0	-	5,5
Protea/Leucadendron	-	-	-	1,0	57,0	35,0
Compositae:						
Senecio/Metalasia/Elytropappus	1,5	9,0	11,0	1,0	20,0	17,0
Euryops/Relhania	2,0	-	5,0	-	-	2,5
Pegolettia/Tarchonanthus	7,5	7,0	1,5	6,0	-	-
Brachylaena	0,5	4,0	-	-	-	1,0
Colpoon	0,5	1,5	3,0	2,0	-	-
Anthospermum	-	-	-	-	16,0	0,5
Unidentified:						
Type A	-	-	-	-	-	3,0
Type C	5,0	3,0	-	-	-	3,5
Type H	-	1,5	-	-	-	16,0
Other	0,5	-	-	4,0	7,0	1,5
Total number of charcoals in sample	225	69	65	85		138

* Sample taken from one hearth only

than the bushy vegetation in the vicinity at present (Klein 1972a,b; Avery, D.M. 1979:147, 1982), as may be expected from the clayey soils and the topography of the continental shelf which was exposed at that time, and from cooler and drier climatic conditions. The sedimentological analysis of the NBC sequence (Butzer 1973) shows two or more intervals of spalling in YGL (referred to as YSL in the publication because this was the designation used during the first season of excavation) with wetter conditions both pre- and post-dating this unit which is dated between ca 19 000 and 18 000 B.P. From this we can assume that while there is good evidence for colder conditions at this time at NBC, there is no good sedimentological evidence for an increase in precipitation coincident with the glacial maximum.

On balance, the data from a number of lines of evidence at both NBC and BPA agree that there is good reason for accepting the GCM predictions for a glacial maximum temperature 5-6°C cooler than at present and a rainfall 30-50% lower in the southern Cape.

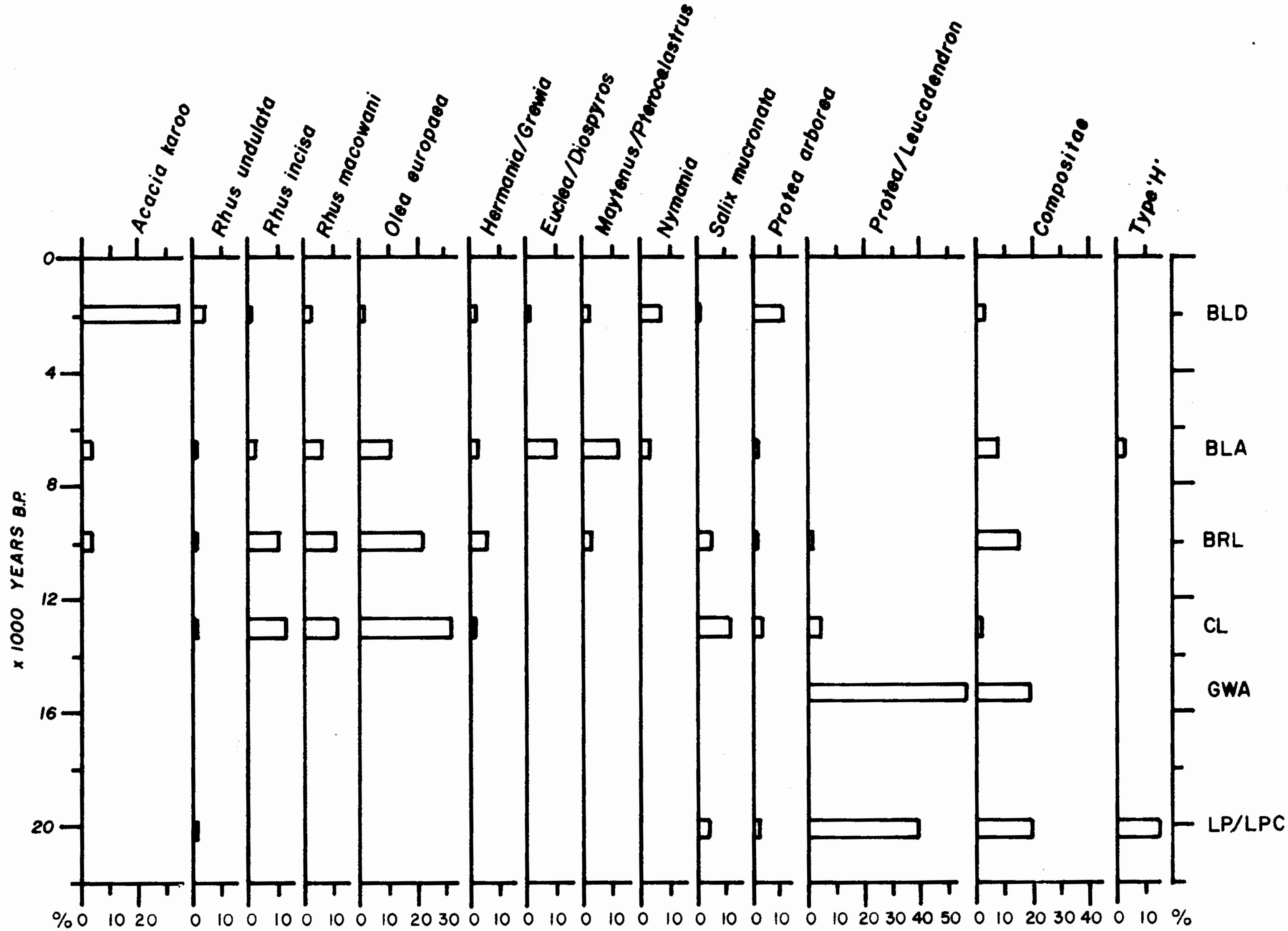
Palaeoecological evidence for post-glacial climates

Analyses of deep-sea cores from the southern oceans confirm the results from Dome C in Antarctica (Fig. 7) which show a dramatic increase in southern hemisphere temperatures between 16 000 and 14 000 B.P. (Shackleton 1978:76; Hays 1978; Lorius et al 1979), preceding similar changes in the northern hemisphere by about 3000 years (Hays 1978:57; Martin & Peterson 1978; Salinger 1981). Glacial changes on land were equally rapid. In New Zealand deglaciation started before 14 500 B.P. and conditions similar to those of today were prevalent by 13 500 B.P. (Suggate 1965; Salinger 1981:107) while in New Guinea post-glacial times can be counted from between 15 000 and 14 000 B.P. (Walker, D. 1978:88; Salinger 1981). In South America, deglaciation began well before 12 000 B.P. and by that time glaciers were in positions similar to those of today in southernmost and south-central Chile (Mercer 1978: 89).

That the timing of post-glacial warming was similar in the southern Cape is confirmed by the oxygen isotope curve from Cango II which shows a rise in temperature after 15 000 B.P. (Vogel, in press; Fig. 7) that closely parallels that from Dome C in Antarctica. Another temperature-dependent variable, the size of Crocidura flaviscens, shows a similarly

Fig. 10

BPA: PERCENTAGE FREQUENCIES OF SELECTED WOODY SPECIES IDENTIFIED FROM CHARCOALS



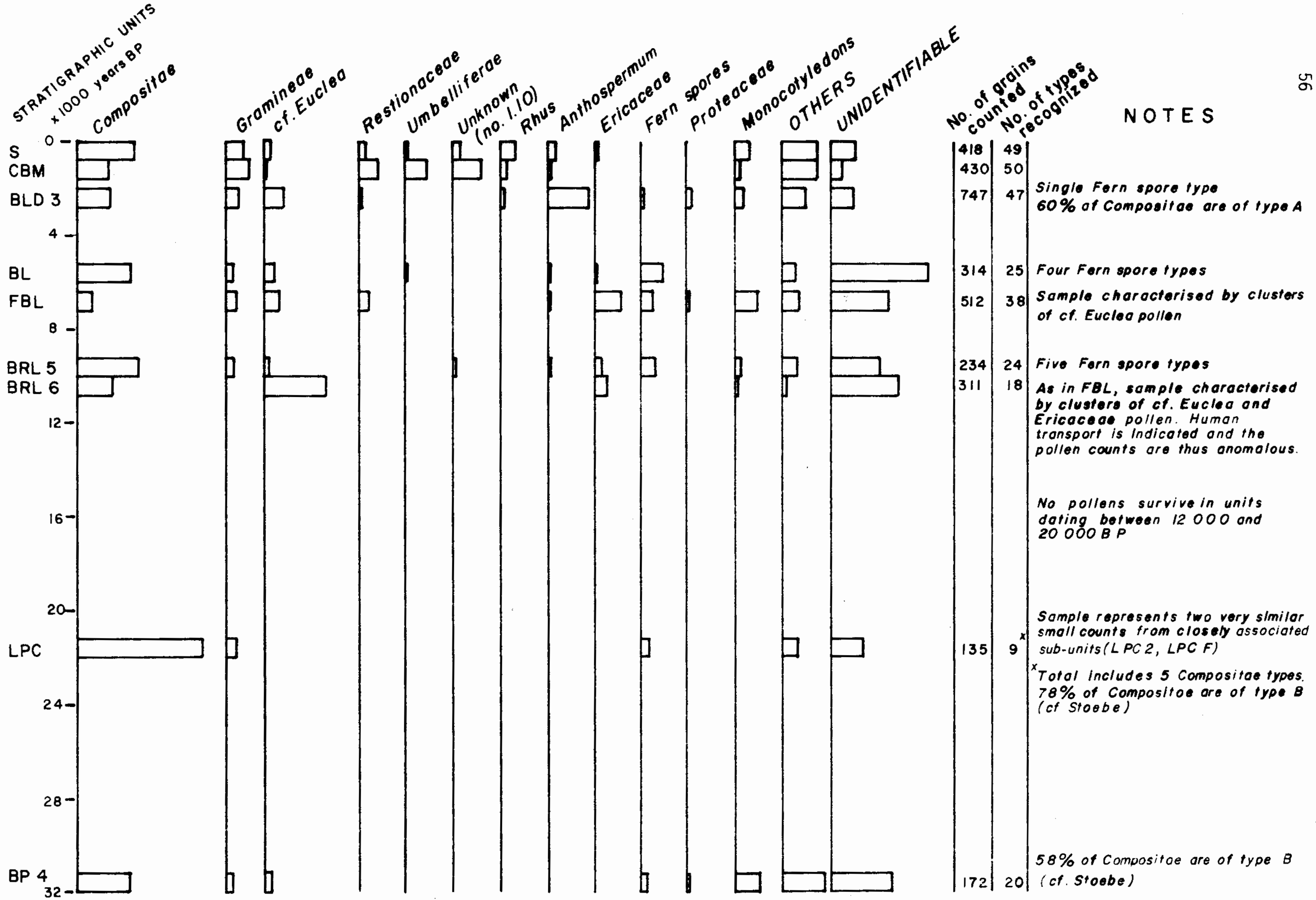
sudden shift between GWA (estimated to date between 16 000 and 15 000 B.P.) and the base of CL (dated to 14 200 B.P.), but not all the body parts of micromammals measured show the same trend (Avery, D.M. 1979, 1982).

In addition to a sudden shift in temperature between ca 16-15 000 and 14 000 B.P., there is clear evidence from BPA for an increase in precipitation as well. This can be seen in the change in relative abundance of two of the most common micromammals hunted by owls, Myosorex varius, the forest shrew, and Otomys irroratus, the vlei rat (Fig. 7). Although both prefer dense vegetation cover, O. irroratus is more often found with 75%+ shrub cover whereas M. varius can extend to grassy slopes. The main differentiating factor, however, is that M. varius is found today in areas of more than 200 mm rainfall p.a. whereas O. irroratus is found in areas with more than 400 mm. The shift in emphasis between GWA and CL would therefore seem to be indicative of an increase in precipitation and this is confirmed by the results of the charcoal analyses. These show a sudden increase at the same time (GWA/CL) of Rhus and Olea/Dodonea species which occur today in moist environments and which contrast markedly with the Compositae and Leucadendron of GWA and LP. Changes in humidity and temperature are also indicated by the cessation of deposition of the stalagmite at BPA which was active from the base of the deposit dating to ca 75-80 000 B.P. through to the base of CL at ca 14 000 B.P., and the break in deposition of the Cango II stalagmite after 15 000 B.P. Higher effective precipitation persisted through the BRL Member at BPA to ca 9000 B.P., but thereafter it declined again. Between ca 6000 and ca 2000 B.P. the incidence of Acacia karoo rose at BPA and Buffelskloof and may in turn indicate more than 600 mm of rain p.a. or a change in edaphic conditions along the river bed at that time (Heydorn & Tinley 1980:29).

In contrast to the micromammalian fauna, the larger mammal fauna at both BPA and NBC shows no dramatic change between 16 000 and 14 000 B.P., but there is a clear shift between 12 000 and 10 000 B.P. from mainly larger gregarious grazers to smaller non-gregarious browsers. Over this time period, and extending into the early Holocene, there is also the gradual extinction of several 'giant' bovids, the giant Cape horse and two springbok species.The extinctions probably resulted partly from habitat changes, but the persistence of these species for several thousand years after major habitat changes reduced their numbers lends credence

Fig. 11

POLLEN DIAGRAM BASED ON PRELIMINARY COUNTS : BOOMPLAAS CAVE, CANGO VALLEY



to the suggestion of Klein (1980:272) that their extinction had much to do with over-exploitation by man.

While temperature changes in the immediate post-glacial period seem to have occurred at much the same time in the southern Cape as in other southern hemisphere continents, this does not apply to subsequent temperature shifts on present evidence. Salinger (1981) reports that the period of maximum warmth in Australia, New Guinea and New Zealand dates to between 10 000 and 8000 B.P., but on the basis of the incomplete sequences from BPA and NBC and from more isolated observations such as that from Groenvlei near Knysna (Martin, A.R.H. 1968), it would seem that the period of maximum warmth in the southern Cape was between 7000 and possibly 5000 B.P. and that it occurred over a similar time period in the northern Cape on the Gaap Escarpment (Butzer et al 1978) and at Aliwal North (Coetzee 1967).

The pollen sequence from Groenvlei, situated about 20 km west of Knysna, dates from greater than 8000 B.P. to the present. From the base of the sequence to about 7000 B.P. the vegetation of this coastal area, dominated by consolidated dune sands and lakes of low salinity, was essentially non-arboreal heath, verging on semi-arid (Martin 1968:128). Immediately overlying this is a pollen spectrum marked by a much higher relative frequency of arboreal pollens, but a low absolute frequency of all pollens. Martin suggests two possible explanations: either there was a real increase in forest species, or active dune movement may have led to the deterioration of the heath vegetation thereby lowering its contribution to the pollen rain (Martin 1968:130). The top of this subzone is dated to 6870 ± 160 B.P. (Y-466) and in the deposits overlying it are sediments of marine origin indicating a marine transgression at +1,5 m above the present sea level. Saline conditions persisted in the lake sediments until about 4000 B.P. By 3000 B.P. dune heath vegetation became re-established. From about 2000 B.P. more effective precipitation, the retreat of the shoreline and warmer conditions led to a period of forest expansion, also noted at Norga about 10 km to the east after 2500 B.P. (Scholtz, unpublished), which halted within the last 1500 years with forest clearance. Warmer conditions between 7000 and 3000 B.P. are indicated from the analysis of warm water diatoms in the core samples from Groenvlei (Martin 1968).

Thus the Holocene record in the southern Cape is patchy, but while there is an incomplete record of precipitation changes, most available evidence points to the warmest conditions occurring around 6000 B.P. accompanied by a marine transgression of ca 1,5 m. Within the last 2000 years, between about 1800 and 200 B.P., there is evidence from several parts of the world, including the Antarctic, for a 'Little Ice Age' (Lamb 1977; Burrows 1979). Cooler temperatures are apparently indicated at about this time in the Cango II stalagmite (Vogel, in press; Fig. 7) and in the micromammalian data from BPA.

Changes in sea level

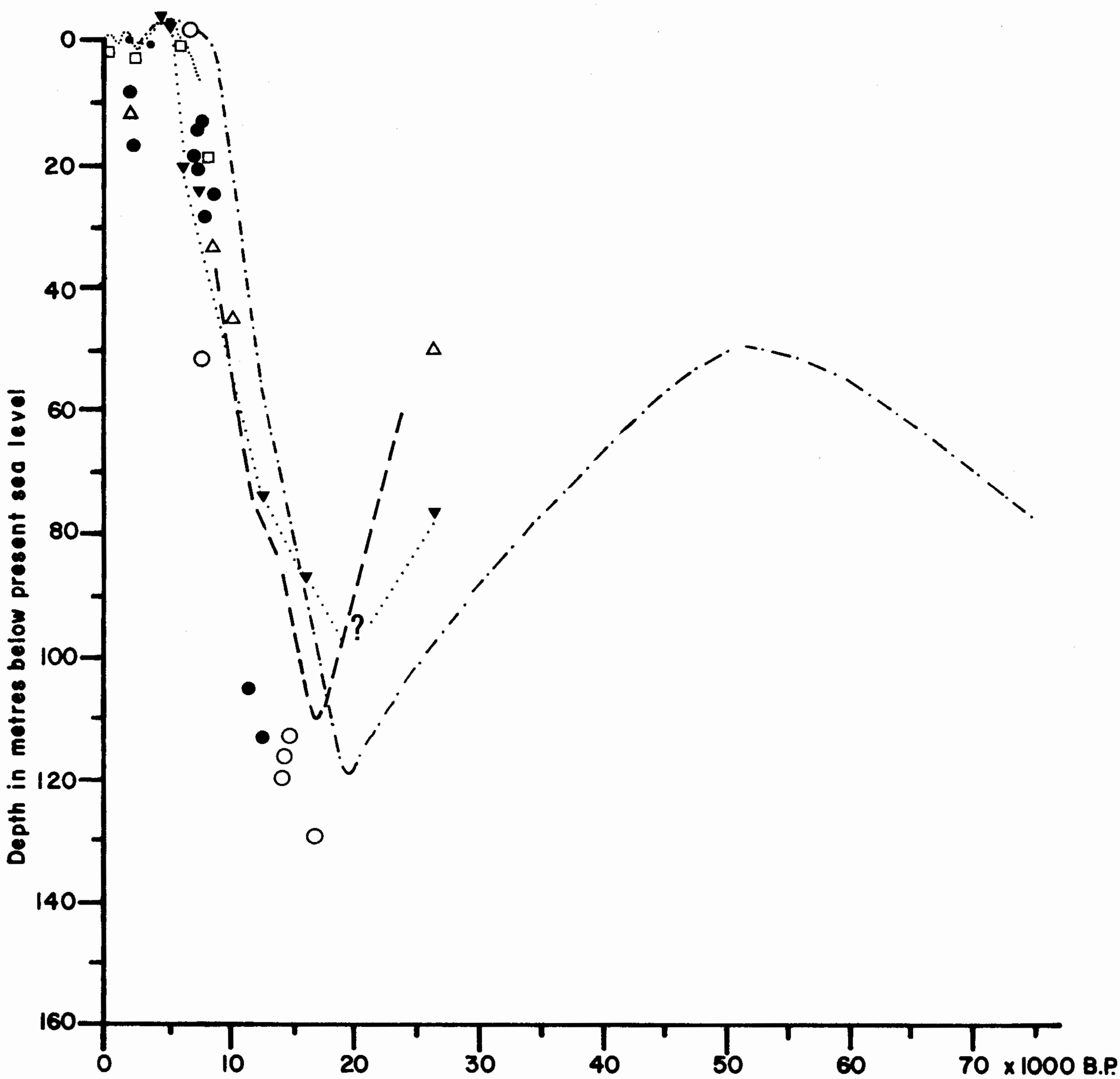
On a global scale, CLIMAP members (1976) have given a conservative estimate for a maximum lowering of sea level to -85 m 18 000 years ago, but data from Barbados and New Guinea (Shackleton & Opdyke 1973) and from the western and southern African coasts suggest a figure closer to -130 m (Fig. 12). Different sectors of the African coast are out-of-phase with each other because of the differential rising of stretches of coastline (Faure 1975; Laborel & Delibrias 1976; Pomel 1976; Cornen et al 1977; Einsele et al 1977; Elouard et al 1977) as is clear in the data summarized in Fig. 12. Southern Africa and most of the rest of Africa have emergent coastlines, while the Congo and Niger deltas, part of North Africa and eastern Madagascar are areas of submergence (Pirazzoli 1977:85).

At the maximum lowering of sea level, Nelson Bay Cave is estimated to have been some 90 km inland, placing Boomplaas some 170 km from the coast. Two aspects are of interest: the geography of the exposed continental shelf, and the speed with which this was covered as the sea level rose after ca 15 000 B.P.

A bathymetric study of the continental shelf has shown that the bed-rock south of NBC consists of soft clayey rocks on the landward side composed of Mesozoic sediments which would have produced fertile soils under well drained conditions, but marshy ground if poorly drained. On the seaward side are calcareous rocks from Tertiary deposits of limestones and marls which Dingle & Rogers (1972b:161) suggest would have been very flat, windswept and bleak with soils rich in lime. Birch (1979) notes that the ridge-and-vale nature of this Tertiary substrate would have encouraged the formation of dunes and lagoons similar to those present in the Knysna-Wilderness area today (Tyson 1971:11). The very low relief

Fig. 12

GENERALIZED CURVES AND DATED SAMPLES SHOWING CHANGES IN SEA LEVEL ALONG THE WESTERN AND SOUTHERN AFRICAN COAST OVER THE LAST 30 000 YEARS



○ *Dated shells from sea bed off Cape St Francis (Dingle & Rogers 1972) and peaty material from Wilderness (Martin 1968)*

● *Wood, shell and tourbe vaseuse from cores off Congo coast 4°S (Giresse & Kouyoumontzakis 1974:59)*

△ *Shell from core 67 off coast of Mauretania (Einsele et al 1977:38)*

• *Shell from sea bed off Sao Thomé Island in Gulf of Guinea (Cornen et al 1977:63)*

□ *Shell from sea bed off coast at Dakar, Senegal (Elouard et al 1977:46)*

Data from Ivory Coast summarized by L. Martin(1972)

Data from Mauretanian coast summarized by Einsele et al 1977

▼ *Shells from continental shelf between Orange River mouth and Luderitz (Vogel & Visser 1981)*

Curve based on data from Barbados and New Guinea (Shackleton & Opdyke 1973) included for comparison

Table 4

RADIOCARBON DATES ON LITTORAL SHELLS FROM OFFSHORE AND ONSHORE STATIONS ON THE SOUTHERN CAPE COAST

Depth below present sea level in m	Lab. no.	Age in years B.P.	Material dated	Location
0	Y-467	1905 ± 60	Gytta overlying marine deposits	Groenvlei
+1,5	Y-466	6870 ± 160	Humified fresh-water peat below marine mud	Groenvlei
- 51	Pta-183	7580 ± 70	Oyster shell	Cape St Francis
-112	Pta-265	14 510 ± 120	Oyster shell	Cape St Francis
-115	Pta-264	13 670 ± 120	Calcareous algae	Cape St Francis
-120	Pta-185	12 990 ± 100	Calcareous algae	Cape St Francis
-130	Pta-182	16 990 ± 100	*Pecten* valve	Cape St Francis

SOURCES:

Groenvlei dates from Martin, A.R.H. (1968)

Cape St Francis dates from Dingle & Rogers (1972a,b) and Vogel & Marais (1971).

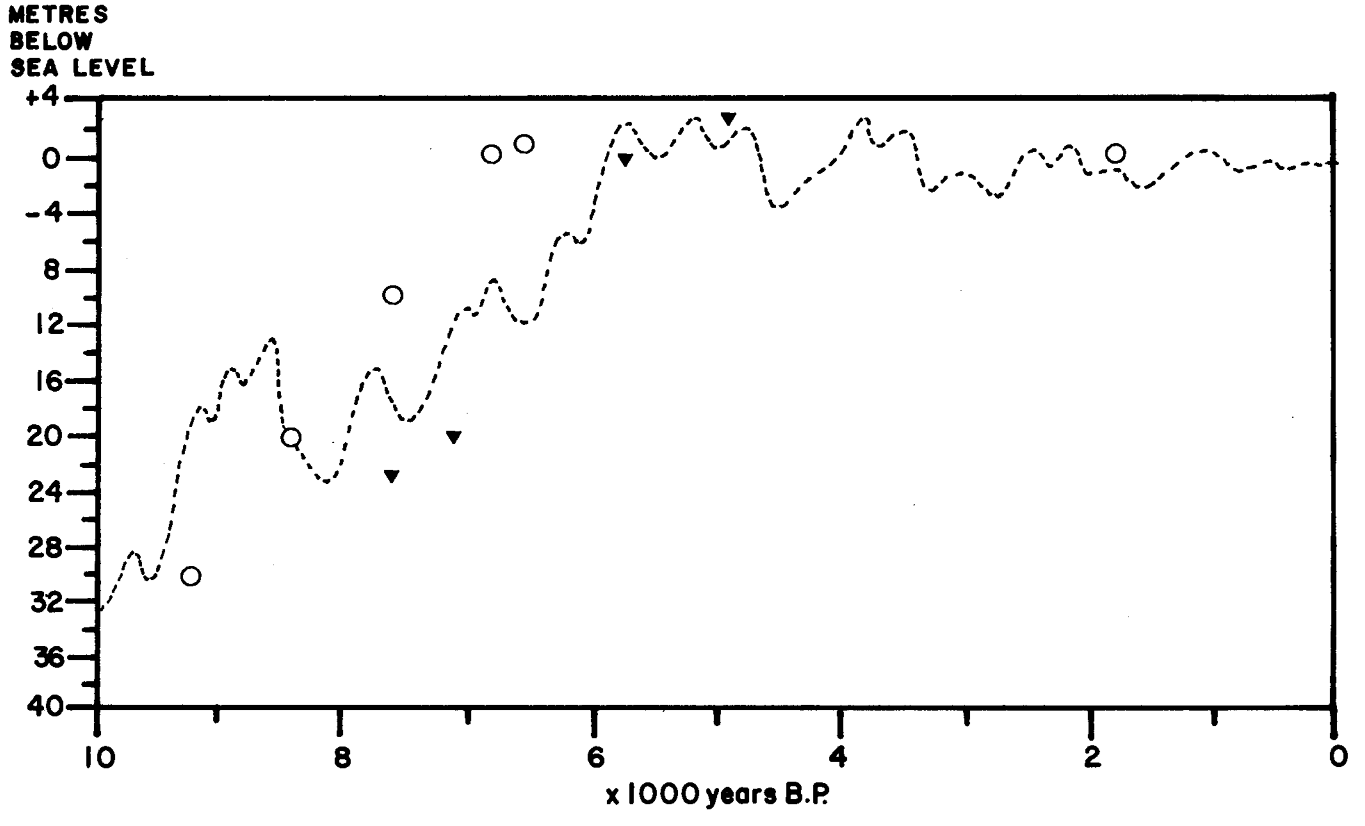
of the Agulhas Bank in general means that dune sands and lagoons or marshes would have been the most prominent topographical features with grassy plains predominating on the clayey soils traversed by a meandering Keurbooms/Bitou River in the immediate vicinity of NBC. The Robberg Peninsula would have been a distinctive and relatively mountainous feature in the landscape.

Radiocarbon dates on littoral shells from the continental shelf south of Cape St Francis to the east of Plettenberg Bay, and from samples from Groenvlei to the west are listed in Table 4 to demonstrate the timing of the rise in sea level along the southern Cape coast; they are also plotted in Fig. 12. The low relief of the shelf would have led to rapid flooding as the sea rose for while the coast is estimated to have been 90 km south of NBC at -130 m, at 80 m it was only 8 km away, a distance of 82 km covered with a 50 m rise in sea level that probably took place within 3-4000 years (assuming an even rise of 1,3m/100 years based on the youngest and oldest dates in Table 4) (Figs 13 & 14). By the time shell is common but not abundant in the NBC deposits (GSL unit), the sea shore is estimated to have been between 7,5 and 2,5 km from the site and, using the same extrapolation, present day sea level would have been reached by about 7000 B.P. with a subsequent marine incursion of +1,5 m at ca 6000 B.P. Changes in the relative frequency of shellfish species brought to the cave reflect both the changing configuration of the coastline, and changes in ocean temperatures with the warming up of the Agulhas current after ca 10 000 B.P. This is most noticeable in the change from the black mussel to the brown mussel between CS and BSBJ at ca 10 500 - 10 000 B.P. (Klein 1972a), the former preferring cooler waters than are present in the vicinity today, and the latter the warmer waters of the present day.

Confirmation of a mid-Holocene transgression is given in data from the western Cape coast at Langebaan where Flemming (1977) shows still-stands to have been as high as +3,5 m above present mean sea level, and from shells offshore between the Orange River mouth and Lüderitz (Vogel & Visser 1981:68). The dates are compared with a worldwide Holocene sea level curve constructed by Wilks (1979) in Fig. 13 to show that the southern African dates follow the general pattern observed elsewhere.

Fig. 13

Comparison between worldwide sea level curve and data from southern Africa over the last 10 000 years

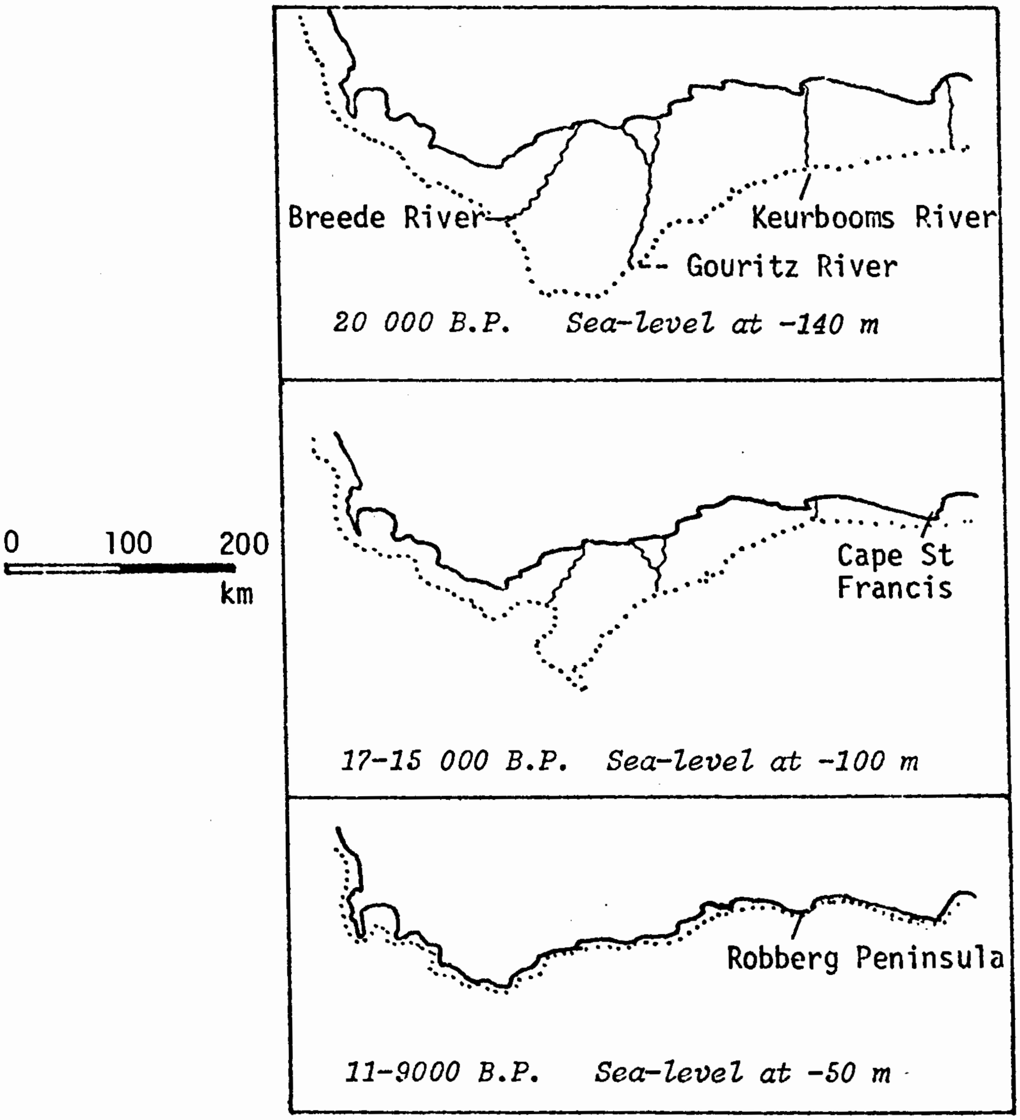


○ *Positions extrapolated for southern Cape coast from dated samples off Cape St Francis (Dingle & Rogers 1972) and Wilderness (Martin 1968)*

▼ *Littoral shells offshore between Orange River mouth and Luderitz (Vogel & Visser 1981:68)*

Worldwide Holocene sea level curve after Wilks (1979)

Fig. 14



POSITION OF LATE UPPER PLEISTOCENE COASTLINE BETWEEN 20 000 and 9000 B.P. OFF THE SOUTHERN CAPE. After Dingle & Rogers (1972a:56).

A wider perspective on climatic change

Several theories have been proposed in the past to account for the periodicity of cooler and warmer climatic cycles during the Pleistocene. With improved techniques of deep-sea coring and analyses as well as of dating methods, the model most widely favoured at present is the astronomical theory elaborated by Milankovitch (1938) which predicts cyclic changes at intervals of 22 000, 40 000 and 100 000 years based on the geometry of the earth's path around the sun, in particular the eccentricity of the orbit, the inclination of the earth's axis and the precession of the equinoxes. These predictions agree reasonably well with changes observed in deep sea cores (Lamb 1969; Chappell 1973, 1978; Kukla 1975; Berger 1978; Hays et al 1976; Shackleton 1978; Imbrie & Palmer 1979). Of particular interest is a careful review of the data from continental Europe by Kukla (1977) who uses contemporary climatic data to demonstrate a direct relationship between seasonal changes of snow cover and radiation which suggests that the effect of the precession of the equinoxes (i.e. the position of the equinox in relation to the point at which the earth is closest or furthest from the sun on its orbit) on glaciation in the northern hemisphere appears to be at least as strong as the obliquity effect, with the month of most critical radiation levels being more important than the mean annual radiation budget. This means that a cold summer (i.e. when the orbital position of the summer is furthest from the sun) with a warm winter in the northern hemisphere is conducive to glacial advance, while warm summers and cold winters promote glacial retreat. Central to this model for glacial build-up in the northern hemisphere is the presence of a warm North Atlantic Ocean which would promote evaporation to feed the build-up of ice (Andrew & Barry 1978; Ruddiman & McIntyre 1979). A similar study has not as yet been attempted for the southern hemisphere, but it is acknowledged that the Antarctic ice sheet played a key role in the global heat budget and theories that Antarctic ice surges at critical times may have acted as triggers for the initiation of cooler global conditions have recently been revived (Wilson 1978; Aharon et al 1980; Bowen 1980) but are not universally accepted (Chappell 1978).

In spite of demonstrations of correlation between climatic change and the Milankovitch model, however, the link between theory and the mechanism for change is poorly understood (Shackleton & Opdyke 1973:47; Bryson in Pittock et al 1978:354). However, as the mechanism for change is of only peripheral interest here it will not be discussed further, suffice to say that the astronomical theory and the data gathered so far from deep sea cores and glaciated regions have demonstrated conclusively that there is a distinct periodicity of around 100 000 years in the climatic cycles of the Quaternary.

The most important single source of information on global temperature changes has been the analyses derived from the oxygen isotopic composition of calcareous foraminifera preserved in deep-sea sediments and obtained in cores from a large number of sites on the ocean floors of the world. First worked out by Urey (1947), the method depends on the observation that, during times of glacial expansion, the ice sheets removed from the oceans a certain amount of isotopically light water, i.e. water depleted in ^{18}O, resulting in a slight enrichment in the ^{16}O content of the remaining ocean water. Thus, by measuring the ratio of ^{18}O to ^{16}O in calcareous shell deposits it is possible to gain an estimate of the amount of ocean cooling at the time when the animals were alive. Absolute temperature calculations depend on a number of variables which differ from one locality to another and from one species to another, but formulae for conversion of the ^{18}O content to absolute temperature estimates have been calculated (Kipp 1976). Temperature and salinity estimates can also be derived from the relative frequencies of individual species of Foraminifera, Radiolaria and Coccolithophoridae, their size, coiling directions and species combinations (Imbrie & Kipp 1971; Lamb 1977:91; Hays et al 1976; Kennett 1978; Shackleton 1978; Imbrie & Palmer 1979). While material in most cores is undated, the periodicity of changes is cross-correlated from dated to undated cores on the basis of peaks and troughs in frequencies and ^{18}O content, and key sequences are dated by $^{230}Th/^{234}U$ which is cross-checked by palaeomagnetism, sedimentation rates and radiocarbon dates where possible. The most important result of this work has been the establishment of a series of numbered stages for the glacials and interglacials of the last 500 000 years or more, glacial maxima being given even numbers and interglacials odd ones. The two ^{18}O isotope stages which are considered here are the last glacial maximum, stage 2, and the present interglacial, stage 1.

As Lamb (1972:94) has pointed out, it is inequalities in temperature which provide the energy for atmospheric circulation and, therefore, climate. The presence or absence of significant quantities of ice on and around Antarctica has a significant effect on the southern hemisphere air and ocean temperatures as well as on the wind and ocean currents as can be illustrated in the following figures. The Antarctic ice sheet at present contains 90% of the world's ice and covers an area of 14 million km^2. In addition, the Antarctic sea ice varies from 4 million km^2 in March to 20 million km^2 in September. By contrast, the Arctic sea ice cover has an extent of only 7-12 million km^2 in September-March respectively. Thus, while the heat budget of the Arctic leads to minimum temperatures of -35°C, those in the Antarctic drop as low as -70°C or lower (Pittock 1978:4), leading to a pole-to-equator temperature gradient which is 40% larger over the southern hemisphere than over the northern hemisphere (Lamb 1972:94). The implications are that the mid-latitude westerly winds in the southern hemisphere are much stronger than they are in the northern hemisphere, but during a glacial maximum the temperature gradient in the northern hemisphere would be increased owing to the greater extent of the continental ice sheets. The strength of the present-day southern hemisphere westerlies leads to a displacement of the 'meteorological equator' or the Intertropical Convergence Zone (ITCZ) 7° northward of the geographical equator in Africa (Pittock 1978), but with more similar pole-equator temperature gradients in the glacial maxima it can be expected that the ITCZ would be displaced southward nearer to the true equator over Africa than at present (Nicholson & Flohn 1980:335).

The position and strength of the westerly winds in the South Atlantic are particularly important in the assessment of glacial maximum conditions for southern Africa because they bring much of the winter rainfall to the southern and western Cape at present. Any substantial northward displacement would mean an expansion of the winter rainfall belt. Strong westerlies also help to maintain the zonality of the present day circulation pattern by preventing the poleward migration of sub-tropical anticyclones (Boucher 1975:280), while on the polar side of the westerlies the pack-ice border limits the southward movement of cyclonic vortices (Schwerdtfeger & Kachelhoffer 1973). Thus the zone between the pack ice and the equatorward boundary of the westerlies, i.e. between what is known as the circumpolar trough and the subtropical ridge, is dominated by cyclonic circulation while anticyclones prevail to the north of the subtropical ridge. These two patterns at present maintain the summer rainfall maxima in the interior and on the eastern side of southern Africa on the one hand, and the winter rainfall maximum to the south and west on the other. The identification of the boundary between the two systems is therefore important to locate palaeoclimatologically if models for glacial maximum climates are to be evaluated.

The position of the westerlies in the southern hemisphere fortunately corresponds closely with ocean currents between the Antarctic Polar Front and the Subtropical Convergence in the southern oceans. The Antarctic Polar Front was first mapped by G. Deacon (1937) who demonstrated that its most outstanding feature from the point of view of its effect on the atmosphere is a sharp southward drop in sea surface temperature, often of several degrees within a few km (Hamon & Godfrey 1978:38). The Subtropical Convergence (Deacon, G. 1966) is some 10° of latitude north of the Antarctic Polar Front and is an oceanic front which has distinct temperature and salinity characteristics due to the convergence of warm, saline subtropical and cool, low-salinity sub-polar waters. These characteristics make it possible to identify the boundary of the Subtropical Convergence on the basis of the composition of the fauna in deep sea cores. The location of this oceanic boundary or front marks the most northerly extent of the West Wind Drift and reflects the position and strength of the westerly winds (Prell et al 1979). The westerlies and related cyclones do penetrate north of the Subtropical Convergence, however, but their strength and frequency are limited.

Based on a factor analysis of radiolarian assemblages from over 30 deep sea cores from the South Atlantic, Morley & Hays (1979) have provided estimates of the positions of the Antarctic and Subtropical Convergences 18 000 years ago. The results suggest that the Subtropical Convergence moved only marginally northwards off the south coast of Africa and this conclusion is confirmed by a similar study of core materials from the southern Indian Ocean (Prell et al 1979) which indicates that there the convergence moved less than 2° of latitude north of its present position during the last glacial maximum. The Antarctic Polar Front, however, is estimated to have shifted 1°-3° of latitude northwards in the eastern South Atlantic (Morley & Hays 1979) and the effect would have been a slight narrowing of the zone between the two convergences thereby increasing the temperature gradient and the wind speeds.

These studies therefore confirm that the position of the Subtropical Convergence shifted very little northwards 18 000 years ago making it unlikely that the westerly wind belt would have shifted as much as 10° of latitude northwards as suggested by Van Zinderen Bakker (1976). On the other hand, even if the westerlies had shifted northwards it is doubtful that they would have been moisture-laden because of the lower evaporation rates from the cooler ocean and air temperatures 18 000 years ago. Furthermore, as pointed out by Chang (1972:16), rain from the westerlies is in fact associated with weaker winds and upward motion. Stronger westerlies tend to lead to subsidence which is not conducive to rain as the stronger westerlies blow at higher elevations.

The positioning and strength of the two ocean currents which most affect southern Africa, the cold Benguela on the west coast and the warm Agulhas on the south and east, are also reconstructable for 18 000 B.P. from the analysis of deep sea cores. The CLIMAP (1976) project and GCM estimates by Gates (1976) suggest a drop of between 0° and 2°C in sea surface temperatures off the west coast of southern Africa between the Cape and the Gulf of Guinea, but a drop of between 2° and 4°C in the Gulf itself. The authors suggest that this was the result of a stronger flow of cold Benguela water 18 000 years ago and that the axis of the cold Benguela lobe was possibly displaced westwards and away from the coast south of Angola, although it is acknowledged that this pattern may be the result of inadequate core coverage (CLIMAP 1976:1135). That the cold current extended well northwards of its present position is confirmed by analyses of marine fauna in cores from the Gulf of Guinea between Zaïre and Gabon which show cold water species to be present there in deposits dated to around 18 000 B.P. and present-day species replacing them after 12 000 B.P. (Giresse 1975:48). Cold water species are also present in deposits off the coast of Angola dated to ca 18 000 B.P. (Bornhold 1973, quoted in Van Zinderen Bakker 1976:166) in an area where tropical species predominate at present. A more detailed analysis of the data by Morley & Hays (1979) suggests a 4,1°C drop in sea surface temperature off the coast of Walvis Bay and a 5,3°C maximum depression in the Gulf of Guinea. In summary, while the actual figure for the drop in sea surface temperatures off the west coast of Africa is not precisely agreed upon, the fact that the current moved well north of its present position is undisputed. Furthermore, the trajectory of the current west of South Africa and Namibia must have been somewhat westward of its present position for it to have cleared the 'bulge' in the coastline just south of the Congo River mouth which at present deflects it into the Atlantic away from the Gulf of Guinea.

For Agulhas Current sea surface temperatures CLIMAP estimates a drop of more than 4°C and a decrease in the influence of the current overall, although Morley & Hays suggest a drop of only 0,3°C for the water temperature from a single core south of Cape Agulhas (Morley & Hays 1979). Bé and Duplessy (1976:419), using a single indicator in the changes in shell size of Orbulina universa to estimate temperature, proposed that the sea-surface temperature off the coast near Durban was some 5°C cooler than at present 18 000 years ago, implying a markedly inactive Agulhas Current. Doubt has been expressed about the validity of this measurement to estimate temperature (Williams 1976; Malmgren & Healy Williams 1978) and Prell et al (1979) have shown that it is a poor indicator of the position of the Subtropical Convergence. Nevertheless, they confirm that cooler ocean temperatures prevailed off the Natal coast 18 000 years ago and Hutson (1978) suggests a -2°C drop in sea surface temperature. CLIMAP (1976:1135) and Martin (1981) suggest that a strong anticlockwise gyre formed at temperate latitudes off the eastern African coast during the last glacial turning the Mozambique Current eastwards instead of joining the Agulhas Current to the south, thereby creating a thermally isolated area of ocean water off the coast of southern Africa.

Taken together, these data indicate that climatic conditions 18 000 years ago in the southern Cape would have been cooler, windier and drier and that any instances of higher rainfall would be better explained by an increase in the activity of anticyclones further south of their present position than of cyclonic rain from the south and west moving northwards.

GENERAL SUMMARY

A combination of several sources of evidence in the BPA and NBC sequences, coupled to the predictions from GCMs for the last glacial maximum, lead to the conclusion that the climate 20-18 000 years ago was much harsher than that of the present day with temperatures 5-6°C cooler and rainfall 30-50% lower. This reflects in a low diversity of species in the pollens and charcoals (which are dominated by Compositae and Leucadendron) as well as in the fauna. In common with other southern hemisphere countries, the initial warming after the glacial maximum was some 3000 years earlier than in the northern hemisphere with rapid changes taking place at BPA between ca 16 000 and 14 000 years ago. The evolution and synthesis of present day plant communities began in the Cango Valley from ca 14 000 B.P. with the appearance of modern woodland and fynbos communities and by 12 000 B.P. the diversity was similar to that of today with relatively low amplitude adjustments thereafter, particularly in the mammalian faunas after 10 000 B.P. The period of initial post-glacial warming between ca 16 000 and 12 000 B.P. is marked at BPA and NBC by a higher rainfall with effective precipitation levels exceeding those of the present day.

The timing of the shifts in vegetation and micromammals is not matched by changes of similar amplitude in the larger mammal fauna which showed its most dramatic shift some 3-5000 years after the major post-glacial temperature change. This highlights the problems inherent in using changes in hunted larger mammals as a guide to environmental changes for it is apparent that they were relatively insensitive because of their mobility, their ability to adjust to a changing food supply, and the fact that the frequencies in archaeological sites are subject to human selection and may not be a true reflection of the abundance of the animals in the habitat. The time lag in the post-glacial larger mammal changes can be seen as the result of adjustment by the larger and 'giant' grazers to an environment with less grassland as the woodland and fynbos communities encroached after 15 000 B.P. and the sea level rose to cover the continental shelf south of NBC.

The Holocene sequence in the southern Cape is incomplete, but from the available data it would appear that the warmest period dates to the mid-Holocene between ca 7000 and 5000 B.P. at the time of a marine incursion of +1,5 m on the southern Cape coast. There is no unequivocal evidence for wetter conditions at this time, but forest species spread in the late Holocene on the coastal foreland and, in the Cango Valley, Acacia karoo spread after 6000 B.P. The Cango II oxygen isotope curve indicates a cooler interval, matched in the small mammal fauna, from 1600 B.P..

In assessing climatic modelling for glacial cycles it is clear that hypotheses which assume simple equatorward shifts of climatic belts during cooler periods are inadequate to explain the complexity of climatic responses noted in pre- and post-glacial maximum times in the palaeoenvironmental record. GCMs have been useful in modelling changes by keeping modern climatic relationships constant, but the variability noted between different models only highlights the complexity of these relationships. As noted by Nicholson (1980:197-8), any meteorological model must take synoptic weather features as well as general circulation patterns into account. We must expect that the 'mix' of synoptic patterns may have changed in the past, and this would not show up on GCMs which model mean temperatures, rainfall and pressures without investigating how these could have accumulated.

At the present time, southern Cape rainfall is governed both by the frequency of cold fronts from the westerlies and the periodicity of cyclogenesis in the south Atlantic, and by the incidence of coastal and cut-off lows that originate from local variations in land and sea temperatures. At times when cold and dry conditions prevailed, the dryness can be explained as the result of lower evaporation rates reducing the amount of precipitable water. With a weaker Agulhas current off the southern Cape coast, this would have been reduced even further. However, where rainfall increased so markedly after 15 000 B.P. and temperatures were still several degrees centigrade cooler than at present, higher rainfall is likely to have been derived from moist tropical air to the north and east rather than from the south and west as happens at present. This implies an increase in the frequency of Hadley cell activity in the southern Cape rather than of present-day Ferrel cells and assumes a southward displacement of the Intertropical Convergence Zone over Africa. When such conditions prevail today, flooding can occur in the southern and south-eastern Cape as the summer low pressure cell over the interior of South Africa moves south and east of its 'normal' position and warm moist air is drawn in from the Congo and the Indian Ocean. It was conditions of this kind that led to the spectacular floods at Laingsburg and the southern Cape towns of George and Ladismith in January 1981 and again in 1982. The difference that such floods can make to the normal rainfall figures is illustrated in Fig. 3 by the inclusion of the monthly temperature and rainfall means for the period July 1980 to June 1981. A southward displacement of the Intertropical Convergence Zone is not unlikely in immediately post-glacial times in the southern hemisphere, for with the earlier warming of the south the global temperature differential would have changed, drawing the meteorological equator southward as glacial conditions persisted over the Eurasian land mass. An increase in the frequency of summer rains over such an extended period in the southern Cape could have changed the rainfall regime to the extent suggested by the vegetation pattern in the Cango Valley between 14 000 and 12 000 B.P.

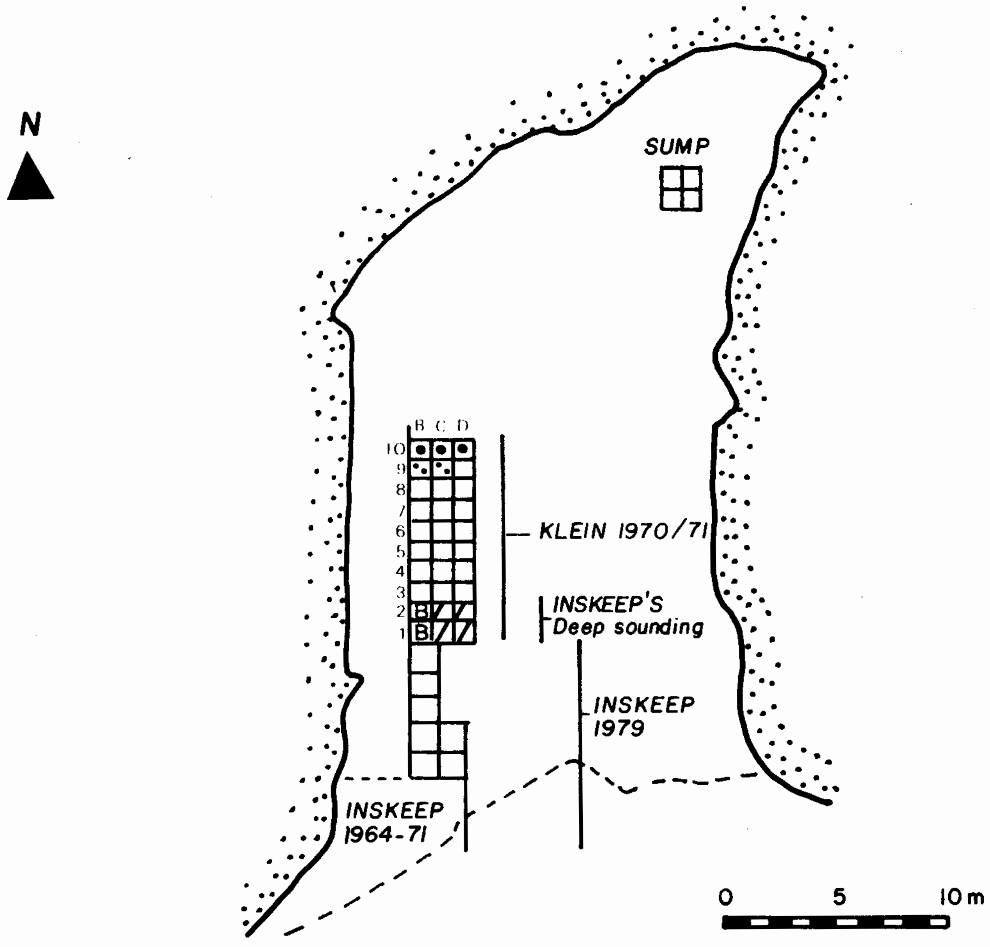
The palaeoenvironmental data summarized here provide a more detailed and more complete record of the last glacial maximum and subsequent climatic changes than is available anywhere else in southern Africa and it stresses the value of obtaining information from a variety of different aspects of the archaeological record. The charcoal data both confirm and expand the sequence of changes noted in the micromammalian fauna, and these in turn give a check, that is unbiased by human selection, on changes in the fauna hunted by people occupying BPA. The oxygen isotope record from Cango II is of particular value in giving a measure of the intensity of temperature fluctuations. More sequences of this kind are needed to document the climatic and environmental changes in southern Africa through the last glacial and present interglacial cycle for they are more reliable than the accumulation of geomorphological observations that are isolated in time and space and are subject to local variability and dating difficulties.

4

THE EXCAVATIONS

Fig. 15

Nelson Bay Cave : Plan of cave and position of the excavation



EXCAVATED TO :

- ⊡ **Base of RC within RB**
- ⁘ **Base of CS**
- □ **MSA Crust**
- ⧄ **ca 2,5 m below surface**
- Ⓑ **Bedrock**

THE EXCAVATIONS

The excavations at Nelson Bay Cave, Kangkara and Boomplaas were undertaken during the 1970s. The NBC project was directed by R G Klein of the University of Chicago and the Langkloof Archaeological Project incorporated the excavations of Kangkara and Boomplaas, amongst other sites, under the direction of H J Deacon of the University of Stellenbosch. NBC and BPA are long-sequence sites extending from the Middle Stone Age through to the Christian era, but Kangkara, although also including Middle Stone Age artefacts, was excavated with a single 1 m^2 test pit and the material has not therefore received the same amount of attention as has that from the other two sites.

NELSON BAY CAVE

Nelson Bay Cave (NBC) was first excavated systematically in 1964 and 1965/66 by R R Inskeep (1965, 1972) who worked again at the site in 1970/71 and 1979. Apart from an initial test cutting which established the depth of the deposit, however, his investigations have been limited to the areal excavation of the uppermost units dating within the last 5000 years. These will not be discussed here, but it should be remembered that the occupation of the site does extend through to the last 1000 years. The material to be discussed in this thesis was excavated in two seasons in 1970 and 1971 by R G Klein (1972a,b: Deacon, J. 1978).

NBC is in the shape of a long rectangle with the narrower ends at the mouth and along the rear wall. It is on average 18 m wide and about 35 m long from the back wall to the mouth (Fig. 15). Where deposits have built up at the mouth it is necessary to stoop to enter, but elsewhere the roof is on average 3-4 m above the present surface. The deposit is about 6 m deep at the mouth, but only 5 m deep in the area excavated to bedrock by Klein and only 1 m deep at the rear end of the cave. Bedrock was estimated to lie about 11 m above sea level at the back of the cave, rising to 18-20 m at the mouth. The maximum height of the roof above bedrock is therefore about 10 m. Butzer has estimated that some 3000 m^3 of contact breccia was removed from the cave during its formation, of which 2500 m^3 was removed prior to the cutting of the 10-12 m beach (Butzer 1973:98).

The cave has been formed by wave action in a breccia found here and elsewhere in the region at the contact between quartzites of the Table Mountain Group of the Cape Supergroup (Devonian) and the quartzitic sandstone of the Uitenhage Group (Cretaceous). The walls and roof of the cave are composed of rounded cobbles of estuarine origin in a hard reddish matrix and many of the flaked cobbles in the occupation deposit have originated from the conglomerate. Butzer (1973) suggests that the initial cutting and enlargement of this and other caves on the peninsula took place during pre-Eem high sea levels, but that the beach sands and gravels in the sump pit at the rear of the cave probably date to oxygen isotope stage 5e when storm waves could have entered the cave, but no detailed geomorphological study of the site has been undertaken to establish this point.

The location of the excavation is shown in Fig. 15. Inskeep's initial test pit was situated at the southern end of Klein's trench which extended back into the main body of the cave. A total of 30 m^2 was covered by the trench, including four squares begun by Inskeep. Four of the squares were taken to a depth of 2 m, four to 2,5 m, sixteen to between 2,5 and 3 m (i.e. to the base of the Later Stone Age deposits discussed here) and one and a half squares were taken to bedrock through the Middle Stone Age units. The method of excavation has been detailed by Klein (1972a:178-9). Due to the high density of marine shell in the upper layers and the damp nature of the lower units, some of which were periodically water-logged due to the position of a perched water-table within the cave, relatively thick units were removed during excavation on the basis of similar colour, texture and composition. This has made it difficult to follow gradual changes through time, but the low frequency of formal tools in all but the upper-most units makes it debatable whether finer stratigraphic control would have been of much value.

Stratigraphy

Three sets of stratigraphic units have been recognized in the deposit (Fig. 16). The uppermost 2 - 2,5 m date from within the last 12 000 years. They contain Later Stone Age cultural material and faunal remains which include marine mammals, fish and shellfish indicating that at the time of occupation the sea was close to its present position.

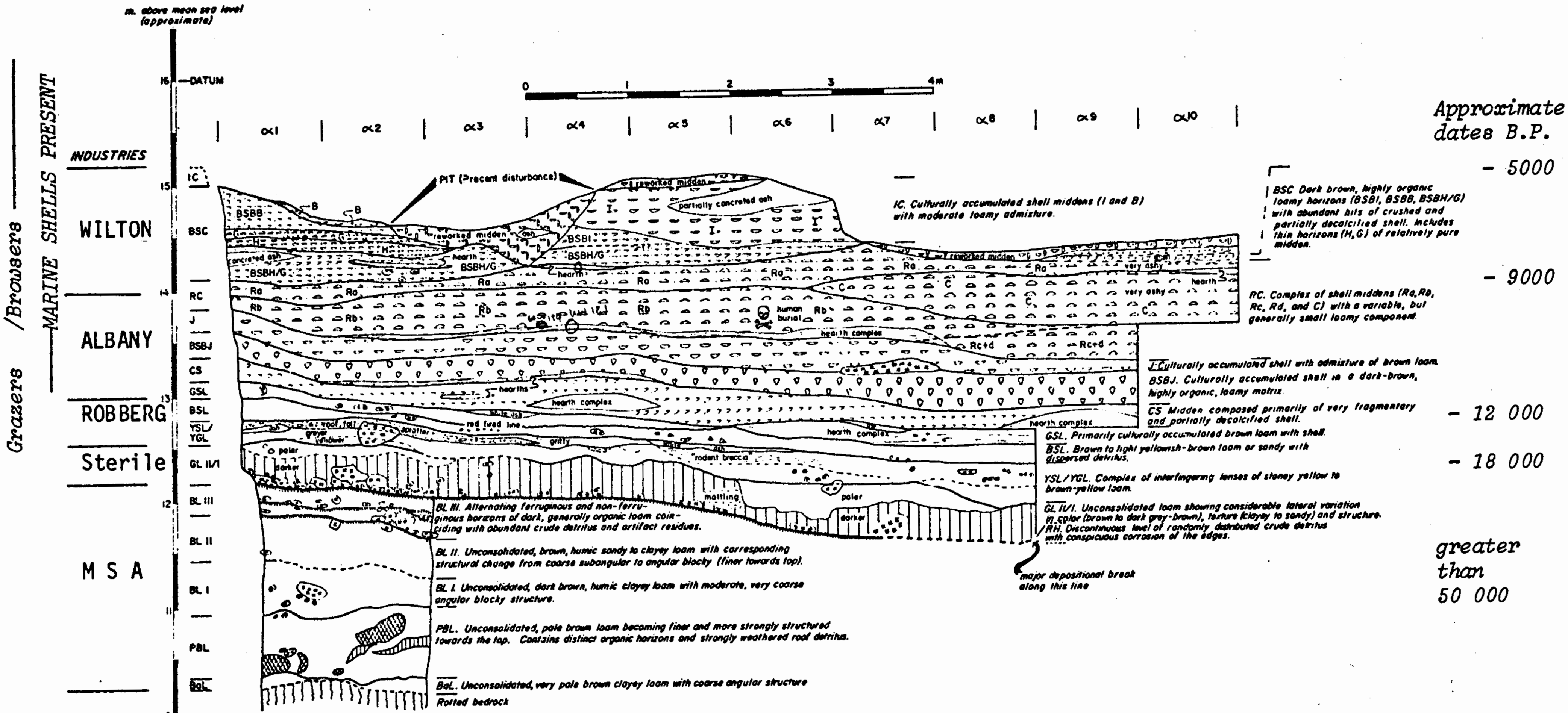
The underlying 0,75 - 1 m is dated to between 12 000 and 18 000 B.P. and consists of occupation deposits with bone of terrestrial animals and little or no marine remains, but an abundance of microfauna. The basal 0,2 - 0,5 m is a sterile grey loam.

The third set of stratigraphic units is 1,5 - 2 m thick and underlies the sterile grey loam. It includes a partly ferruginized rubble horizon at the top which is up to 0,15 m thick with a lack of fines indicating a slow deposition rate over some period of time. Beneath this is a series of lag deposits of black and pale brown loams with abundant Middle Stone Age artefacts but no bone or other organic materials preserved. At the base is a sandy loam similar to weathered bedrock of contact breccia. These lower units are all below the perched water table in the cave and a pump had to be used to lower the level of water in the cutting to allow excavation of the deposits. This set of stratigraphic units is estimated to pre-date 50 000 B.P. (Butzer 1973:109; Klein 1974) and will not be considered further here. A full description of the deposits and the Middle Stone Age artefacts has been prepared by Volman (1981).

The deposits which will receive attention in this thesis are those from the first two sets of stratigraphic units from the upper 3 - 3,5 m of Klein's excavation, dating between about 18 000 and 5000 B.P. They do not include the deposits more recent than 5000 B.P. which have been excavated by Inskeep and will be described elsewhere. The individual units recognized during excavation are as follows, from top to bottom. The numbers on the left are those used in marking artefacts. Artefacts originally marked 2 and 17 (Ben and Grey Ash under Ben) were excluded from the analysis as the units were disturbed and contained bottle glass and other modern materials.

<u>1 + 3: IC (Ivan Complex)</u>. This unit, 0,10 - 0,55 m thick, includes middens Betsy (1) and Ivan (3) which were partly truncated by the disturbed units named Jo, Ben and Grey Ash under Ben. The middens are packed with large quantities of marine shell with lenses of well-sorted sand which Butzer (Klein 1972a:180) believes are aeolian in origin. The middens have been grouped together for the purposes of analysis

Fig. 16



NELSON BAY CAVE. Profile of the 1970/71 excavations along the line separating the α and β rows of squares.

(After Klein 1972a and unpublished).

because Betsy appears to have been part of midden Ivan, but the two deposits have been split into two sections with recent disturbance in the form of a pit (Fig. 16). Betsy is the section towards the front of the trench while Ivan is towards the rear. Artefact density was high at 29,7 artefacts per bucket of deposit excavated (Table 11).

4,5,6,7,8,: BSC (Brown Soil Complex). Grouped together here are two brown soils, 0,35 - 0,80 m thick, below middens Ivan and Betsy, in which the matrix is highly organic sandy silt containing artefacts, bone and crushed shell which is often partly decalcified. Klein (1972a:181) suggests that such deposits may be considered as occupation soils as opposed to the purer middens in which whole shells predominate. The unit also includes two minor middens found over part of the excavated area only and called Glen (6) and Helgren (7), and the brown soil which developed below them (8). Klein reports that in the area excavated where middens Glen and Helgren were absent, the Brown Soil below Glen and Helgren merged with the Brown Soil below Ivan (op.cit:183), and it was therefore considered justifiable to group all these units together for analysis. On occasion, where it has been convenient to do so, BSC upper has been separated from BSC lower, the former including 4 and 5, the latter 6, 7 and 8. The ratio of artefacts to buckets of deposit is higher than in any other unit at 36,0 artefacts/bucket (Table 11)which largely confirms Klein's observation that the brown soils relate to occupation deposit rather than to refuse heaps.

9: RA (Rice A). This is a shell midden, 0,10 - 0,20 m thick, with a large quantity of whole and crushed shell which is partly decalcified in places. It extends over the entire excavated area, becoming more ashy towards the rear where it is covered by a thin overburden (Fig. 16). It is considered as the upper part of the Rice Complex (RC) recognized by Klein (1972a) as a stratigraphic unit. Analysis of the artefacts suggests that this upper portion (RA) is different from the lower part of the Rice Complex, Rice B, and the two are therefore considered separately here.

10, 21, 22, 23: RB (Rice B, Chris, Rice C and Rice D). This unit, 0,30 - 0,50 m thick, is composed of an extensive shell midden (Rice B) and several smaller middens of more limited extent but nevertheless broadly contemporary. Chris is found towards the front of the area excavated between Rice A and Rice B, while Rice C and D are towards the rear. There is little soil matrix between the shell, and within the main body of the midden is a massive lense of calcined (burnt) shell covering several square metres which is possibly the result of a bedding fire (Klein 1972a:183). This unit has the lowest density of artefacts with 5,9 per bucket. The shell is loose and partially crushed and is mixed with shell, ash and a limited amount of light brown grey loam matrix.

11: J (Jake). Of similar composition to the middens above, the shell debris of J, 0,20 - 0,25 m thick, is loosely packed with a matrix of light brown sandy clay loam, and includes lenses of burnt shell.

12: BSBJ (Brown soil below Jake). This unit, 0.25 - 0,35 m thick, is intermediate between a true midden and an occupation soil (Klein 1972a: 183) as the shell content is reduced and the matrix of light brown grey humic loam is consequently more prominent. Unlike the upper brown soils, however, the artefact content is slightly lower than would be expected (7,4 artefacts/bucket in BSBJ vs 7,8 in Jake) although the quantity removed was high (Table 11).

13: CS (Crushed Shell). This midden has been crushed and decalcified resulting in a grey brown loam, 0,20 - 0,35 m thick, in which small shell fragments are abundant but whole shells are rare. Artefact density is low at 5,5 artefacts/bucket.

14: GSL (Grey-Brown Shelly Loam). An occupation soil of grey brown colour, 0,10 - 0,15 m thick, with conspicuous hearths, decalcified shell ash and dispersed shell fragments, this horizon is not a shell midden in the same sense as those above, but some shell has been brought into the cave. The artefact density is similar to that in the units immediately overlying GSL at 7,9 artefacts/bucket although the number of buckets of deposit removed is low because the excavation was stepped in at this level over the back two rows of squares (Fig. 15).

15: BSL (Brown Stony Loam). In his analysis of the NBC sediments, Butzer (1973:101, 107) considers that all the units below GSL are built up of essentially natural sediments in contrast to those above which consist primarily of cultural deposit. The Brown Stony Loam, 0,10 - 1,30 m thick, contains some shell but it is almost completely decomposed and the sediment appears to represent the mineral residue of organic refuse mixed with naturally accumulated sediment derived primarily from the cave roof (Butzer 1973:107). An erosional disconformity separates this unit from the underlying Yellow Stony Loam suggesting a depositional break; this is referred to by Butzer (1973: fig. 4) as Oxidation Horizon 3 and its equivalent horizon is seen at the top of the stratigraphic sequence exposed in the sump pit at the rear of the cave (Butzer 1973:103). Artefact density was low at 4,9 artefacts/bucket.

16: YSL (Yellow Stony Loam). This unit consists of a light yellow to brown yellow silt loam, 0,10 - 0,20 m thick, with angular fragments in grit horizons or lenses of crude rock, including kaolinized slabs of contact breccia that have fallen from the cave roof. Klein (1972a: 183) notes that there were almost no pieces of marine shell visible to the naked eye, but Butzer (1973:101) reports fragments of shell. Localized pockets of microfauna from owl pellets occur in this horizon and have been studied by D.M. Avery (1979, 1982). Artefact density is relatively high at 27,9 artefacts/bucket.

18: YGL (Yellow Grey Loam). A light yellow brown loam to silt loam, 0,10 - 0,30 m thick, with dispersed angular stone and a high frequency of well preserved bone, both macro and microfaunal. Rare pieces of shell were present (Klein 1972a:184). Artefact density is as high as in YSL, the artefacts/bucket count being calculated for the two units together at 27,9.

Sterile Grey Loams I & II. Brown to dark grey brown silt loam, 0,20 - 0,50 m thick, the lower unit (I) being darker. Sterile of artefacts and bone and other macroscopic traces of human occupation, but includes microscopic pieces of corroded shell. Dispersed angular stone occurs in patches towards the front of the cave. Klein reports the presence of burrows or tunnels in this unit, 1-3 cm in diameter. As no artefacts were recovered from this unit, it is not included in any Tables but is mentioned here to show that the Later Stone Age materials are separated from the Middle Stone Age artefacts by a sterile deposit.

Dating

A suite of 21 radiocarbon dates has been obtained for the Later Stone Age levels at NBC, excluding those from units excavated and described by Inskeep post-dating 5000 B.P. The dates for the units described above are listed in Fig. 17 and Table 5. They show a fairly constant build-up of deposit from ca 12 000 B.P. to ca 5000 B.P., a thickness of just over 2 m on average that accumulated over some 7000 years, or

Table 5

RADIOCARBON DATES FOR NELSON BAY CAVE

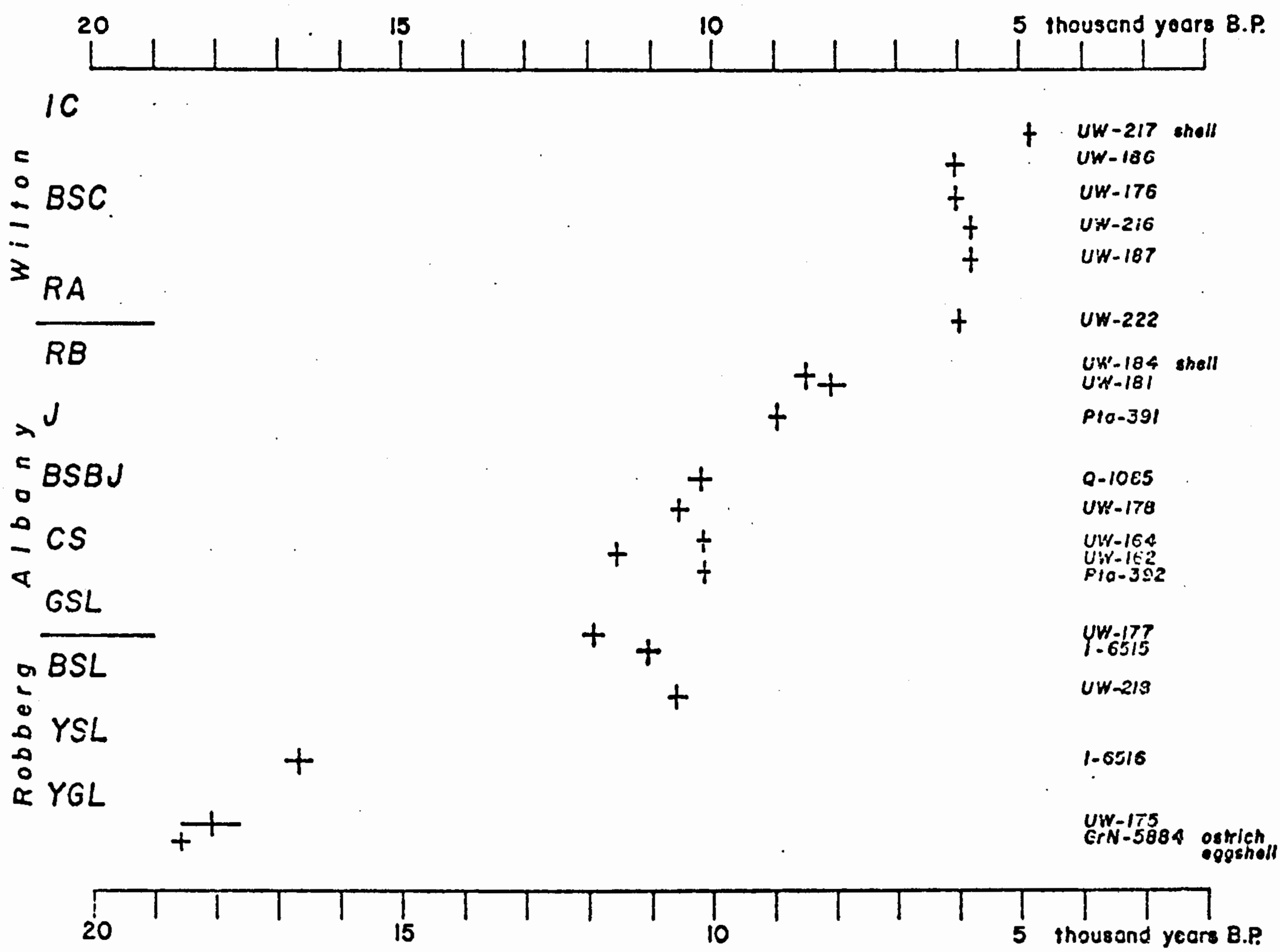
Unless otherwise stipulated all dates are from Fairhall et al (1976)

STRATIGRAPHIC UNIT	LAB. NO	SAMPLE AND POSITION	DATE B.P.
IC	UW-217	Shell of Patella sp. from sq B5 in midden Ivan	4860 ± 65
BSC	UW-187	Charcoal from sq B2 in Brown Soil below Helgren	5825 ± 150
	UW-216	Charcoal from midden Glėn/ Helgren	5830 ± 115
	UW-176	Charcoal from sq Gamma-5 in Brown Soil below Ivan	6020 ± 160
	UW-186	Charcoal from sq Gamma-4 in Brown Soil below Ivan	6050 ± 80
RICE A	UW-222	Charcoal from sq B3 in midden Rice A	6070 ± 125
	UW-179	Shell of Patella sp. from top of Rice A	9080 ± 185
RICE B	UW-181	Small charcoal fragments from sq Gamma-4 at interface of Rice B and J	8070 ± 240
	UW-184	Shell of Patella sp. between squares Alpha-3 & 4 at interface of Rice B and J	8570 ± 170
J	Pta-391	Charcoal from interface between Rice B and J (Klein 1972a)	8990 ± 80
BSBJ	Q-1085	Ash with charcoal from base of Brown Soil below Jake (Switsur & West 1973)	10 256 ± 210
	UW-178	Dense, clay-like black material with no clear charcoal from sq B4 from hearth at base of BSBJ	10 540 ± 110

Table 5 contd.

STRATIGRAPHIC UNIT	LAB. NO	SAMPLE AND POSITION	DATE B.P.
CS	Pta-392	Charcoal from hearth in sq B-1 near top of Crushed Shell midden (Klein 1972a)	10 150 ± 90
	UW-164	Charcoal from sq Gamma-4 in a hearth in CS	10 180 ± 85
	UW-162	Charcoal from sq B2 in hearth at base of CS	11 505 ± 110
GSL	UW-177	Charcoal from sq Gamma-3 in GSL	11 950 ± 150
	I-6515	Charcoal from same level as UW-177 (unpublished)	11 080 ± 260
BSL	UW-218	Charcoal from interface between BSL and YSL	10 600 ± 150
YSL	I-6516	Charcoal from YSL (unpublished)	16 700 ± 240
YGL	UW-175	Finely divided charcoal from sq B3 at base of YGL	18 100 ± 550
	GrN-5884	Ostrich eggshell fragments collected from test pit by Inskeep at level correspon- ding to YGL (Klein 1972 a)	18 660 ± 110

Fig. 17



NELSON BAY CAVE Radiocarbon dates plotted against stratigraphic units. All samples charcoal unless specified. (After J. Deacon 1978).

at a rate of about 0,3 m per 1000 years. Below this, an erosional disconformity separates BSL and YSL, the latter dating to some 4000 years earlier at ca 16 700 B.P. The base of the LSA sequence dates to between 19 000 and 18 000 B.P.

Two determinations are apparently out of place: UW-179 dating a shell to 9080 B.P. in Rice A is more likely to date to between 6500 and 6000 B.P.; the discrepancy is the result of shell rather than charcoal being used for dating. UW-218 dates the base of BSL to 10 600 B.P. while the overlying GSL unit is dated with three determinations to between ca 12 000 and 11 000 B.P. It is not inconsistent when the standard error is taken into account, however, and should be regarded as a minimum estimate.

The apparent 'break' between dates of about 6000 B.P. for Rice A and about 8000 B.P. for the base of Rice B below should be considered more apparent than real. The Rice A/B interface is not dated and the dated samples come from the base of the lower unit and the top of the upper one. The interface is therefore likely to be about 7000 years old on extrapolation. The two dated samples came from a part of the excavation where Rice B is particularly thick and an estimate of 1000 years for its accumulation can be considered a reasonable one. The closeness of the dates within BSC provides justification for considering the middens and brown soils as a single stratigraphic unit for the purposes of the artefact analysis and it is clear that they all accumulated over a period of about 1000 years.

Faunal remains

The results of the analysis of the faunal remains have been published in detail by R.G. Klein (1972a,b, 1974, 1976) and will be discussed where appropriate in later chapters. A summary of the minimum numbers of larger mammals is given in Table 6 and Fig. 18, and changes in fish and shellfish frequencies are summarized in Figs 19 and 20 respectively.

Table 6

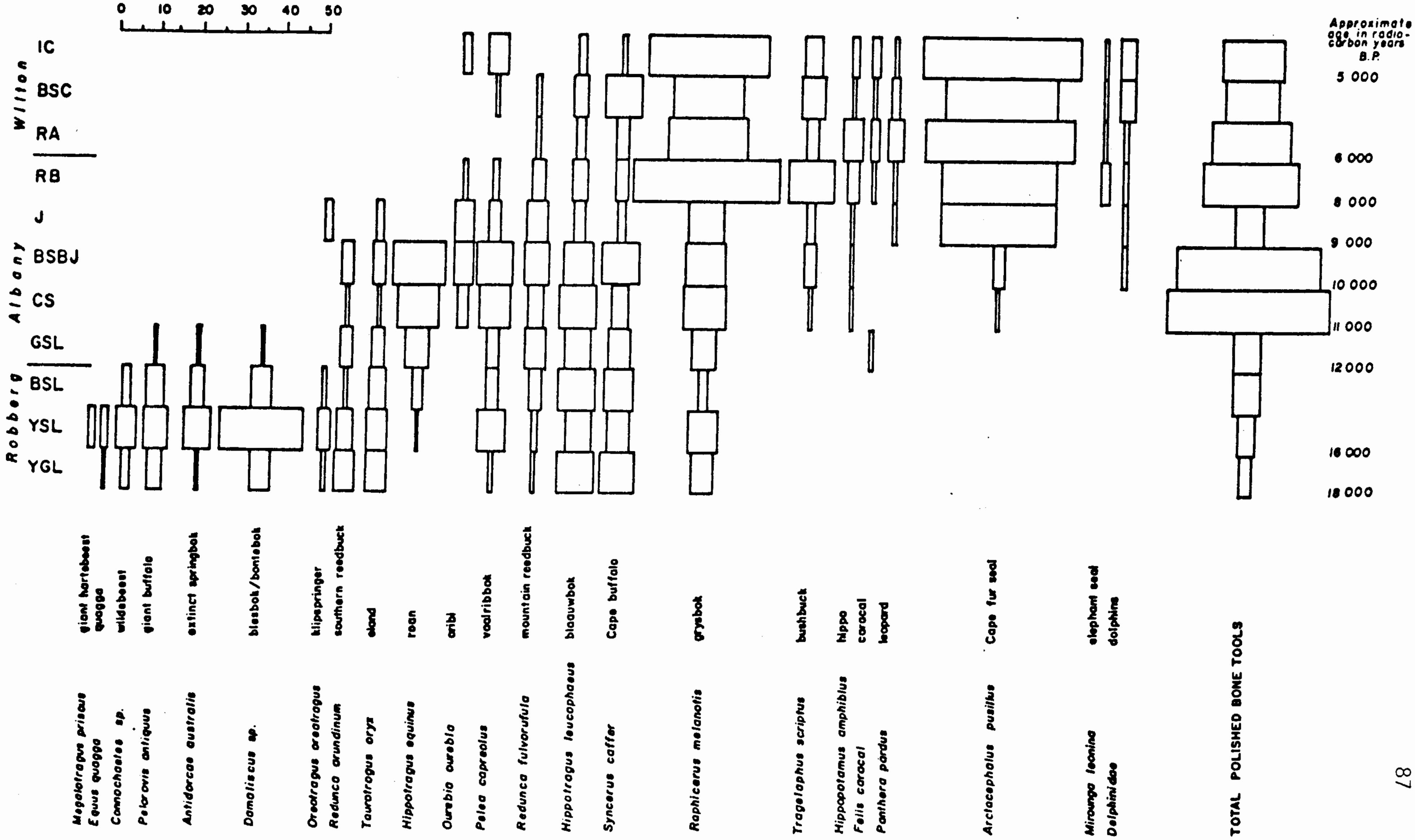
MINIMUM NUMBERS OF LARGER MAMMALIAN SPECIES REPRESENTED IN DIFFERENT STRATIGRAPHIC UNITS AT NELSON CAY CAVE. After Klein (1972b) and unpublished.

SPECIES	IC	BSC	RA + RB		J	BSBJ	CS	GSL	BSL	YSL	YGL
Homo sapiens, man	3	1	3		1	-	-	-	-	-	-
Papio ursinus, baboon	1	1-3	11-13			2-3	2	1	2	2	1
Manis cf *temmincki*, pangolin		-	-		-	-	-	-	-	-	1
Canis mesomelas, jackal	-	-	1		1	1	-	-	-	1	-
Mellivora capensis, honey badger	-	-	?1		-	-	1	-	-	-	-
Aonyx capensis, clawless otter	-	1	-		-	-	-	-	-	-	-
Herpestes ichneumon, Egyptian mongoose	-	2-3	1-2		?1	1	-	-	-	1-2	-
Herpestes pulverulentus Cape grey mongoose	1	2	2		-	-	-	-	-	1-2	-
Atilax paludinosus water mongoose	1-2	3	-		-	-	-	-	-	-	-
cf *Hyaena brunnea*, brown hyaena	-	-	-		-	-	-	-	-	1	-
Felis libyca, wildcat	1	1	-		-	-	-	-	-	-	-
Felis cf *caracal*, caracal	2	1	1-2		1	-	-	1	-	-	-
Panthera pardus, leopard	1	2	3-4		1	1	-	-	-	-	-
Arctocephalus pusillus, Cape fur seal	36-38	27	36		28	28	3	1	-	-	?1
Arctocephalus gazella, gazelle seal	-	-	-		-	1	-	-	-	-	-
Mirounga leonina, sea elephant	1	1	1		1-2	-	-	-	-	-	-
Orycteropus afer, aardvark	-	-	-		1	1	-	-	-	-	-
Procavia capensis, rock hyrax	20	27	27		6	8	6	7	5	25	14
Equus quagga, quagga	-	-	-		-	-	-	-	-	2	1
Potamochoerus porcus, bushpig	3	3	2	6	3	5	3	3	2	2	1
Phacochoerus aethiopicus, warthog	-	-	-	-	-	-	2	2	-	2	-
Hippopotamus amphibius, hippopotamus	2	1	5		2-3	1	1	1	-	-	-
Tragelaphus scriptus, bushbuck	4	4	6	3	11	6	3	1	-	-	-
Taurotragus oryx, eland	-	-	-	-	2	1	2	3	4	4	6
Syncerus caffer, Cape buffalo	4	9	3	3	2	9	4	5	7	6	7
Pelorovis antiquus, giant buffalo	-	-	-	-	-	-	-	1	5	6	4
Sylvicapra grimmia, Grimm's duiker	1	1	1	-	-	-	-	-	-	-	-
Redunca arundinum, southern reedbuck	-	-	-	-	3	1	3	1	9	-	-
Redunca fulvorufula, mountain reedbuck	-	1	1	3	5	6	4	5	3	2	-

Table 6 contd.

SPECIES	IC	BSC	RA + RB		J	BSBJ	CS	GSL	BSL	YSL	YGL
Hippotragus equinus, roan	-	-	-	-	-	13	10	6	3	1	-
Hippotragus leucophaeus, blaauwbok/blue antelope	2	3	2	4	3	7	9	6	9	7	9
Damaliscus dorcas, blesbok/bontebok	-	-	-	-	-	-	-	1	5	20	5
Connochaetes gnou, wildebeest	-	-	-	-	-	-	-	-	2	5	2
Megalotragus priscus, giant alcelaphine	-	-	-	-	-	-	-	-	-	2	-
Antidorcas spp., springbok	-	-	-	-	-	-	-	1	3	7	1
Raphicerus melanotis, grysbok	27	17	19	35	8	9	10	6	2	4	5
Ourebia ourebia, oribi	-	-	-	-	5	5	3	-	-	-	-
Pelea capreolus, vaalribbok	5	1	-	2	3	9	8	3	3	7	1
Oreotragus oreotragus, klipspringer	-	-	-	-	2	-	-	-	-	1	4
Lepus cf *capensis*, Cape hare	-	-	-	-	-	-	-	-	1	1	1
Hystrix africae-australis, porcupine	1	3	2	1	1	-	-	1	-	1	-
Delphinidae, dolphins	4	4	1	-	-	-	-	-	-	-	-

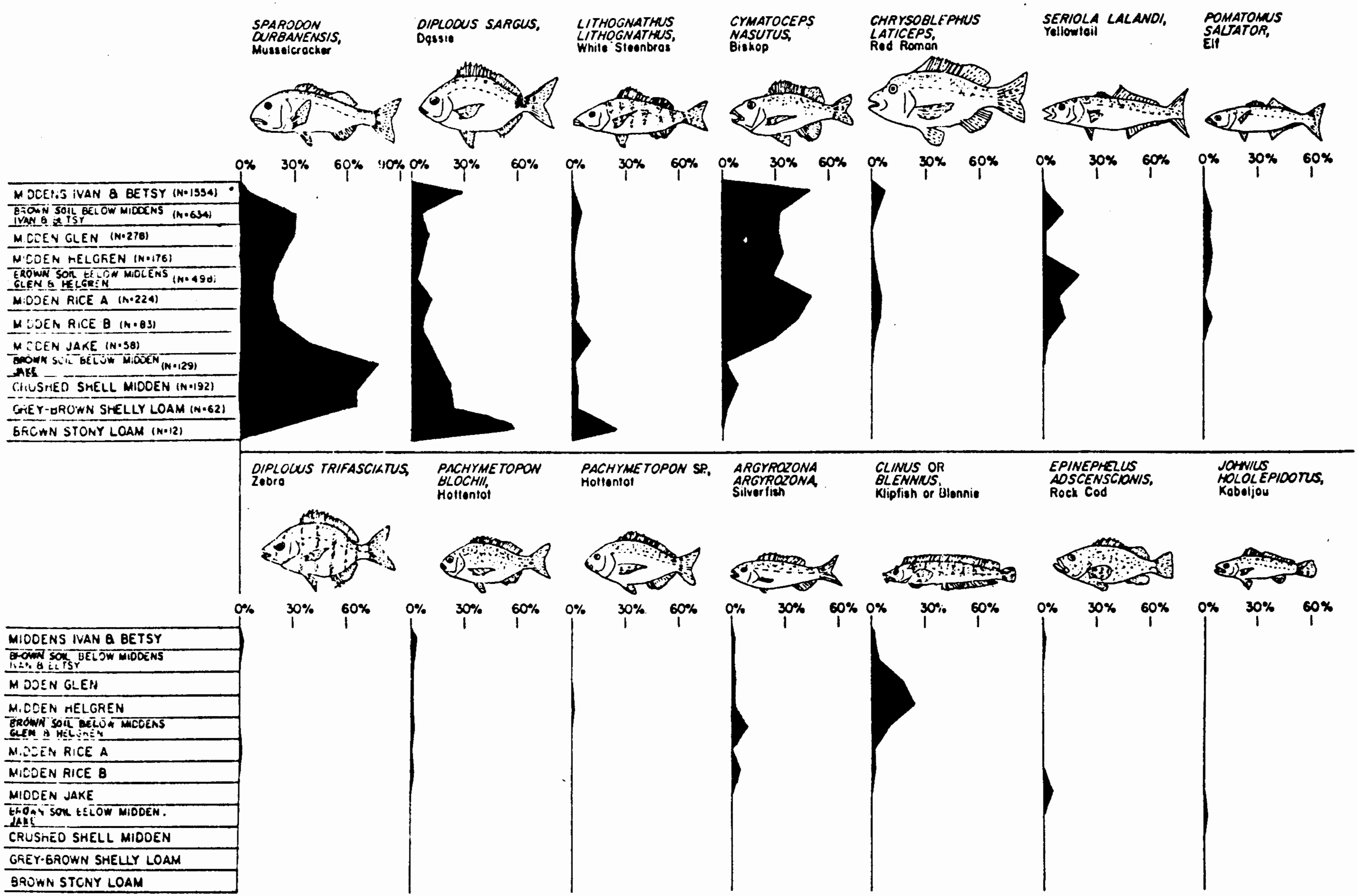
Fig. 18



NELSON BAY CAVE 1970/71 from R.G. Klein (pers. comm.) — ***Minimum numbers of individuals of some mammals and total polished bone tools*** *(Diagram from J. Deacon (1978)).*

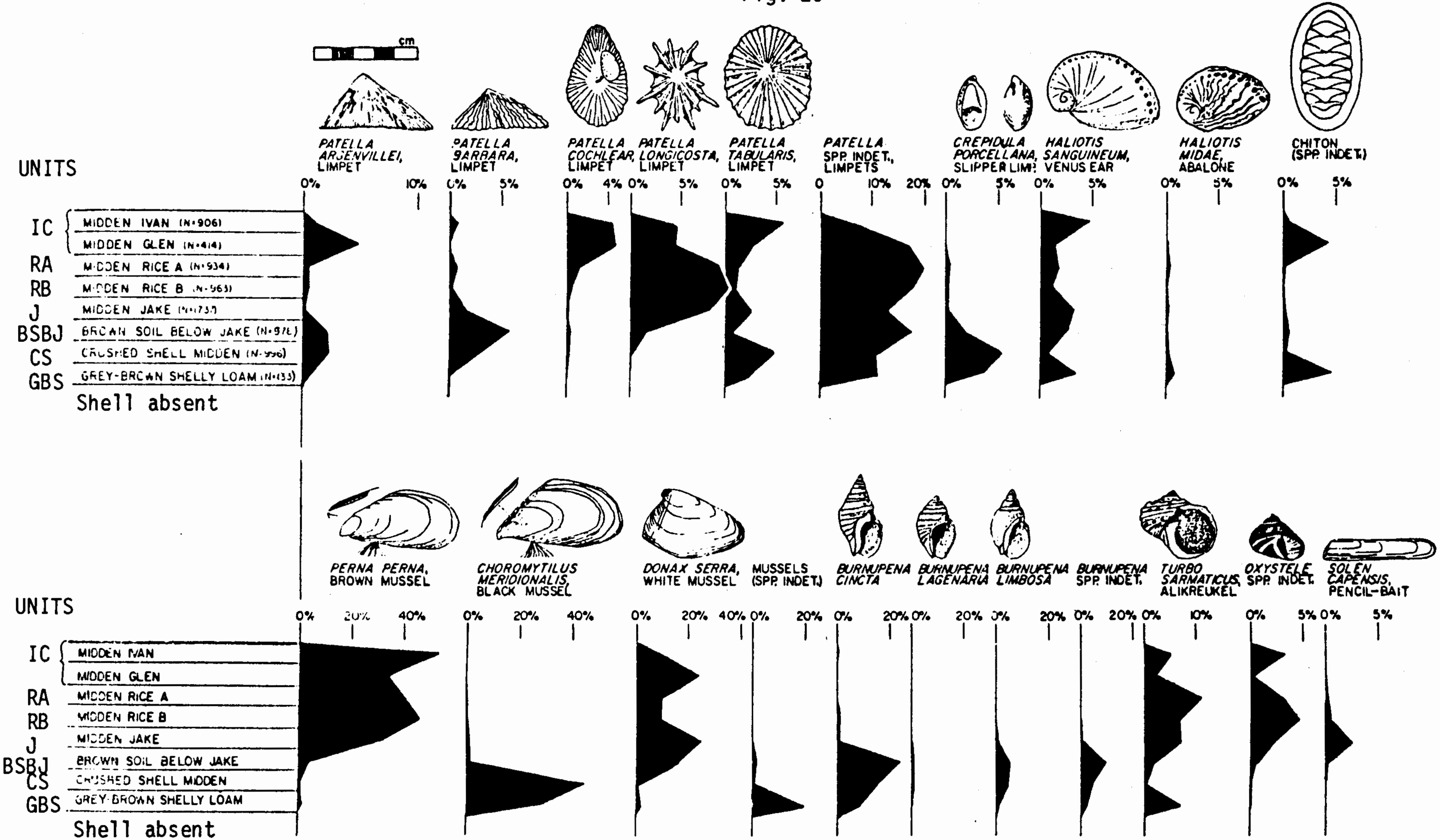
Fig. 19

NELSON BAY CAVE. Percentages of principal fish species found in the various stratigraphic units of the 1970 excavations (Identifications and counts by C. Poggenpoel.



(After Klein 1972a)

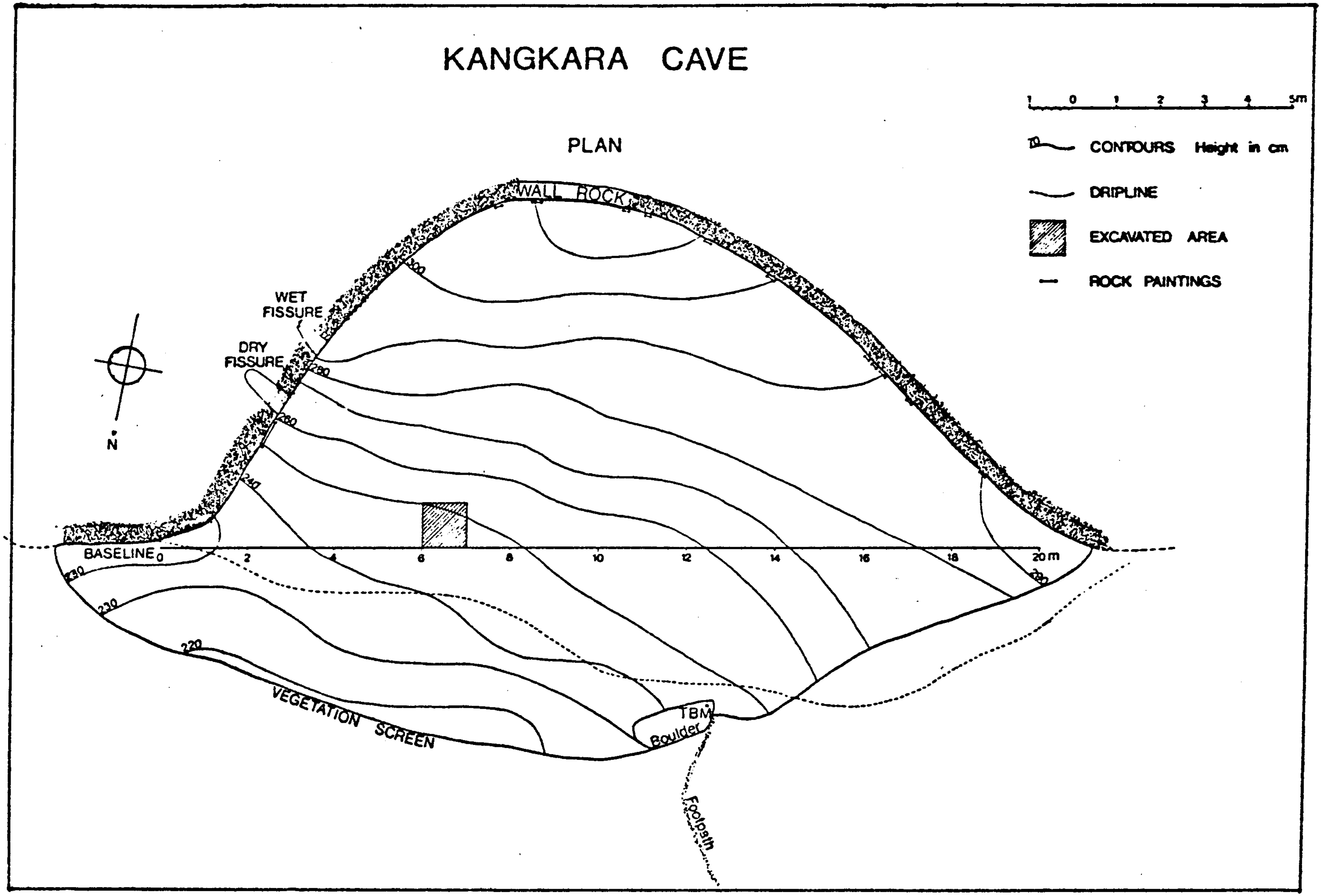
Fig. 20



NELSON BAY CAVE. FREQUENCIES OF SHELLFISH SPECIES IN VARIOUS HORIZONS OF THE 1970 EXCAVATIONS (Based on identications and counts by G. Rice)

(After Klein 1972a)

Fig. 21


KANGKARA CAVE
PLAN
1 0 1 2 3 4 5m
CONTOURS Height in cm
DRIPLINE
EXCAVATED AREA
ROCK PAINTINGS
WALL ROCK
WET FISSURE
DRY FISSURE
N
280
260
240
230
230
220
BASELINE
0
2
4
6
8
10
12
14
16
18
20 m
VEGETATION SCREEN
TBM
Boulder
Footpath

KANGKARA CAVE

A test excavation was undertaken at the site in June 1972 under the direction of H J Deacon, with R G Klein, Janette Deacon and students from the universities of Cape Town and Stellenbosch. As bone was not preserved in the deposits older than ca 12 000 B.P., however, the site was not excavated further.

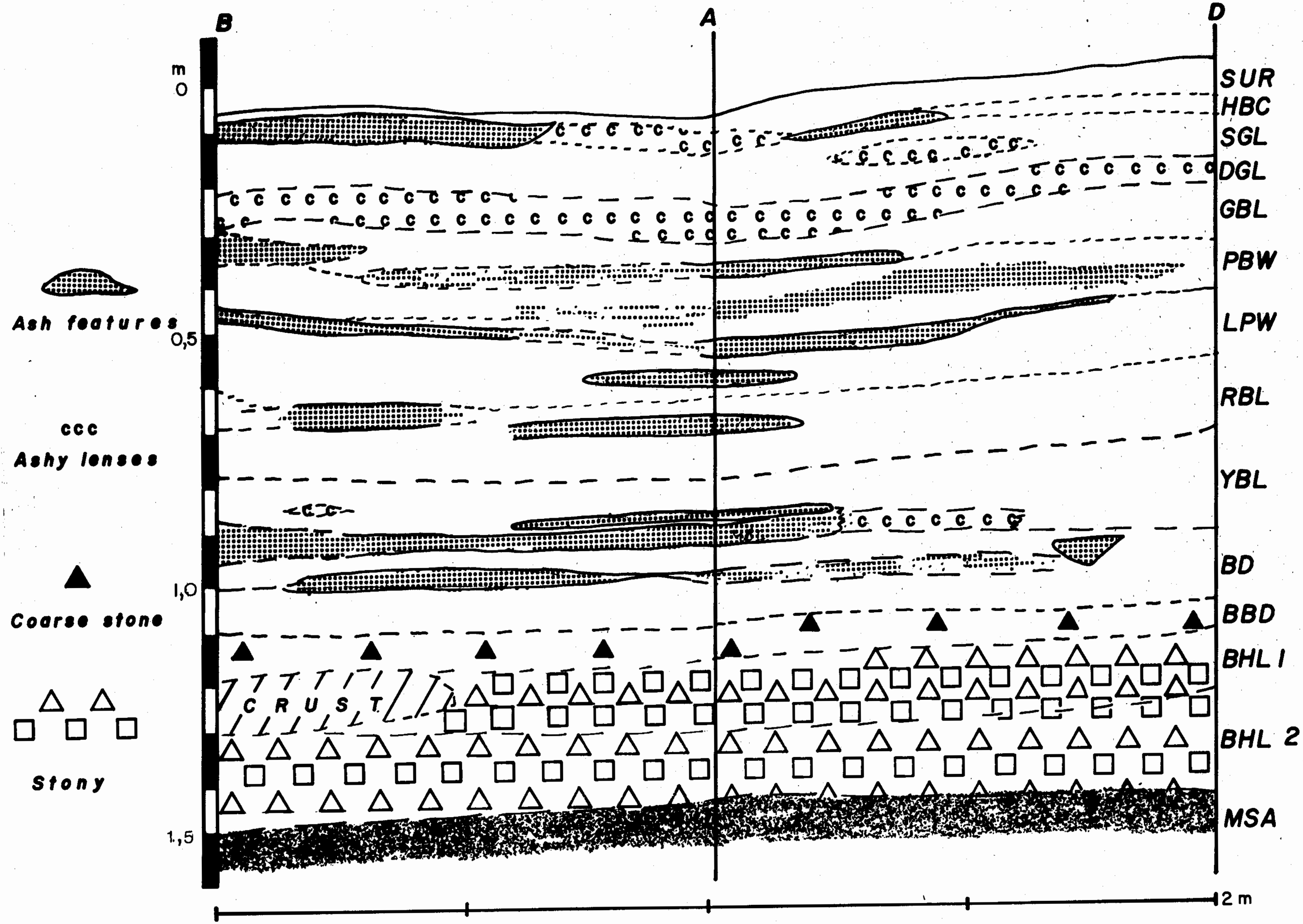
The cave floor is about 22 m across and about 8 m from the back wall to the middle of the cave mouth (Fig. 21) which faces west towards the bank of the Kangkara stream. A 1 m^2 was excavated in the centre of the cave floor and was abandoned at a depth of 1,7 m. Bedrock was not reached. Despite the small size of the cutting, a reasonably large sample of formal tools was recovered. The upper 1,1 m relates to a suite of Later Stone Age occupation units with Middle Stone Age artefacts (but no bone) within and below a hard crust of cemented deposit beneath 1,7 m. These MSA artefacts have been described by Volman (1981).

Stratigraphy

As the cave has been in use as a sheep kraal in recent years, the uppermost 50 - 100 mm has been disturbed through trampling as is evident in the find of four potsherds in the HBC unit dated to 5300 B.P. The following units were recognized on the basis of colour and texture of the soil matrix and are described from top to bottom (Fig. 22):

		Average thickness in mm
SUR	Surface dust, uncompacted	50 - 100
HBC	A relatively hard and compact deposit with an impersistent ash band within it suggesting that the material was largely *in situ*	90 - 110
SGL	A soft grey loam with minor interleaving ashy bands	100 - 110
DGL	A dark grey loam somewhat more ashy than SGL	90

KANGKARA : SECTION



GBL	A rather stony grey loam containing two ash features with some carbonized plant material	80 - 120
PBW	A black-grey loam with two pronounced yellow cemented ash bands	70 - 80
LPW	A grey brown earth with a partly cemented ashy feature and a thin impersistent layer of yellowish ash	80 - 150
RBL	A red brown loam which includes two ashy hearth features	130
YBL	A thick loam with one extensive hearth complex and two less prominent hearths	150 - 180
BD	A spally layer in a grey black loam	150 - 160
BBD	A grey black horizon with large roof blocks	50 - 100
BHL	A hard crust with some oxides and carbonates and MSA artefacts	100
BL	A black loam which lay beneath the hard crust and includes MSA artefacts	150 - 200

A major break in the sequence is represented by the disconformity in the form of a cemented crust over part of the excavated area between BBD and BHL which means, in cultural terms, that the time period between 'typical' MSA and the earliest LSA is not represented at the site.

Dating

Six radiocarbon dates have been obtained for the Kangkara sequence. The small size of the cutting meant that charcoal samples large enough

Table 7

RADIOCARBON DATES FROM KANGKARA CAVE

STRATIGRAPHIC UNIT	LAB. NO	SAMPLE AND POSITION	DATE B.P.
HBC	Pta-2286	The uppermost unit considered to be *in situ*. Sample includes four pot-sherds. Low frequency of charcoal so material dated was 260g of bone fragments.	5355 ± 55
GBL	Pta-2287	Artefacts included seven backed tools (absent in underlying units). Dated material consisted of 510g of unidentifiable bone fragments.	6600 ± 75
PBW	Pta-2812	Cultural material some large scrapers. Dated material consisted of fragments of unidentifiable bone.	7330 ± 100
RBL	Pta-2813	Some large scrapers. Charcoal in a sandy matrix yielding 140mg of carbon was analysed in a mini-counter. Result should be regarded as a minimum date. Actual age is estimated between 7500 and 9000 B.P.	5600 ± 370
YBL	Pta-2307	Some large scrapers. Sample of 285g bone fragments.	9260 ± 90
BBD/BHL	Pta-782	Sample of charcoal from a hearth immediately overlying the crust containing MSA artefacts and therefore post-dating them. The two determinations represent two different chemical fractions of the same sample.	12 550 ± 110 12 330 ± 130

Table 8

KANGKARA CAVE : MINIMUM NUMBERS OF INDIVIDUALS BY WHICH MAMMALIAN SPECIES ARE REPRESENTED IN THE VARIOUS STRATIGRAPHIC UNITS - R.G. KLEIN*

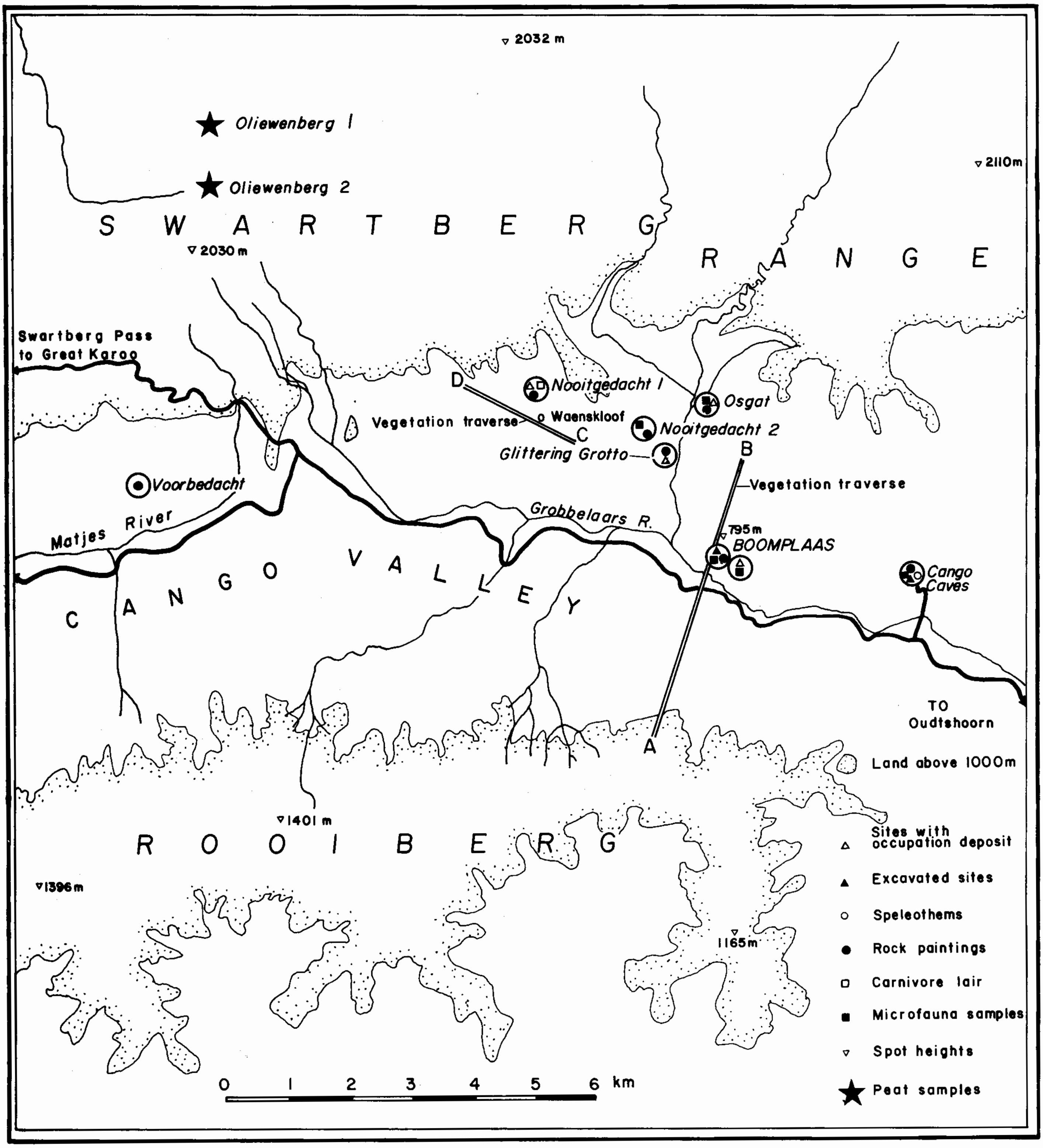
	HBC	SGL	DGL	GBL	PBW	LPW	RBL	YBL	BD
Viverridae indet.			1						
Other carnivora indet.		1				1-2			
Felis caracal caracal			1				1		
Orycteropus afer aardvark				1					
Procavia capensis dassie	1	3	11	6	2	4	2	1	1
Equus cf. *zebra* mtn zebra					2	1		1	
Potamochoerus porcus bushpig		1	1			1	1	1	?1
Hippopotamus amphibius hippo								1	
Raphicerus sp. grysbok/steenbok	?1	1	1	1	?1			?1	
Oreotragus oreotragus klipspringer		?1	1	1		1		?1	
Redunca fulvorufula mountain reedbuck		2			?1		1		
Alcelaphus caama hartebeest							1 cf		1 cf
Syncerus caffer buffalo								?1	
Lepus sp. hare			1 cf					1 cf	
Small Rodentia			x	x		x			

*

Faunal remains identified and counted by R.G. Klein (1972 unpublished).

Fig. 23

Map of the Cango Valley showing location of Boomplaas, Cango and other sites (after Deacon, H.J. 1979)



for dating could seldom be found and most of the dates were therefore run on samples of unidentifiable bone fragments taken from sieves throughout the thickness of the stratigraphic unit. They should therefore be considered as only generalized estimates of the ages of these units. The determination for RBL (on a very small sample of charcoal) is clearly out of place and should be considered as a minimum estimate (J C Vogel, pers. comm.). All the dates were processed at the National Physical Research Laboratory of the C S I R in Pretoria by Dr J C Vogel (Table 7).

Faunal remains

The small sample of identifiable faunal remains has been analyzed by R G Klein and minimum numbers are listed in Table 8.

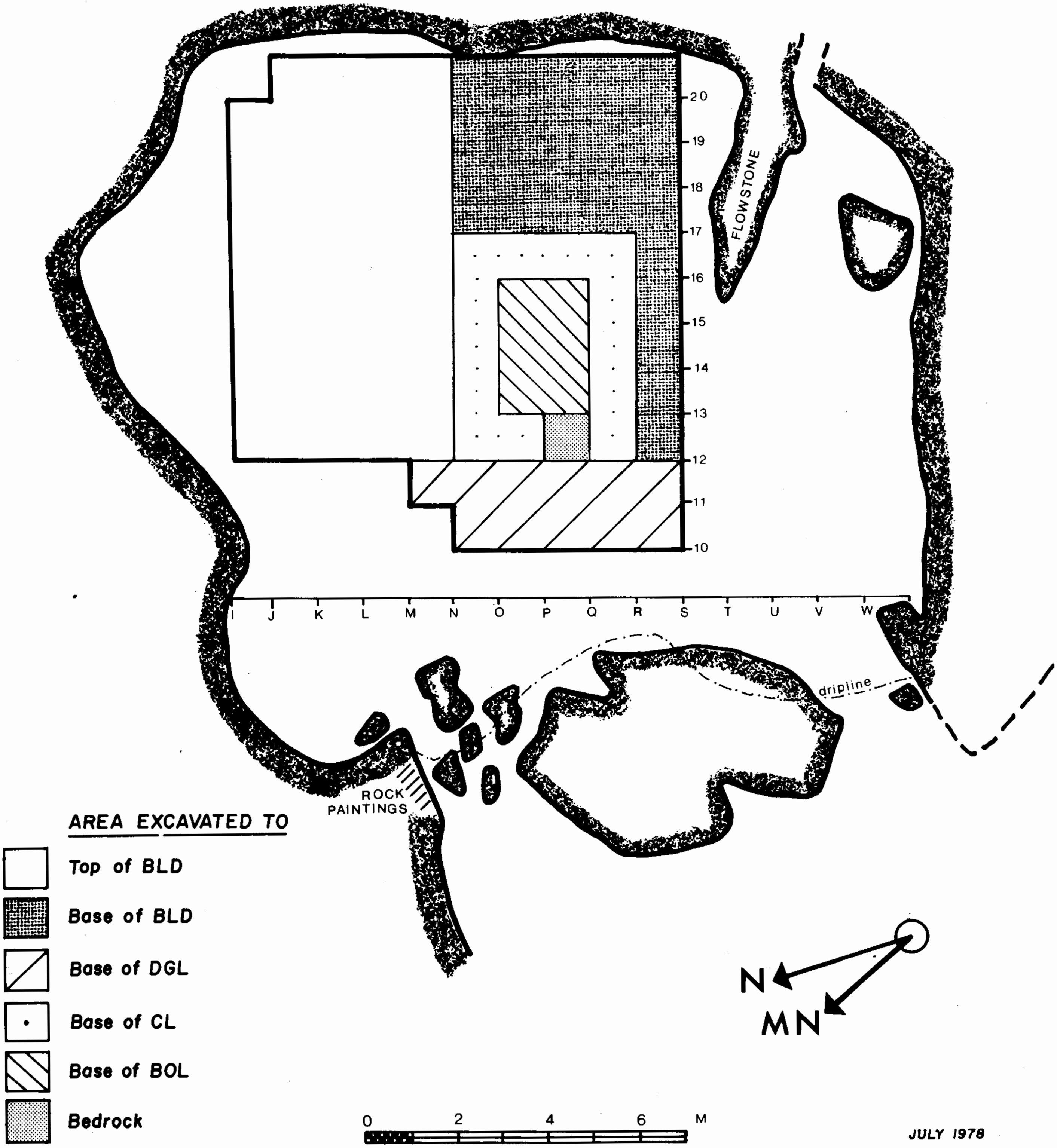
BOOMPLAAS CAVE

Boomplaas Cave A is located some 4 km west of the Cango Caves in an unrelated fissure opening at the same elevation above the valley floor, but on a minor limestone band that forms a prominent cliff face known as Drupkelderkop (Fig. 23). Several smaller fissures have opened in the south face of the cliff and one of these has been occupied by owls (Avery, D.M. 1979, 1982) providing a modern sample of micromammals against which prehistoric samples could be compared. Excavations were begun in 1974 with two seasons annually until February 1979, and a final week in December 1979 when the cutting was filled in.

The floor area is 225 m² and roughly square in shape measuring some 15 m across the mouth which faces west, and 13 m from the rock fall at the mouth to the rear wall. Large roof blocks partly seal off the entrance and have served to retain the deposit within the cave. A control cutting 1 m² (grid square P12) was excavated to bedrock in January/February 1974 to a depth of 5 m and off this 100 m² was excavated in later seasons to a depth of 1 m. Thereafter, the excavated area was reduced to 20 m² to a depth of nearly 2 m and finally 6 m² were taken to bedrock (Fig. 24). Only those units dating within the last 20 000 years (GWA to DGL) are discussed here. Descriptions of the full sequence which includes Middle Stone Age and other late Pleistocene occurrences dating probably within the last 80 000 years

Fig. 24

BOOMPLAAS CAVE : PLAN



After Deacon, H.J. 1979

have been published elsewhere (Deacon & Brooker 1976; Deacon, H.J. 1979; Deacon, J. 1979).

Preservation of macroscopic plant remains is restricted to the most recent units, but pollens are preserved in some earlier stratigraphic units and have been studied by Scholtz (unpublished). Charcoals are present in most units and have been used both for dating (J C Vogel) and for wood identifications (Daitz and Scholtz in prep.). Faunal remains are preserved throughout and include bone accumulated through human occupation as well as micromammals accumulated by owls. The micromammalian remains have been studied by Polly Scott (unpublished) and D M Avery (1979, 1982) who has included modern comparative samples from several nearby sites (Fig. 23). The larger mammals have been studied by R G Klein (1978b) and Brink (unpublished) has obtained comparative Pleistocene samples from carnivore lairs in other caverns in the Cango Valley (Fig. 23; Deacon, H.J. 1979). Vogel has analysed oxygen isotopes for palaeotemperature data in stalagmite material incorporated in the dposits, and Webley (1978) has done a preliminary analysis of the sediments.

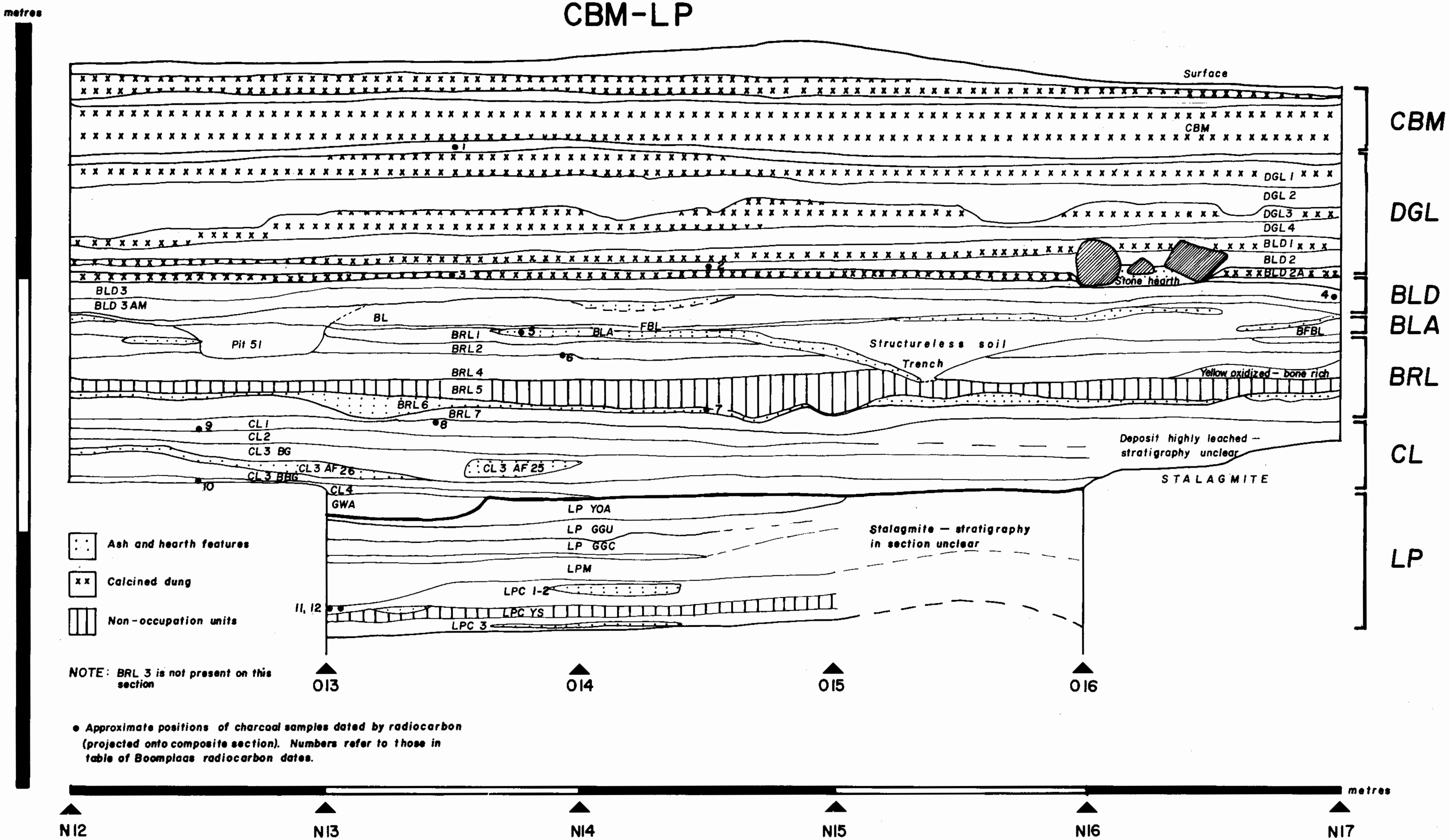
Stratigraphy

Except where masked by secondary cementation, the deposits are well stratified unlike other sites in the region which are formed in rocks of the Table Mountain Group. The deposits consist of sandy loams with inclusions of coarser spalls and blocks (Fig. 25). Grading analysis shows little difference through the sequence in the finer component (the -2 mm fraction) in the parameters calculated, for example in mean grain size, sorting, skewness and kurtosis (Webley 1978). This might be expected in situations such as this cave on a slope above a valley where the sources contributing to the build-up in the deposit are limited and have remained constant. The major source of coarser material has been the cave interior and some horizons are marked by a higher component of roof debris. There is a clear contrast between sediments built up largely through natural agencies and those which are the result of human occupation in that the latter include ash lenses and carbonized organic materials. Human occupation has been episodic throughout the time period represented by the deposits and the main phases of human occupation are well separated by culturally

Fig. 25

BOOMPLAAS A: COMPOSITE SECTION

CBM-LP



sterile deposits.

The lithostratigraphy has been described in a hierarchical scheme of Members, Units and Sub-units, from highest to lowest order (Deacon, H.J. 1979). The sequence can best be described in terms of Members which represent sets of pene-contemporaneous Units which have had a similar origin. The Members recognized in the Boomplaas sequence dating within the last 20 000 years are as follows, from top to bottom (Fig. 25). Details on the full sequence may be found in Deacon, H.J. (1979).

CBM Member. Below a superficial layer of loose dust is a massive porous white layer some 0,25 m thick formed through the burning of sheep dung that accumulated on the cave floor when the site was used as a stock kraal in the late 18th century and early 19th century (Green 1955:120). No cultural material was found associated with this layer.

DGL Member. The deposit is of similar origin to that in CBM, but is less massive and is composed of a series of discrete thin bands of white calcined material with soil partings between the bands. The interpretation is that this accumulation represents more intermittent use of the cave as a kraal and as a habitation site, probably over a century or less about 1700 years ago. The associated cultural material includes pottery, stone artefacts, a copper bead and circular stone-packed hearths (Fig.26). The faunal remains include both domesticated sheep and small game (Klein 1978b). The pottery is typical of the Cape Coastal ware which is widely associated with stock keeping and continued to be made by the Hottentot-speaking herders in historic times (Rudner 1968; Deacon et al 1978). The Units recognized during excavation and grouped within the DGL Member are:

DGL : DGL 1, DGL 2, DGL 3, DGL 4

BLD : BLD 1, BLD 1a, BLD 1/2, BLD 2, BLD 2a

BLD Member. The burning of the kraal dung layers in DGL has carbonized the underlying surface litter accumulated over about 300 years between the two occupations and this parting, which was found over the entire area excavated, serves as a marker for the separation of the DGL and BLD Members. The BLD Member is divided into two Units, BLD 3 and BL which consist of the following sub-units:

Fig. 26

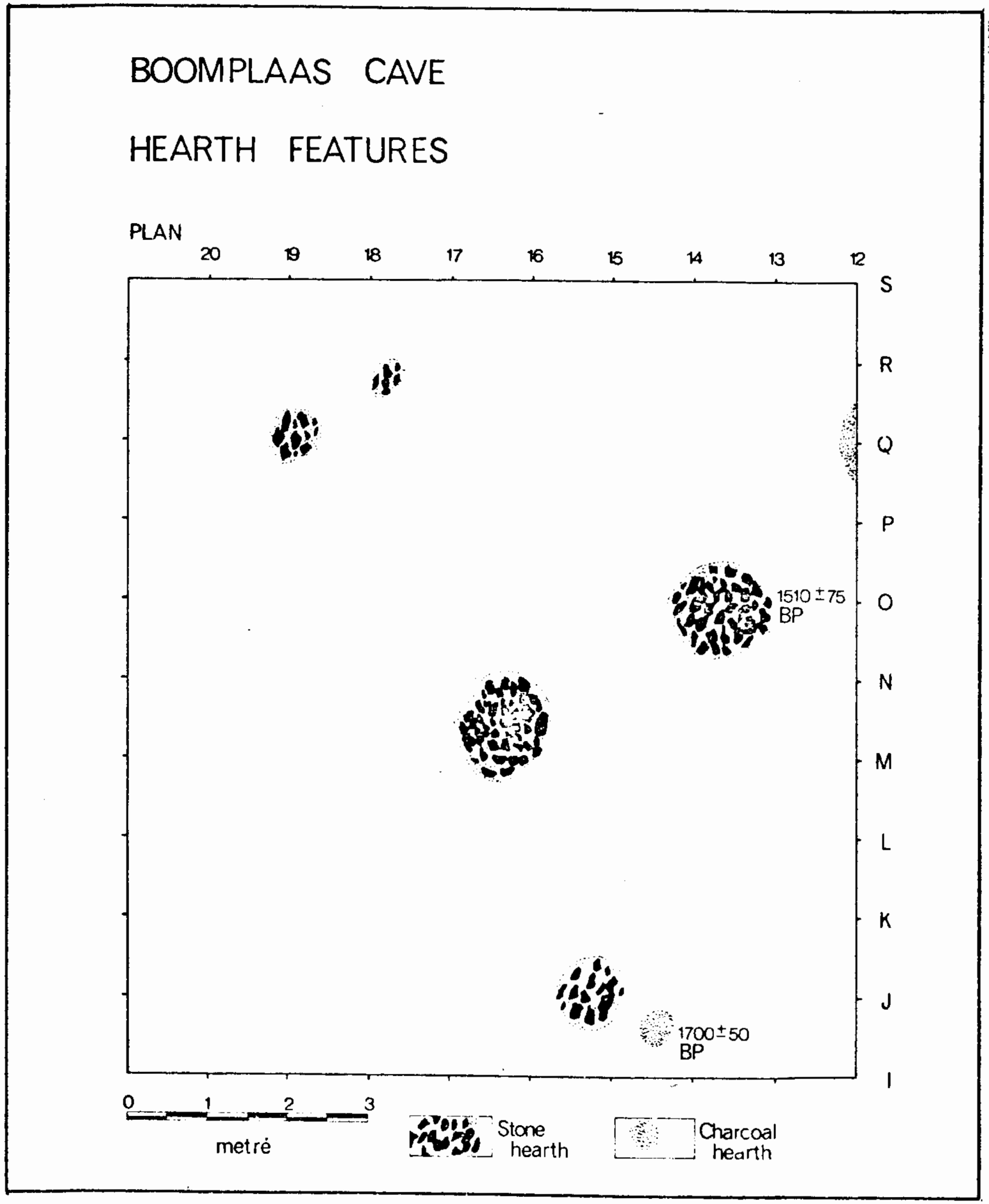
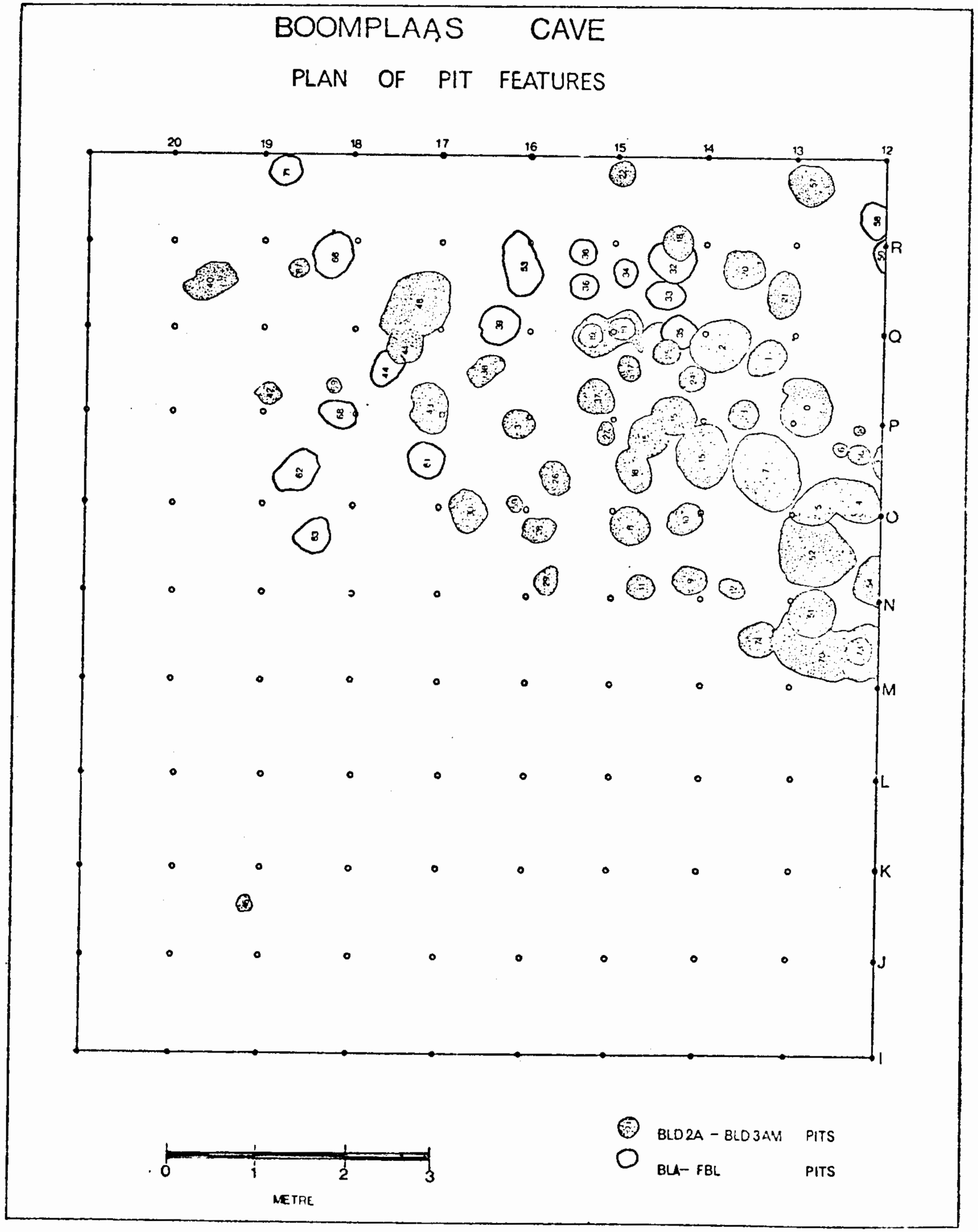

BOOMPLAAS CAVE
HEARTH FEATURES
PLAN
20 19 18 17 16 15 14 13 12
S
R
Q
P
O
N
M
L
K
J
I
1510 ± 75 BP
1700 ± 50 BP
0 1 2 3
metré
Stone hearth
Charcoal hearth

Fig. 27


BOOMPLAAS CAVE
PLAN OF PIT FEATURES
20 19 18 17 16 15 14 13 12
R
Q
P
O
N
M
L
K
J
I
0 1 2 3
METRE
BLD2A - BLD3AM PITS
BLA- FBL PITS

BLD 3 : BLD 3, BLD DB, BLD 3U, BLD 3UA, BLD 3L
BLD 3A, BLD 3AM, BLD ARB, BLD DR, BLD R, BLD SH
BLD 3B, BLD 3AM2, BLD 3BM, BLD SH2
BLD 3C, BLD 4, BLD z, BLD bh

BL : BLD BL, BLD BL1, BLD BL2, BL

The BLD Member consists of brown loamy occupation deposits dated to around 2000 B.P. Within the Member are more than 45 deliberately made pits ranging in diameter from 0,20 to 0,80 m (Fig. 27). In many instances there is a lining of the papery bulbar leaves of Boophone disticha, then a layer of grass and finally a second layer of bulbar leaves. The common name of B. disticha is 'gifbol' or 'poison bulb' and apart from the toxic properties of the bulb which probably helped to keep insect pests away from the pit contents, the papery bulbar leaves have been reported as having been used to cover skin wounds (Moffett & Deacon 1977) and are known from archaeological examples to have been used as a wrapping material (Parkington & Poggenpoel 1971; Deacon, H.J. 1976). The contents of several of the pits had not been cleared and all were filled with the seeds of Pappea capensis fruits which are ethnologically and pharmacologically known as a source of vegetable oil used on the skin. The kernels are also edible and the fruits, too, are fairly palatable. No stands of P. capensis were recorded in the floristic survey of the Cango Valley (Moffett & Deacon 1977) and the nearest known source today is some 10 km from the site. For the cave to have served as a base for the harvesting of these fruits it seems probable that there were stands of P. capensis nearby 2000 years ago. The fruits ripen in summer and are easily harvested. Trials undertaken on the farm Buffelskloof some 25 km to the west showed that it is possible to collect fruits at the rate of over 100 per minute and the trees were estimated to carry several thousand fruits each. The implications are that the occupation of the cave at this time was functionally related to the harvesting and storing of these fruits, presumably to allow them to mature so that the vegetable oil and/or kernels could be used at a later date (Deacon, H.J. 1979).

The majority of the pits have been emptied and filled with redistributed occupational debris including bone and other organic material and the stones which had been used to mark the tops of the full pits are often incorporated into the fill of the empty ones. The density of the pits in BLD can be seen in Fig. 27. Three of the more than 100 marker stones found in the pits have paintings on them (Deacon et al 1976).

In addition to the seeds, there is limited evidence for plant food gathering in this Member. Two corm bases of Hypoxis villosa and one corm of Watsonia sp. are the only identifiable remains recovered which is surprising in view of the fact that the empty pit depressions were ideal traps for the accumulation of plant food residues and that conditions were clearly suitable for their preservation. This lack of plant food remains may well be due to the limited availability of geophytes in the vicinity of the site as has been demonstrated in the floristic survey (Moffett & Deacon 1977). Charcoals from this Member have been sampled and identified and the results show that they are dominated by Acacia karoo which is prominent in the woodland of the valley at present (Fig. 10, Table 3).

The faunal remains (Table 10) indicate a predominance of small antelope and ground game from the local shrubland. Some sheep remains (representing one individual) came from a disturbed context in a pit and are thought to be intrusive from the overlying DGL Member.

Repeated occupation of the cave over short periods of a few days rather than weeks is suggested by the limited potential of the plant food resources in the valley and by the low density and discrete scatters of artefactual material on the cave floor reflected in the large number of pene-contemporaneous sub-units identified during excavation.

BLA Member. The deposit in this member is composed of a series of thin occupation surfaces dating to about 6500 B.P. These underlie a hardened parting which must represent the surface which existed during the non-occupation of the site between ca 2000 and 6500 B.P. Two Units are recognized, with the following Sub-units:

FBL	:	FBL
BLA	:	BFBL, AL1 BLA, AL2 BB, AL2A BLA, TA AF1 BRL, BLD BLA 1 = AL2 BLA, CA 1-5 LA, BA BLD BLA 2

BLD BLA 3
BFBL 2 = AL3 BLA
BLD BLA 4

The Sub-units grouped into AF1 BRL and including all those with the suffix BLA are associated with elongated depressions several metres long and about 1 m wide which are filled with charcoal. These features are distinct from the normal sub-circular cooking hearths and again suggest that the cave served a specific function at that time. Direct evidence for what these elongated hearths might represent is lacking, but it may be suggested that the collection of fuel for the beds of charcoal clearly represents a considerable input of effort and their function for curing or drying animal rather than vegetable products can be suggested (Deacon, H.J. 1979).

A single painted stone was found in this Member (Fig. 28). Faunal remains essentially similar to those from BLD were identified, but with the notable absence of domestic stock (Klein 1978b, Table 10).

BRL Member. This brown red loam is dated to between 9000 and 10 500 B.P. and is again separated from the overlying Member by a hardened parting developed during non-occupation of the site from 9000 to 6500 B.P. The following Sub-Units and Units have been recognized:

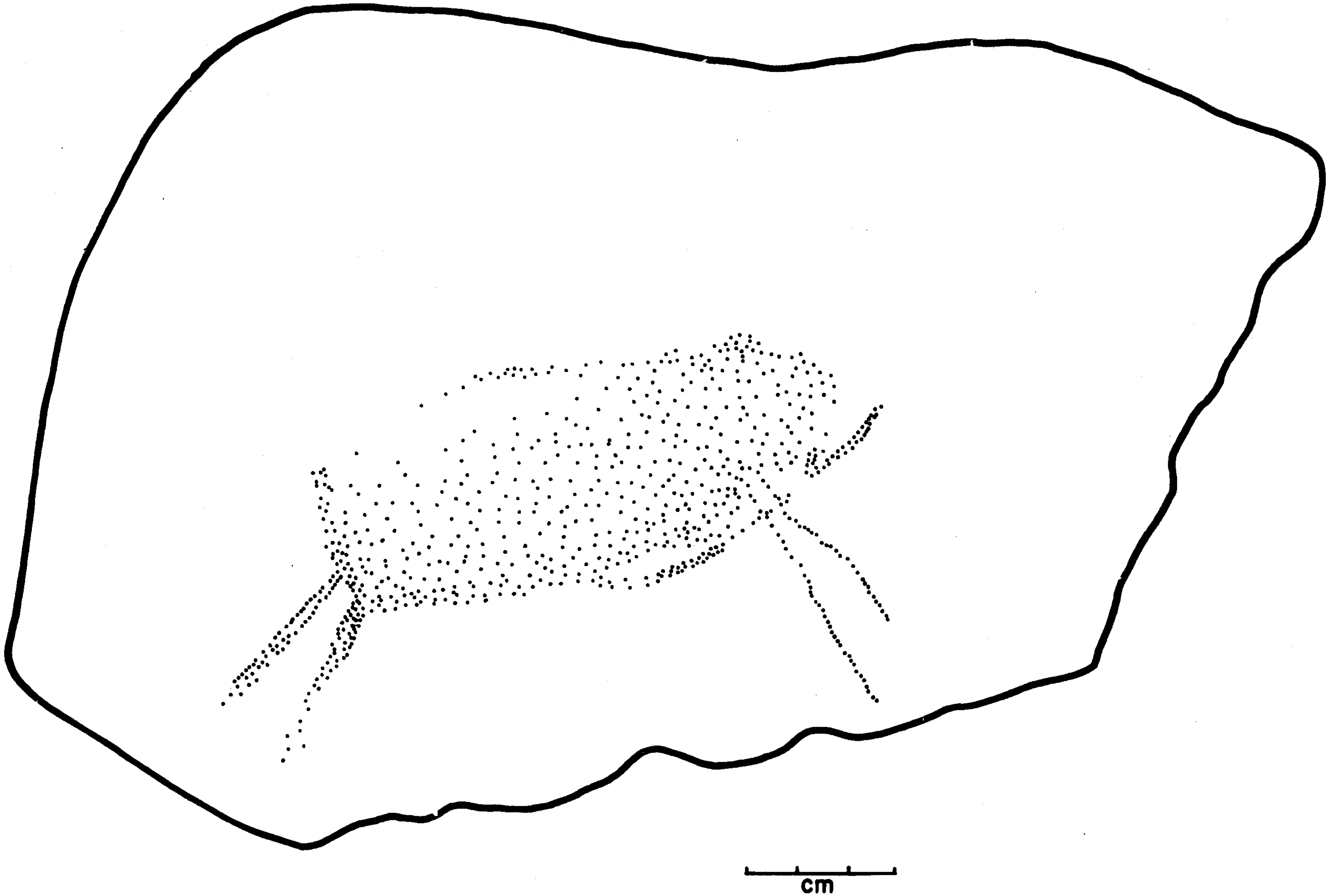
BRL, BRL 1
BRL 2, BRL 2A, BRL 2B, BRL 2C
BRL 3, BRL 3WA, BRL 3A
BRL 4, BRL 4UA, BRL 4A, BRL 4C
BRL 5
BRL 6, BRL 6A, BRL 6W, BRL 6B, BRL 7YA, BRL 7YA2

The Sub-units represent discrete hearths, scatters of artefacts, faunal remains and carbonized organic material, separated by sandy loam. The BRL 7YA and 7YA2 units are virtually sterile and probably represent a non-occupation deposit into which material from the overlying BRL 6 unit has been trampled. The low density of artefacts in BRL 5 would suggest that this, too, is a non-occupation unit.

The fauna from BRL is essentially similar in its range of small antelope and ground game to that of the overlying members (Table 10). In BRL 6, however, alcelaphines and large-medium bovids are more

Fig. 28

Copy of a painting on a stone from Pit 77, BLA Member at Boomplaas Cave associated with date of ca 6400 B.P.



numerous and their frequencies increase further in the underlying CL Member in which the Units BRL 7Y, 7YB, 7, 8 and 7BS have been included. The rationale for making the break between CL and BRL within BRL 7 is that the BRL 7YA and 7YA2 Sub-units appear to represent an accumulation of non-occupation deposit which conveniently separates them from BRL 6W dated to 10 425 ± 125 B.P. (UW-411) and CL 1 dated to 12 480 ± 130 B.P. (UW-412) and CL 1 AF1 dated to 12 060 ± 105 B.P. (Pta-1828). BRL 7 and all its sub-units therefore seem to span a time period of about 1500 years, about the same time period as is represented by the sub-units between BRL 2 and BRL 6W. BRL 6 is therefore placed between two relatively sterile sub-units, BRL 5 and BRL 7YA/YA 2, and while the faunal remains would be comparable with those from the units below BRL 7, the dating is anomalously young when the stone artefacts are taken into account.

CL Member. This is a carbonized loam 0,25 m thick composed of intercalated hearths with carbonization of the organic material in the hearth surrounds. This is the typical product of intensive occupation. The Member has been subdivided into the following Units:

BRL 7: BRL 7Y, BRL 7Yb, BRL 8, BRL 7BS
CL 1
CL 2
CL 3
CL 4

The deposits are relatively leached towards the rear of the cutting where drip erosion has taken place under a prominent fissure. This has led to a localized lag concentration of fauna at the base of the CL Member which is interesting in the predominance of alcelaphine, equid and eland remains. The artefacts associated with the CL Member dating to between 14 500 and 12 000 B.P. are most numerous in the CL 3 Unit, but all units show a high frequency of artefacts per bucket which is much higher than in any other member.

The lower frequency of marine shell in relation to the high density of occupation and the higher frequency in the overlying members is an indication of its late Pleistocene dating and the regression of the sea across the Agulhas Bank. The higher incidence of large alcelaphines and other grazers, a change in the micromammals and the dominance of the Olea/Dodonea charcoals are all further indications of conditions different from those pertaining during the Holocene.

The excavation below the CL Member has been reduced to an area of 7 m² (including the P12 test cutting) and in this more restricted area there is potentially less information on the functional interpretation of finds. The CL Member caps a column of dripstone-cemented deposit in one section of the excavation below a narrow fissure or joint opening in the roof (Fig. 25). Speleothem formation has been continuous with the build-up of the deposit with minor breaks since deposition was initiated at the base of the sequence (LOH) and seems to have stopped at the base of the CL Member. It would thus seem to be coeval with the last glacial cycle from ca 75 000 to 14 500 B.P. The cemented column has an area of approximately 1 m² and built up marginally faster than the uncemented deposits, affecting the lie of strata in its vicinity and the strata thus dip away from the cemented column towards the cave mouth (Fig. 25). That cementation has been contemporary with deposition is supported by two lines of evidence: firstly, the correspondence of radiocarbon dates on speleothem material and on charcoal from uncemented laterally equivalent layers is excellent and, secondly, the occurrence of pure flowstone lamellae through the column demonstrates that they were formed on an exposed surface. There was the possibility that thorium dating of speleothem material from the lower part of the sequence, for which only estimated ages can be given at present, might be possible, but Vogel (pers. comm.) reports that the material is too impure.

GWA/HCA Member. This is a series of highly leached ashy lenses developed in the front squares of the excavation and wedging out against the stalagmite column. The lenses are conformable with the CL Member, but there are local discordances within the member. The following sub-units were recognized:

GWA : GWA, YOA, GGU, GGL, YF, TBF

HCA

The basal unit, HCA, is a massive leached white ash on the irregular and possibly drip-eroded surface on which brown loams and ash have accumulated. The degree of leaching may relate to a relative increase in drip activity from roof fissures. There is no chronometric dating for this member, but it may not be significantly older than about 15 000 B.P. For convenience, artefacts have been included in the CL Member totals.

LP Member. The LP Member is 0,25 m thick and is composed of dark brown loam containing abundant weathered angular roof spalls. It is primarily a natural accumulation and dates to the maximum of the last glacial. This is not a classic éboulis sec horizon, in that the deposit does not consist primarily of angular material, but the increased spalls may reflect the cold dry climate of the last glacial maximum. This conclusion is supported by examination of the textures observed on quartz grains from this member by Webley (1978). The eustatic lowering of sea level and regression of the coastline across the Agulhas Bank would have tended to emphasize the rain shadow effect of the Outeniqua mountains and the lack of mantling screes on the Swartberg support a suggestion of a relatively dry glacial climate. The artefact sample from LP is small, being derived from a humic horizon 20 mm thick (LP CF) which represents a brief occupation of the cave. Small mammal bones derived from owl pellets are abundant in LP and indicate cold conditions (Avery, D.M. 1979, 1982), but the larger mammal fauna is poorly represented. Pollen samples from LP CF show a dominance of Compositae and the closest modern analogue of the pollen spectrum is renosterveld.

LPC Member. The deposits in LPC derive primarily from multiple occupations of the cave leading to the development of a banded series of brown loam and yellow/brown material of probably organic origin with dark carbonized partings associated with charcoal and ash. Charcoal samples have been dated to ca 22 000 B.P. The artefact samples from LP and LPC have not been included in the analyses presented in this thesis but there is a significant break in artefact manufacturing tradition between these members and the overlying CL Member in that the production of bladelets from small bladelet cores is absent and formal tools are virtually absent in LP and LPC. The larger mammal fauna, however, is essentially similar to that in CL although the sample is considerably smaller (Table 10).

Deposits below LPC are not considered in this thesis, but comprise six further Members with cultural material assignable to the MSA and dating back to ca 75 000 or 80 000 B.P.

Table 9

RADIOCARBON DATES FROM THE UPPER LEVELS AT BOOMPLAAS CAVE: DGL to LPC

STRATIGRAPHIC MEMBER	LAB. NO	SAMPLE AND POSITION	DATE B.P.
DGL	UW-337	Charcoal from square L13 in hearth at top of DGL	1630 ± 50
	UW-338	Charcoal from hearth in square I14 in BLD 2	1700 ± 50
	UW-307	Charcoal from a stone packed hearth at the base of BLD 2a in square O13	1510 ± 75
BLD	UW-336	Charcoal from a hearth in square P18 in BLD AM	1955 ± 65
BLA	UW-306	Charcoal from a hearth in square Q13 in AF1 BRL unit near base of BLA Member	6400 ± 75
BRL	UW-410	Charcoal from ash lense in square P14 just beneath BRL 2	9100 ± 135
	UW-411	Charcoal from ash feature in square P14 in unit 6W at the base of BRL 6	10 425 ± 125
CL	Pta-1828	Charcoal from hearth in square O13 in unit CL1 AF1 at the top of the CL Member	12 060 ± 105
	UW-412	Charcoal from hearth in square O12 at the base of CL 1	12 480 ± 130
	UW-301	Charcoal from a hearth in square P12 (test pit) at base of CL Member	14 200 ± 240
LPC	UW-300	Charcoal from hearth in AF1 LP square P12 (test pit) at depth equivalent to top of LPC Member	21 110 ± 420
	Pta-1810	Charcoal from hearth in AF2 LP square P12 (test pit) at depth equivalent to top of LPC Member (sample adjacent to UW-300)	21 220 ± 195

References: UW-300-308, 336-338 in Fairhall et al 1976. UW-410-412 Fairhall pers. comm. All Pta dates J.C. Vogel, pers. comm.

Dating

Two suites of dates have been obtained for the BPA sequence. That associated primarily with human occupation debris has utilized charcoal from hearths and is summarized in Table 9. The second suite has used 'stalagmite' material from cemented calcareous deposits that have built up below a drip in the cave roof. The uppermost one, Pta-2259, confirms the charcoal dates for CL with a date of 13 210 ± 55 B.P. for the top of the stalagmite near the base of CL. The next one, associated with the same 'stalagmite' in the LPC unit again confirms a charcoal date for the same level with a date of 21 070 ± 180 B.P. (Pta-2298). The rest of the suite refers to units below those discussed here.

The dates in Table 9 are all internally consistent and show that the site is characterized by occupation horizons separated from each other by non-occupation deposit that have built up over varying lengths of time.

Faunal remains

The main features of the faunal analyses have been noted in the description of the stratigraphic units above. Minimum numbers of individuals in each member are summarized in Table 10 (after Klein 1978b).

Table 10. Summary of minimum numbers of larger mammalian species from DGL-LP Members at Boomplaas Cave. After Klein (1978b).

	DGL	BLD	BLA	BRL 1	BRL 2	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3/4	GWA	TOTAL CL	LP	LPC
Leporidae (2 spp), hares	6	8	2	1	2	4	1	2	10	2	2	1	1	2	8	-	1
Hystrix africae-australis, porcupine	1	3	2	1	1	2	1	-	5	-	1	-	1	-	2	-	-
Papio ursinus, baboon	7	8	3	2	4	4	1	1	12	1	1	-	1	1	4	1	1/?1
Homo sapiens, people	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Canis cf mesomelas, jackal	1/?2	?2	1cf	1cf	1cf	-	-	-	2cf	1cf	-	-	1cf	-	2cf	-	-
Mellivora capensis, honey badger	-	1cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Genetta sp., genet	-	1/?1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herpestes ichneumon, Egyptian mongoose	1	1/?1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herpestes pulverulentus, Cape grey mongoose	3	3	-	-	1	1	-	1	3	-	-	-	-	-	-	-	-
Hyaena brunnea, brown hyaena	-	-	-	-	-	-	-	-	-	-	-	-	1cf	-	1cf	-	-
Felis libyca, wildcat	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Felis cf caracal, probable caracal	1	3	-	-	1	-	1	-	2	-	1	-	-	-	1	-	-
Panthera pardus leopard	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Procavia capensis, rock hyrax	24	44	5	2	2	7	3	4	18	3	4	2	6	5	20	2	2
Loxodonta africana, elephant	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equus zebra or *E. quagga*, mountain zebra/quagga	5	3	2	1	2	3	1	3	10	2	4	2	8	3	19	2	1
Equus capensis, giant Cape horse	-	-	-	-	-	-	-	-	-	1	1	1	1	1	5	-	-
Rhinocerotidae (?*Diceros bicornis*), rhinoceros	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamochoerus porcus, bushpig	-	-	-	1	1	-	-	-	2	-	-	-	-	-	-	-	-
Phacochoerus aethiopicus, warthog	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
Suidae-- general	1	1	-	-	1	1	-	-	2	-	-	1	-	-	1	-	-
Taurotragus oryx, eland	-	-	-	2	2	2	-	2	8	3	3	4	6	2	18	-	1
Tragelaphus strepsiceros greater kudu	-	-	-	1	-	-	-	1	2	-	-	-	1	-	1	-	-
Hippotragus spp., blue antelope/roan	1	-	1	1	-	-	1	2	4	3	4	1	2	1	11	3	-
Redunca arundinum, southern reedbuck	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Redunca fulvorufula, mountain reedbuck	-	11	3	1	-	3	-	-	4	-	2	1	-	-	3	-	-
Alcelaphus buselaphus/*Connochaetes gnou*, red hartebeest/black wildebeest	-	3	1	3	3	5	3	7	21	5	5	7	14	7	38	4	9
Damaliscus dorcas or *D. niro*, bastard hartebeest	-	-	-	-	-	-	-	2	2	1	-	-	1	1	3	1	1
Alcelaphini gen. et sp. indet., large indeterminate alcelaphine antelope	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	1	2
Megalotragus priscus, giant hartebeest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Antidorcas sp., springbok	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	-	1
Pelea capreolus, vaalribbok	1	-	1	1	2	5	1	2	11	1	1	1	1	2	6	-	-
Oreotragus oreotragus, klipspringer	5	6	4	3	8	10	1	3	25	2	-	-	-	1	3	1	3
Raphicerus sp., grysbok/steenbok	8	10	3	2	5	12	1	2	22	1	1	1	2	-	5	1	-
Syncerus caffer, Cape buffalo	-	-	-	-	-	-	-	-	-	-	-	1	2	2	6	-	-
Pelorovis antiquus, giant buffalo	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	1	-
Ovis aries, sheep	17	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bovidae - general																	
small	34	19	7	5	13	22	2	6	48	4	2	2	2	2	12	1	3
small medium	29	12	4	2	2	8	2	3	17	1	3	2	3	3	12	1	2
large medium	4	6	3	6	6	5	4	13	34	9	9	8	17	12	55	9	12
large	-	2	1	2	2	3	1	3	11	4	4	5	11	5	29	1	2

5

ARTEFACT ANALYSIS

ARTEFACT ANALYSES

In order to describe technological change through time so that we may better understand evolutionary changes and the factors which influence them, the first step in this analysis was to develop a classification scheme. This is detailed in Appendix 1 together with a numerical coding system that may be used in the storage of data on a computer. The scheme is based on that currently used in southern and eastern African Stone Age studies (Kleindienst 1959, 1961, 1962; Leakey 1971: Deacon, J. 1969, 1972, 1978; Deacon, H.J. 1976) but is modified to follow the reduction sequence in stone tool manufacture from unworked raw material to finished tools (Schiffer 1976; Odell 1979; Akazawa et al 1980). The scheme is a hierarchical one with major categories of waste, utilized and formal tools and within each category are classes and sub-classes where appropriate. This subdivision is useful for distinguishing between successive stages of patterned behaviour in artefact manufacture. The patterns we can see may have meant little to the toolmakers themselves, but they allow us to highlight changes in their habits and traditions through time that have some relevance to the development and evolution of stone artefact manufacturing systems and technology in general.

Assuming that the toolmakers had some idea of what they wished to make before they began to flake pieces of stone, there would have been a series of stages in the manufacturing process at which decisions had to be made that would have had a bearing both on the efficiency and design of the end product, and on the nature of the discarded debris. By describing and quantifying the discarded and utilized material we should be able to characterize and recognise some of these decisions such as: (a) the choice of raw material, (b) the flaking method selected for producing artefacts, (c) the choice of pieces for utilization, (d) the choice of pieces for formal retouch and/or extensive re-sharpening, and (e) the choice of a place to discard pieces that were no longer required. The classification scheme and the artefact analyses have been designed around these decision points and they will be discussed in the following sections of this chapter.

In the absence of a body of theory and ethnographic parallels for technological change through time during the Stone Age, several assumptions have had to be made at the outset of this analysis. The first of these concerns sampling. Assemblages of stone artefacts are invariably small samples of the total number of artefacts made and discarded at a site and are, in turn, only a fraction of the number of artefacts made during the lifetimes of the people who inhabited the sites. Furthermore, all three of the sites considered here are rock shelters which may not be representative of the full range of activities of the people who occupied them. We therefore have to assume that much the same conditions pertained throughout the time period in question so that we can accept that all the samples represent the same type of settlement pattern and result from basically similar lifestyles. The assumption that the artefacts in an assemblage from one stratigraphic unit are broadly contemporary because the excavation method has sought to group all those in a similar soil matrix at a particular depth does not mean that they were all made by the same group of people at one sitting, but rather that they represent the cumulative products of social, economic and technological habits and traditions over possibly generations of toolmakers. As such they cannot be compared with the highly variable products obtained over short periods of time from present-day stone workers in Australia and New Guinea who are often no longer knapping stone regularly. Short-term variability caused by annual or seasonal variations in resources or changes in group size or range are therefore assumed to be 'ironed out' in the archaeological samples discussed here. It is unrealistic to expect that we should be able to unravel all the actions and tasks undertaken by people living at the sites, but we are in an excellent position to observe long and short term patterns of change and the development of LSA technology.

The second set of assumptions concerns the functions of stone artefacts. It is assumed that over the last 20 000 years in the southern Cape the range of tasks for which stone tools were used did not change radically, although the designs of these tools were modified from time to time. The tools were presumably made for working of other materials such as skin, bone and wood as well as for the preparation of food and tool maintenance, but relatively few were used directly in the food quest. They therefore represent for the most part discarded tools used in a series of manufacturing and maintenance tasks and they do not directly reflect the subsistence economy. The classification scheme assumes that the formal tool classes recognized here were designed for specific tasks. It is acknowledged that tools designed for one purpose may have been, and indeed often were, used for other tasks as well (Hayden 1977; O'Connell 1977; Gould, R.A. 1980), but we need to assume that the same design features were considered desirable for the same range of tasks through this time period, i.e. that what we recognize as scraper retouch was consistently seen as better suited to skin working than was, for example, adze retouch, and vice versa. Fortunately, microwear studies on Boomplaas artefacts, undertaken as part of the overall BPA research project, have shown a reasonable measure of correspondence (about 90%) between scraper retouch and skin polish and between adze retouch and wood polish (Binneman 1982). Because of a certain amount of overlap, however, broad definitions are used for formal tool classes in contrast to other classification schemes in which formal tools are subdivided into a series of sub-classes (e.g. Tixier 1967; Sampson & Sampson 1967; Sampson 1972). In this analysis the unifying criterion within a formal tool class is the morphology of the working edge rather than the size and shape of the piece. Ethnographic data from Australia (Gould, R.A. 1977:161; Hayden 1977, 1979) show that people who work with stone tools classify them according to the edge morphology, dividing them in this case into cutting and scraping tools and regarding the size and shape of the piece as relatively unimportant.

A factor we have not been able to control for adequately in the present analysis is the likelihood that the manufacture of formal tools was limited at times, not because the tasks for which formal tools were designed at other times were not undertaken, but simply because people used stone tools in a different way and formal retouch was not considered necessary. Such a change in priorities must be part of the reason for the low incidence of formal tools in late Pleistocene samples. To arrive at some quantifiable measure of the frequency with which various tasks were undertaken at times when formal retouch was minimal would require detailed microwear studies beyond the scope of this thesis. However, the likelihood that most tasks were undertaken with untrimmed flakes which are not classified within a functional analysis in no way weakens the typology or the analysis which is designed only to trace changes in stone tool technology and the ways in which tools were made and used, and not to demonstrate how often particular tasks were undertaken. Formal tools were designed for a limited range of tasks which required the repetitive use of a well-designed and efficient tool. During the Holocene these stone tools were standardized to fit into hafts which encouraged the development of formal retouch. Formal tools were not designed for the full range of tasks performed so they give us a false notion of the relative importance of site activities, but without such formal retouch we have very little patterned behaviour to observe. We are therefore obliged to structure much of our analyses around them, not because we believe that they can tell us more about what the people did, but because they are the most consistent record of style and design in stone tool technology.

The method used here for describing and quantifying diachronic change in stone tool manufacture examines the discarded materials at each successive stage of tool manufacture. The points at which options are assumed to have been open to the toolmakers are discussed below, together with the implications for analysis and the information we can expect to gain at each stage. The data from each of the three sites are described separately and inter-site comparisons are made at the end of each section.

CHOICE OF RAW MATERIAL

Raw material frequencies indicate, within some limits, the preferences of the toolmakers, the range of raw materials available in the vicinity of the site, and the distances travelled by some exotic materials. Changes in raw material frequencies through time may be the result of sampling, but may also reflect changing preferences, availability and distances travelled by the site inhabitants. Recent studies of raw material usage in the Western Desert in Australia have led R A Gould (1980) to propose a series of seven 'rules' governing the quantity of raw material that may be discarded at a living site. In summary they suggest that deliberately quarried stone and stones of distinctive appearance or from sites of 'spiritual' significance will be more likely to be transported to a living site than those that are more widely available. This pattern may not apply, however, where a source of usable stone is located close to a living site. In such a case the frequency of this stone far outweighs that of other materials (Gould, R.A. 1980:134). The frequency of a raw material at a site could therefore have as much to do with the availability within the immediate vicinity and the area ranged by the group as with the properties of the stone. The properties of the stone will have some bearing on the use to which it was put, however, and the hardness will affect the amount of retouch necessary or the pattern of damage to the edge through use. The flaking properties of some materials result in the discard of proportionately more waste than in others, and the size of the nodules in which the material is found will have a bearing on the size range of the artefacts made. The choice of raw material can therefore affect the performance of the tool as well as the quantity, size and shape of both the used tools and the discarded toolmaking debris. We can therefore assume that the toolmakers themselves were well aware of these factors and that at times they selected for particular raw materials.

In assessing the changes in relative proportions of raw materials at Kangkara and BPA it has been assumed that each of the raw materials used was available with similar ease throughout the last 20 000 years, but in the case of NBC, changes in sea level in the immediate vicinity of the site may have covered or exposed raw material sources at different times in the past. Emphasis in this analysis is given to the significance of variability at an intra-site level (which is assumed to reflect changes in preference and/or changes in territorial range) rather than to inter-site variations because the latter would be more obviously affected by local differences in availability and location. In this section on raw material choice only data relating to the relative frequencies of raw materials will be discussed. The effect these choices had on the tools and the debris will be analyzed in other sections where appropriate.

Nelson Bay Cave

Changes in raw material usage at NBC are evident in the relative frequencies of fine-grained materials such as quartz, chalcedony and silcrete set against the constant and mostly dominating presence of quartzite derived from waterworn cobbles released through weathering from the conglomerate surrounding the site and forming the roof and

Fig. 29

NBC: PERCENTAGE QUARTZ IN EACH CATEGORY

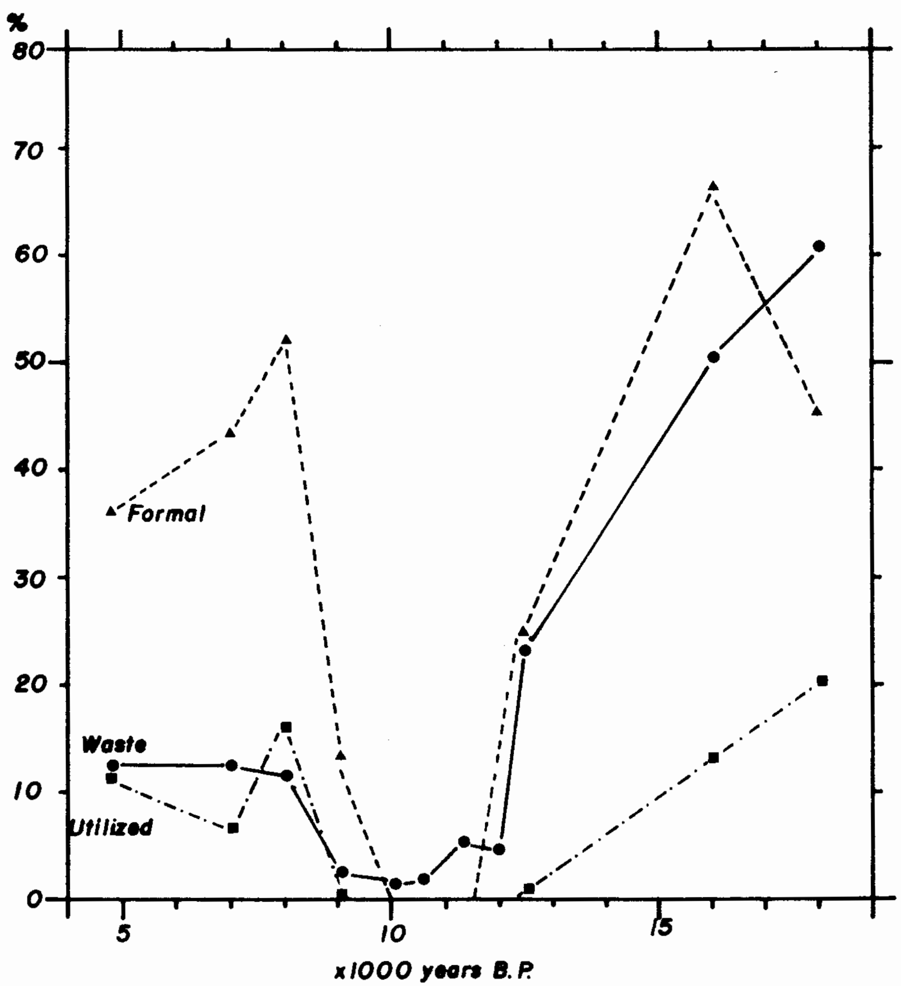
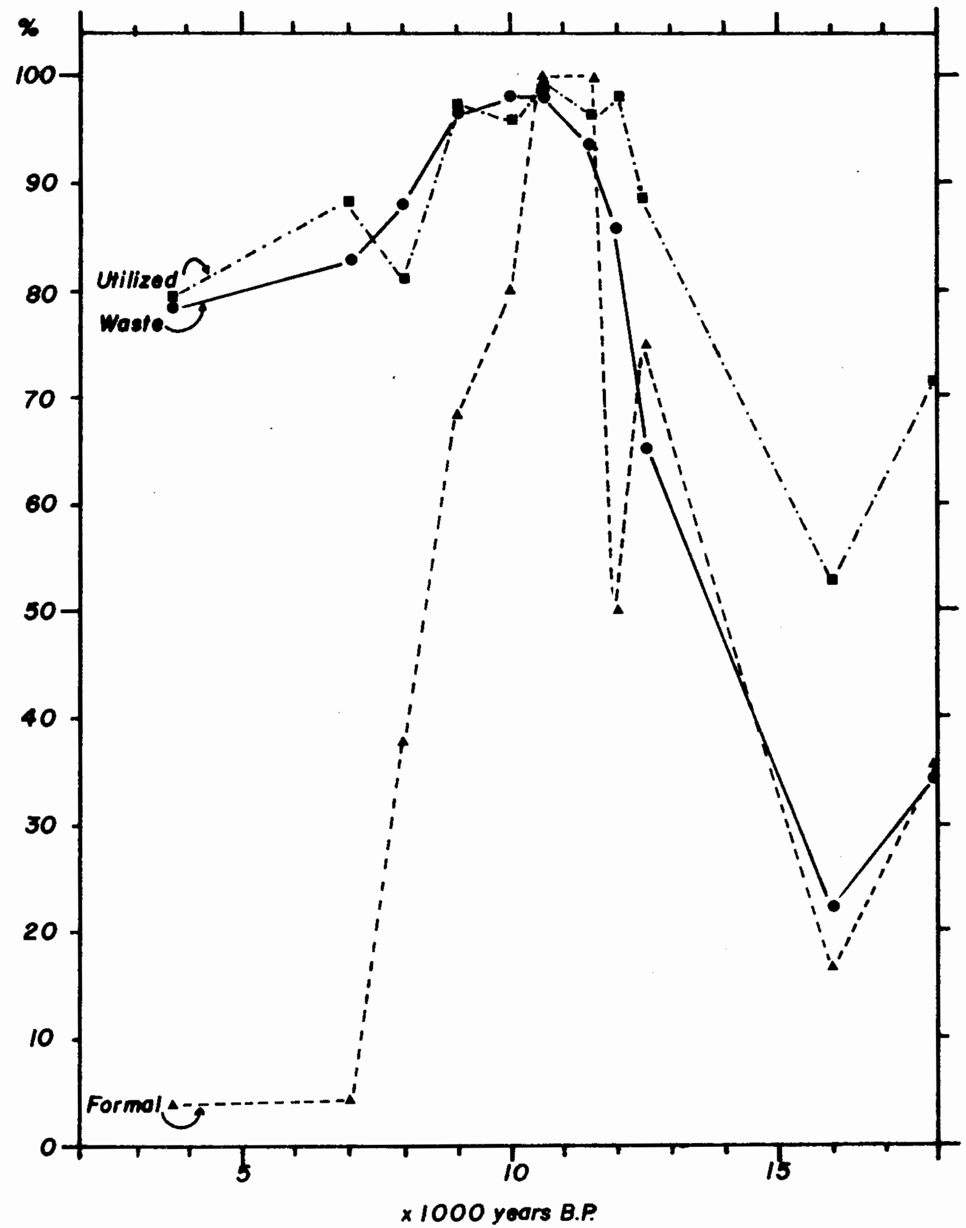


Fig. 30

PERCENTAGE QUARTZITE IN EACH CATEGORY : NBC



part of the walls of the cave. A similar pattern of usage of this quartzite has been noted in the underlying MSA levels at the site (Volman 1981:209).

The data on raw material usage are summarized in Tables 11-13. They show that in the five middle units of the LSA sequence quartzite accounts for between 86% and 98% of all artefacts, while in the lower three units it ranges from 23% to 66% and in the upper three units from 76% to 88%. The dominance of quartzite is undoubtedly due to its easy availability and confirms Gould's observation that where sources of usable stone are located close to a base-camp, the ease of procurement will outweigh other factors. The relatively high incidence of non-quartzitic rocks in the lowest three units, BSL, YSL and YGL, is therefore all the more significant in view of the fact that quartzite was constantly available. The reason must surely lie in the deliberate selection of finer-grained materials for the manufacture of a particular range of stone tools.

Quartz (mostly vein quartz, but some crystal) is the second most common raw material and is also available within a few minutes walk from the site in veins exposed on the top of the peninsula. Silcrete and chalcedony occur in relatively small quantities in all units except YSL where silcrete accounts for nearly 25% of the assemblage. The rarity of silcrete after 12 000 B.P. may mean that an important source was covered with the rising sea level because no outcrops of silcrete were found on the peninsula (Rogers 1966). Chalcedony has been more consistently used, albeit in small quantities, and exceeds 6% of the assemblage only in IC, although it has been used for up to 53% of the formal tools in BSC. It can be found in small waterworn nodules in the conglomerate, but is nowhere abundant.

The extent to which quartz and quartzite were used for formal tool manufacture is contrasted against their frequency in the utilized and waste categories in Figs 29 and 30. They demonstrate that, with the exception of the middle units, quartz was consistently selected for formal tool manufacture whereas quartzite was consistently more common in the waste and utilized categories. There is a difference, however, in the discrepancy between the frequency of quartz and quartzite in the formal and waste categories in the Holocene and late Pleistocene units. Whereas in the latter the percentage frequency in the two categories is

FIG. 31

KANGKARA: PERCENTAGE SILCRETE IN EACH CATEGORY

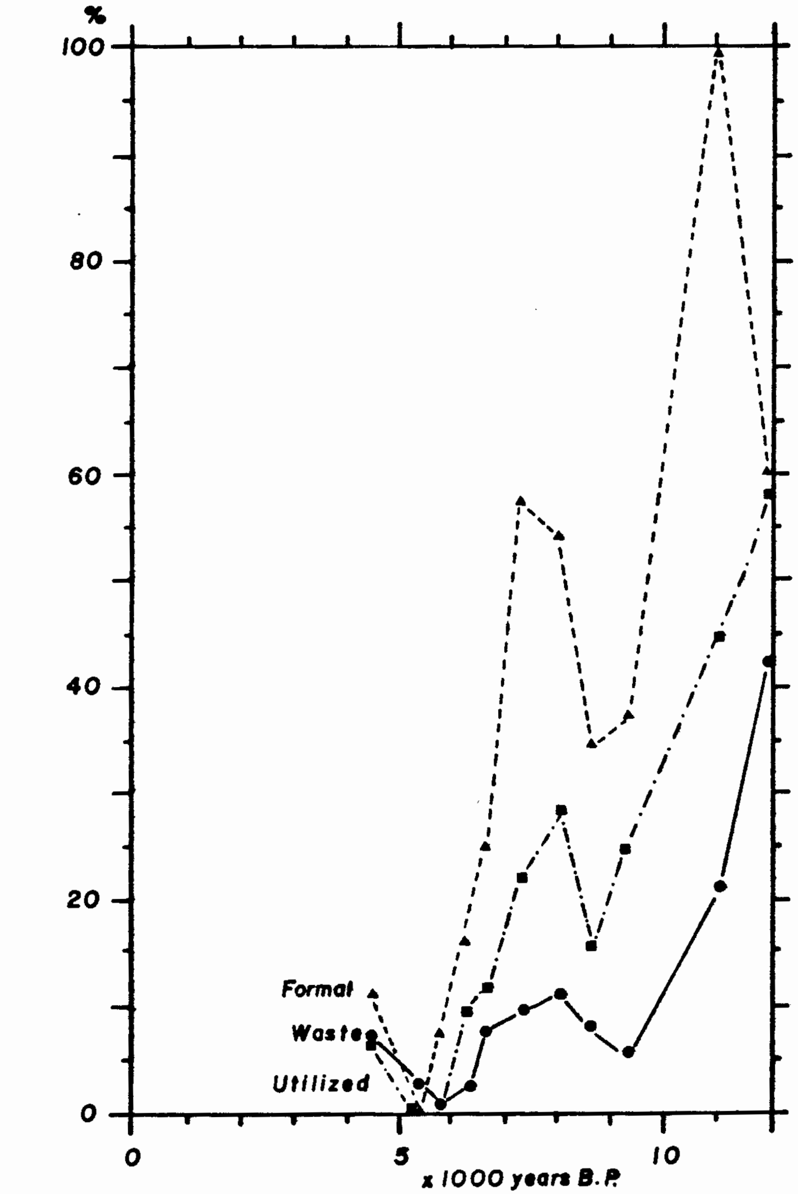
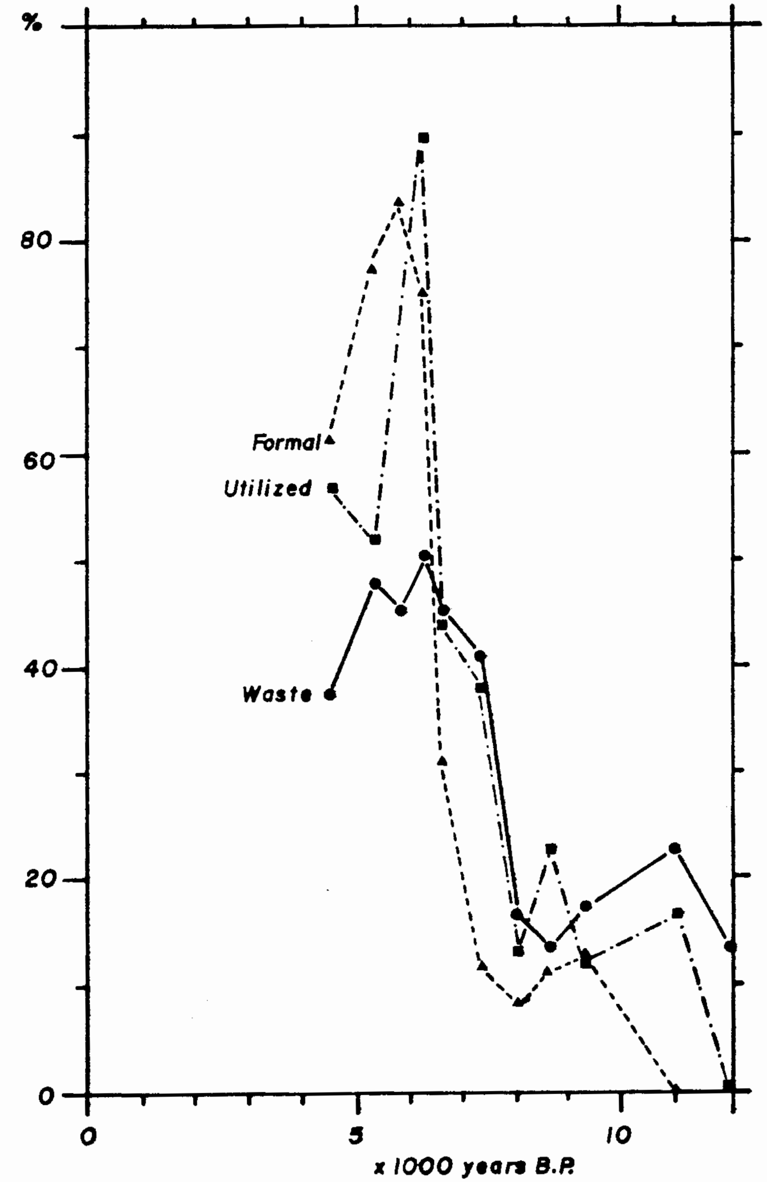


FIG. 32

KANGKARA: PERCENTAGE QUARTZ IN EACH CATEGORY



very similar, quartz was given far greater preference for formal tools than was quartzite in the Holocene. This would again suggest a deliberate selection strategy.

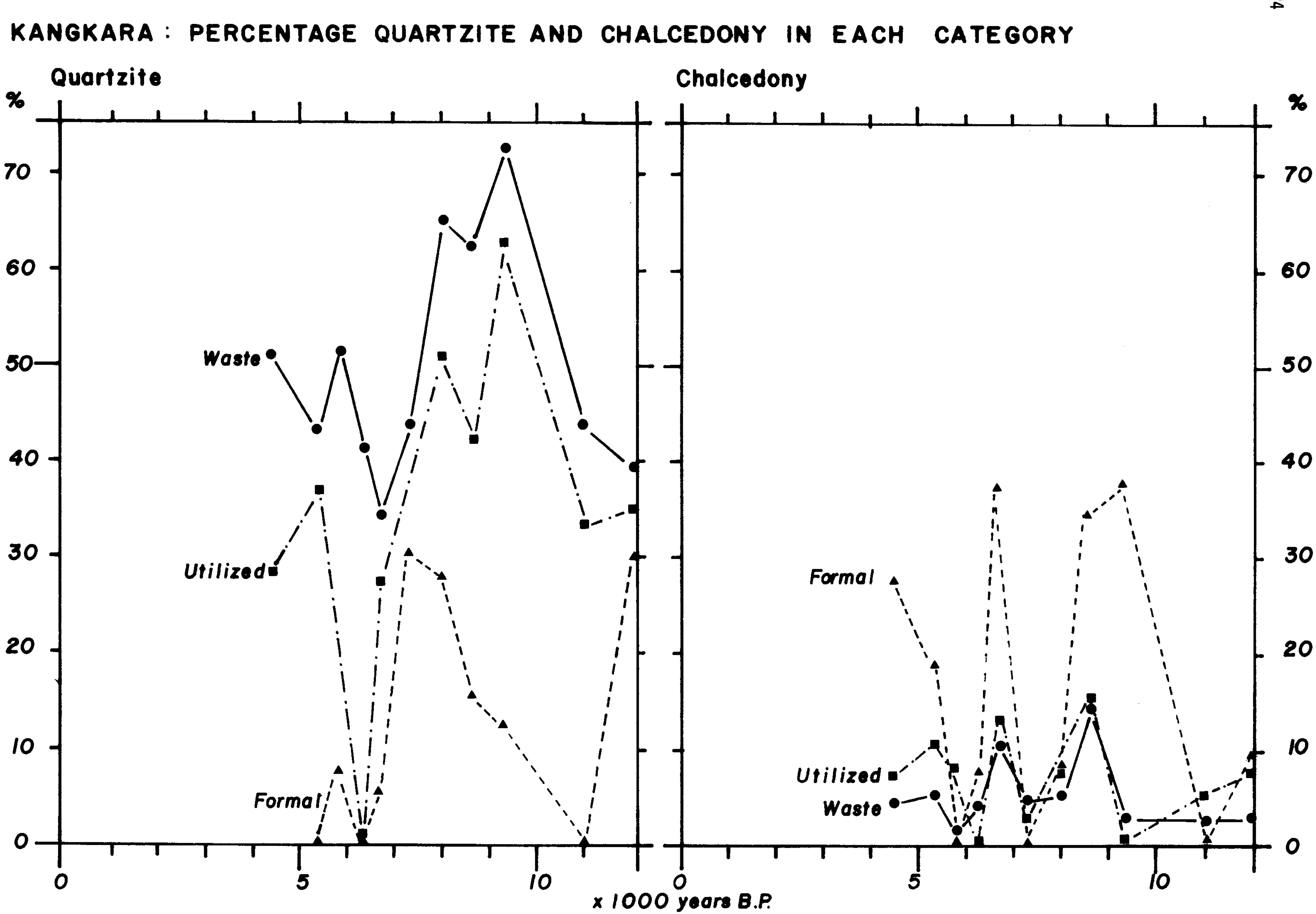
Kangkara

Raw material frequencies at Kangkara are summarized in Tables 14-16. They show that the majority of the artefacts are again made from quartzite in the waste and utilized categories, but the finer grained quartz, hornfels, chalcedonies and silcretes are more common in the formal tools category. There is an interesting contrast in the percentage frequencies of quartz and silcrete, the one replacing the other in an almost mirror-like image after 10 000 B.P., but with a greater selection for silcrete for formal tools in the earlier units (Figs 31-33).

In contrast to NBC, the quartzite at Kangkara is derived from local outcrops rather than from waterworn cobbles and the result is that the flakes are generally smaller at Kangkara. A greater effort was probably involved in obtaining quartzite there and this is evident from the fact that in most units it accounts for less than 65% of the total sample. Quartz is again second in importance with mostly vein quartz and some crystal, silcrete was popular only in the lower units, and chalcedony and hornfels were used in relatively small quantities throughout the sequence. Their low frequency and the fact that they were selected for formal tool manufacture would suggest that they were deliberately transported from a source relatively far from the site.

The major change observable in the Kangkara sequence is similar to that seen at NBC, namely a relatively high incidence of silcrete in the lower units and its replacement by quartz in the Holocene levels where quartz was favoured for formal tools. What we may be seeing here is a shift linked to the superior quality of quartz for the manufacture of formally retouched and hafted tools in the Holocene, although at other sites in the same time range silcrete is favoured above quartz (Schweitzer & Wilson 1982). Because there seems little reason to suppose that the availability of these materials changed substantially over the last 12 000 or more years, it seems likely that the changes in raw material usage at Kangkara were the result of a deliberate choice on the part of the toolmakers and they therefore assume some cultural significance.

FIG. 33


KANGKARA : PERCENTAGE QUARTZITE AND CHALCEDONY IN EACH CATEGORY
Quartzite
Chalcedony
%
70
60
50
40
30
20
10
0
Waste
Utilized
Formal
Formal
Utilized
Waste
0
5
10
x 1000 years B.P.

Boomplaas

As can be seen from Tables 17-19, the assemblages dating within the last 20 000 years at BPA are dominated by vein and crystal quartz. The second most common material is chalcedony in the upper and lowest units, and quartzite and hornfels in the middle of the sequence between about 12 000 and 9000 B.P. Silcrete never exceeds 5% of the assemblage except in the lowest units, CL 4 and GWA, where it accounts for 27% and 34% respectively of all artefacts. The timing of this higher incidence in the late Pleistocene is similar to that at NBC and correlates clearly at these sites and at Kangkara with the production of bladelets from bladelet cores.

The varied surface geology of the Cango Valley (Le Roux 1977) has meant that all these materials are readily found in the vicinity of the cave, but quartz occurs in veins close to the site and was clearly favoured for this reason. Figs 34-36 demonstrate that this was the material most consistently used and it is consequently best represented in the waste category, as was quartzite at NBC and Kangkara. Chalcedony and hornfels, on the other hand, were more often selected for formal and utilized tools at BPA.

Inter-site comparisons

All three sites show some changes in raw materials through time although each is dominated by the most readily available material: quartzite in the case of NBC and KRA, and quartz in the case of BPA. These dominant materials are more common in the waste category, while those brought from further afield are more common in the utilized and formal tools categories. There is a tendency for raw materials which produce larger flakes (quartzite and hornfels in the case of NBC and BPA and silcrete and hornfels in the case of KRA) to occur most commonly in units dating between about 12 000 and about 8000 B.P., while the smaller nodules of finer grained materials are more abundant in the mid-late Holocene and in the late Pleistocene. The fact that the changes in raw material preferences at these three widely separated sites are all broadly contemporary suggests that they had some significance at a regional level.

There is no correlation between the incidence of any particular raw material and the incidence of formal tools (Figs 37, 38), although

FIG. 34

BPA : PERCENTAGE QUARTZ IN EACH CATEGORY

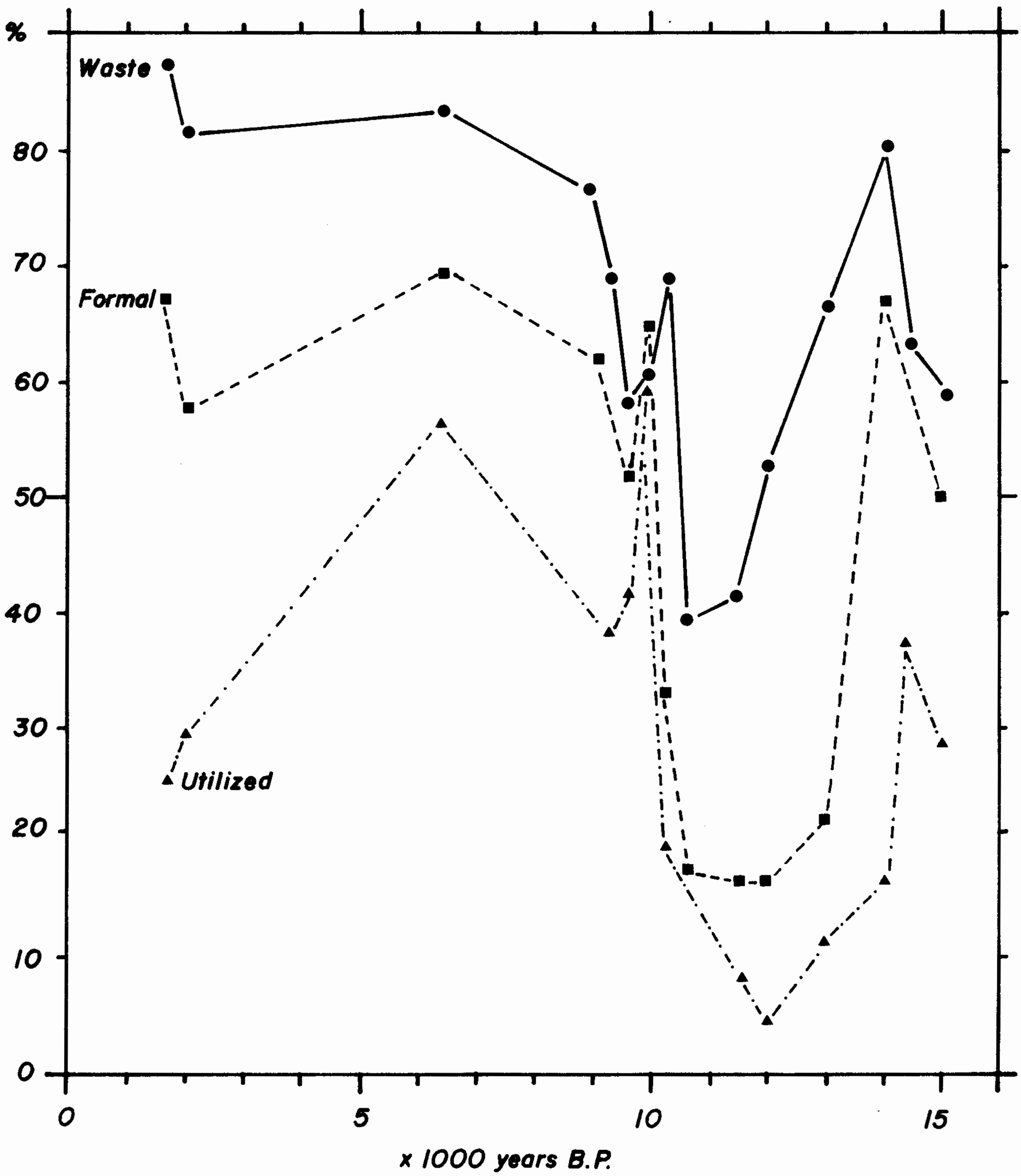


FIG. 35

BPA : PERCENTAGE HORNFELS IN EACH CATEGORY

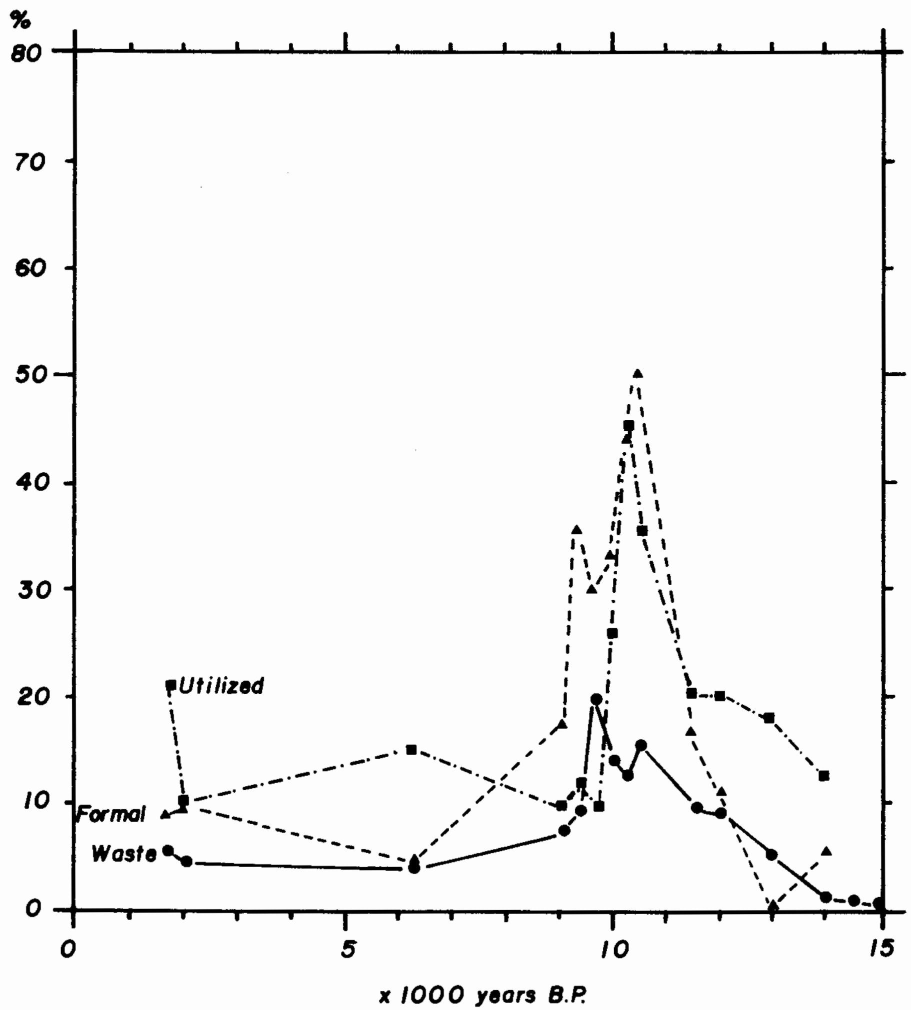


FIG. 36

BPA: PERCENTAGE CHALCEDONY IN EACH CATEGORY

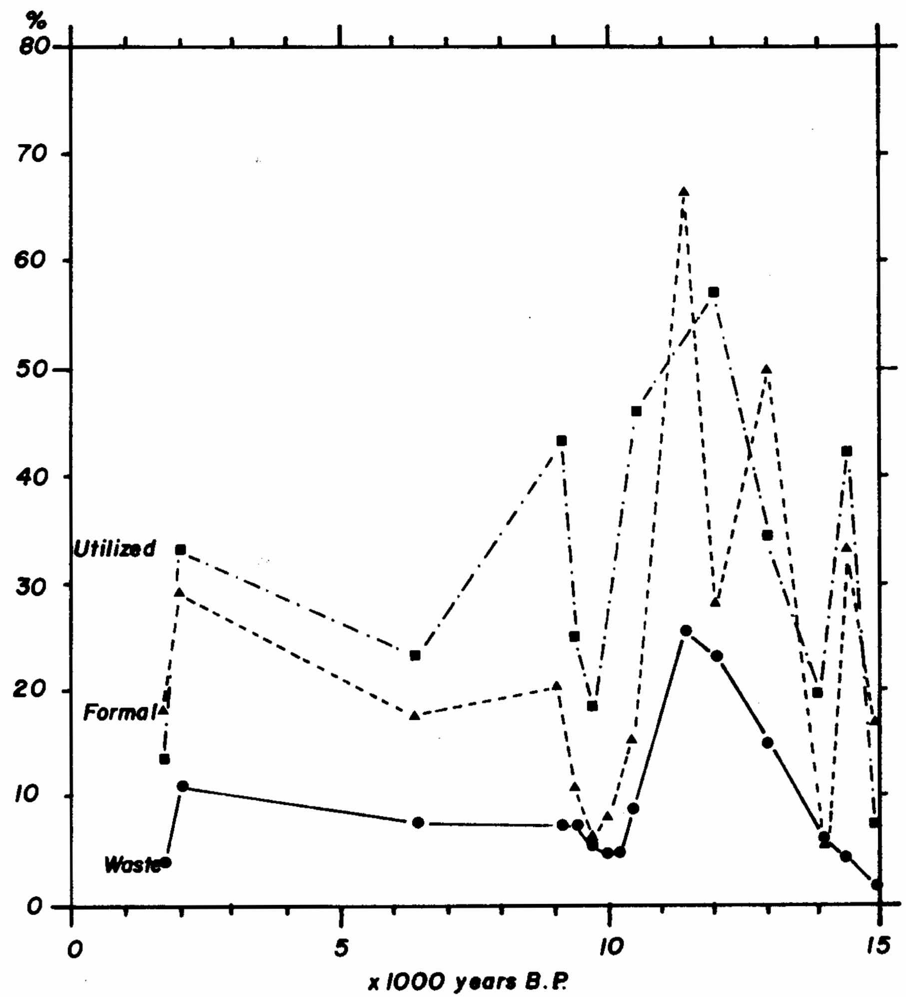
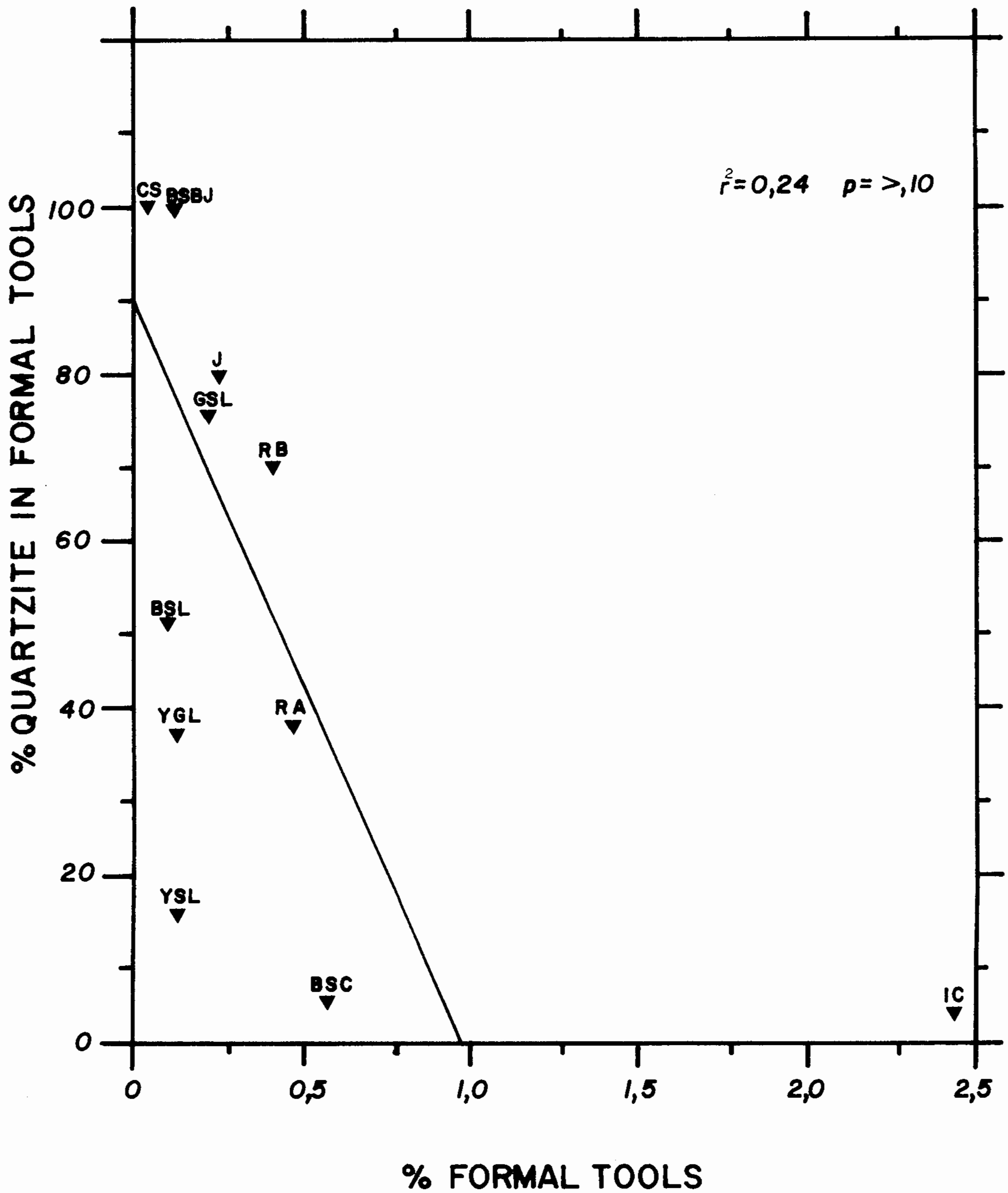


FIG. 37

NBC: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE INCIDENCE OF FORMAL TOOLS AND THE INCIDENCE OF QUARTZITE. FOR EXPLANATION OF LINEAR REGRESSION AND R^2 SEE APPENDIX 2



certain raw materials were preferred for some formal tool classes. As will be demonstrated later, however, there is a correlation between raw material and the flaking technique used to produce artefacts, but not between the abundance of any particular raw material and particular formally retouched or utilized classes.

As noted above, the possible reasons for changes in raw material usage include changes in size or location of the territory covered by the people regularly occupying the site, the covering or exposure of a raw material source due to environmental changes and the deliberate selection of a material for its specific properties. To this list we may add random change or sampling error and changes in preference. These possibilities will be explored further in the following sections, but it is apparent that when a long-term perspective on raw material usage such as that provided here can be studied, it is far easier to factor out random and localized variability that may be site-specific than when only one short sequence site is being considered.

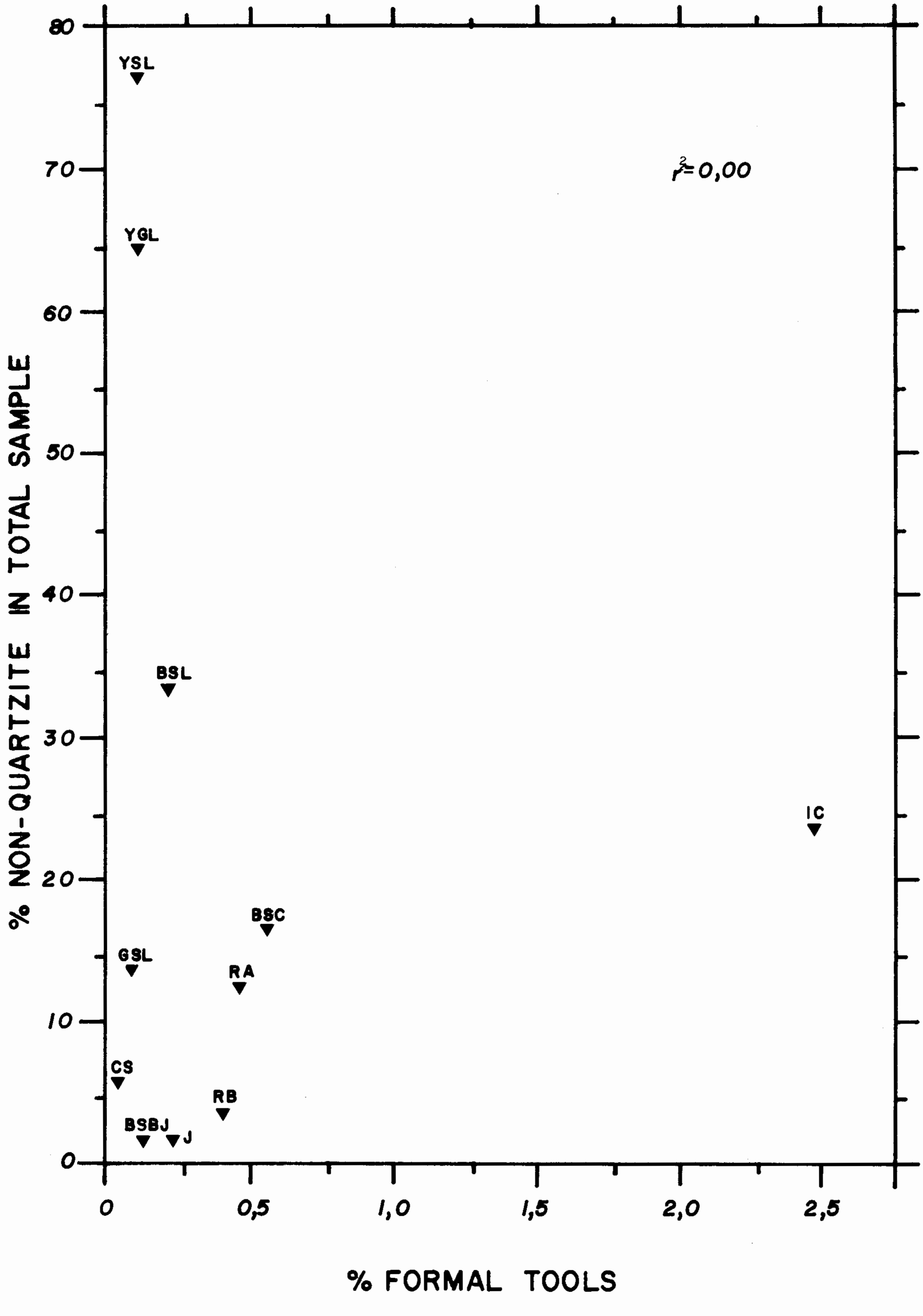
FLAKING METHOD

The attributes and relative frequencies of classes in the waste category are analysed here to demonstrate variability and changes through time in flaking technique and to correlate shifts in raw materials and flaking methods. The expectation is that if shifts noted through time in the choice of raw materials in the three sequences were the result of deliberate and widespread changes in toolmaking technique, then we should see some covariation in the choice of raw material and the relative frequencies of core sub-types, in the nature of the flaking debris, and in the size and shape of the flakes in contemporary assemblages at the three sites. The emphasis here therefore falls on the nature of the changes, on the correlation of the variables and on the timing of shifts in relative frequencies and metric attributes at an inter- and intra-site level.

The method chosen for flaking (which may in turn be limited to some extent by the range of raw materials available as well as by the range of methods known to the toolmaker) is assumed to be detectable in the range of core sub-types and the size, shape and relative frequency of the chips, chunks and flakes produced. While numerous core sub-types are recognized by some researchers (vide Sampson 1972; Clark 1974),

FIG. 38

NBC: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE INCIDENCE OF FORMAL TOOLS AND NON-QUARTZITE RAW MATERIALS



observations of stone workers in Angola (Clark 1963:174) and in Australia (Hayden 1979; Gould, R.A. 1980) indicate that there is little relationship between final core shape and the size and shape of flakes struck from it. Flakes with facetted platforms may be struck as often from unprepared cores as from prepared ones of levallois type. The main distinction noted by both Clark and the Australian observers is between blade or bladelet types and others, although again small numbers of blades and bladelets may be struck from non-blade/bladelet cores. The incidence of core reduced pieces (pièces esquillées) is another indicator of a distinctive tool flaking technique. In this analysis, therefore, bladelet core frequencies are noted as distinct from irregular ones and, in the case of NBC only, radial cores are recognized as a separate core sub-class but, because they seem to be linked to the use of quartzite cobbles, they were not noted in any significant numbers at the other sites and were therefore not separated into a different sub-class at BPA and KRA.

Nelson Bay Cave

The way in which raw material has influenced the relative frequency of waste classes is illustrated in correlations between quartz and quartzite and flakes, chunks and chips. In Fig. 39 it can be seen that there is not as high a correlation (p=.02-.01) between quartzite and the ratio of cores:flakes as there is between the frequency of flakes and quartzite (Fig. 40) where p=less than .001 (methods for calculating these correlation coefficients and regressions are explained in Appendix 2). Quartz, on the other hand, is closely correlated with a high incidence of chips (Fig. 41), but is less closely related to the core:chunk ratio (Fig. 42) which shows that the higher the incidence of quartz, the fewer cores were found. The opposite is the case with quartzite, however, as can be seen in Fig. 43 which shows a weak correlation between a high incidence of cores and a high percentage of quartzite in an assemblage (p=.02-.01).

The core sub-class frequencies summarized in Table 20 demonstrate that irregular quartzite cores, which show no apparent change through time in the size, shape or number of flakes removed, dominate all assemblages with the exception of the uppermost (IC) and the two lowest (YGL and YSL) where radial and bladelet cores

FIG. 39

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING WEAK CORRELATION BETWEEN THE PERCENTAGE OF QUARTZITE IN A SAMPLE AND THE RATIO OF CORES TO FLAKES. SEE APPENDIX 2 FOR EXPLANATION OF TEST FOR LINEAR REGRESSION.

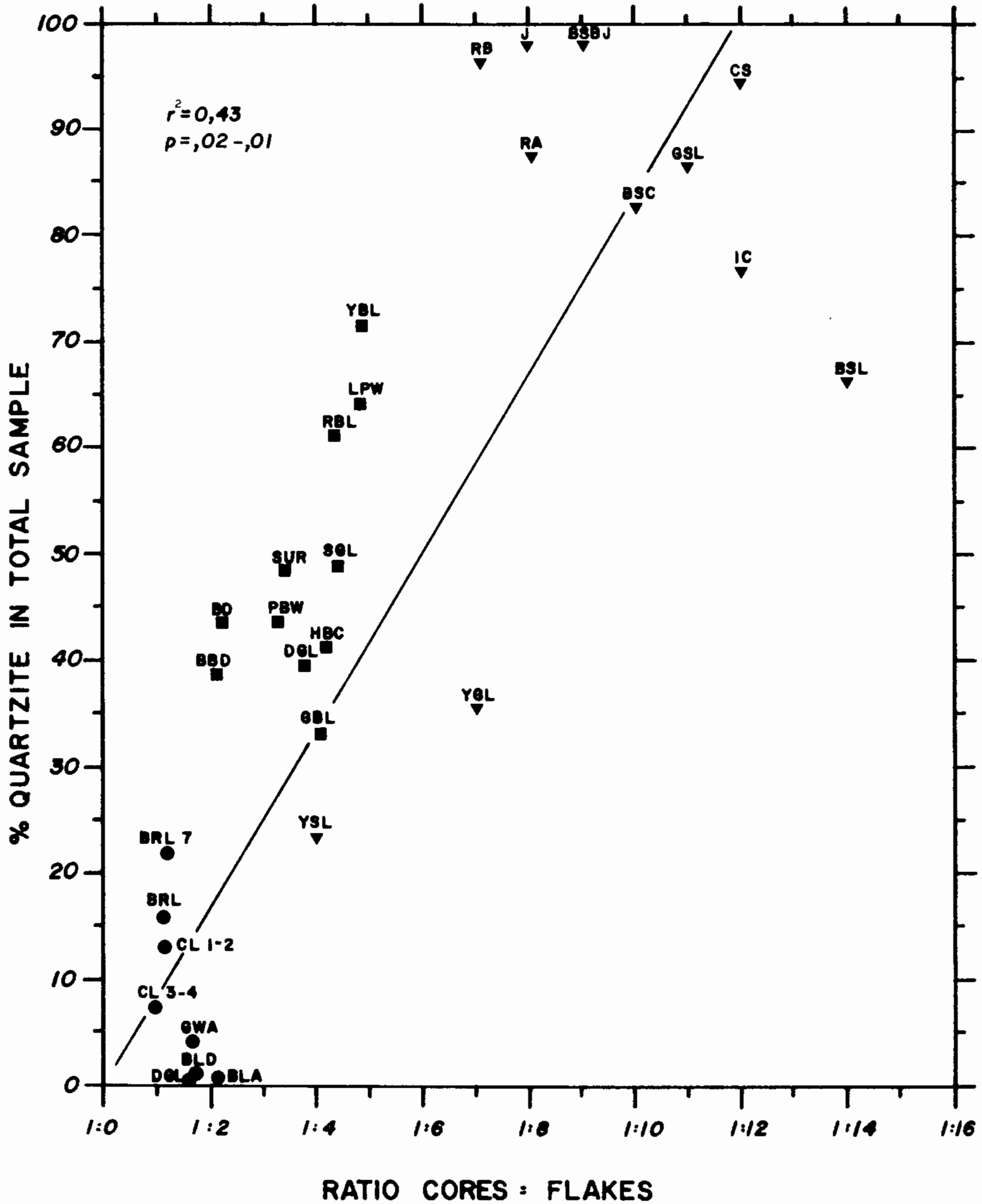


FIG. 40

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING HIGH CORRELATION BETWEEN THE PERCENTAGE OF QUARTZITE AND THE PERCENTAGE OF UNTRIMMED FLAKES IN A SAMPLE

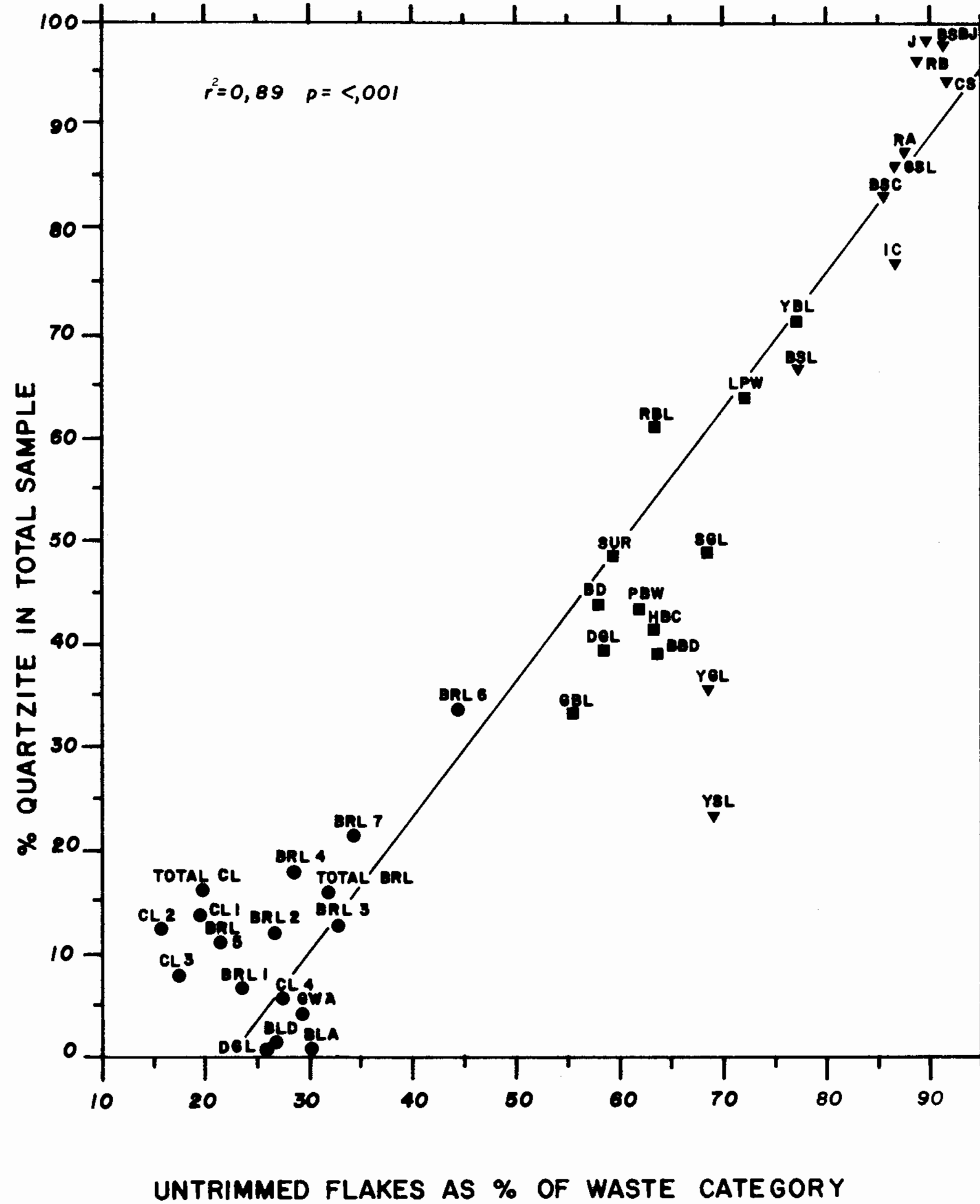


FIG. 41

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING HIGH LINEAR CORRELATION BETWEEN THE PERCENTAGE OF QUARTZ AND THE PERCENTAGE OF CHIPS IN A SAMPLE

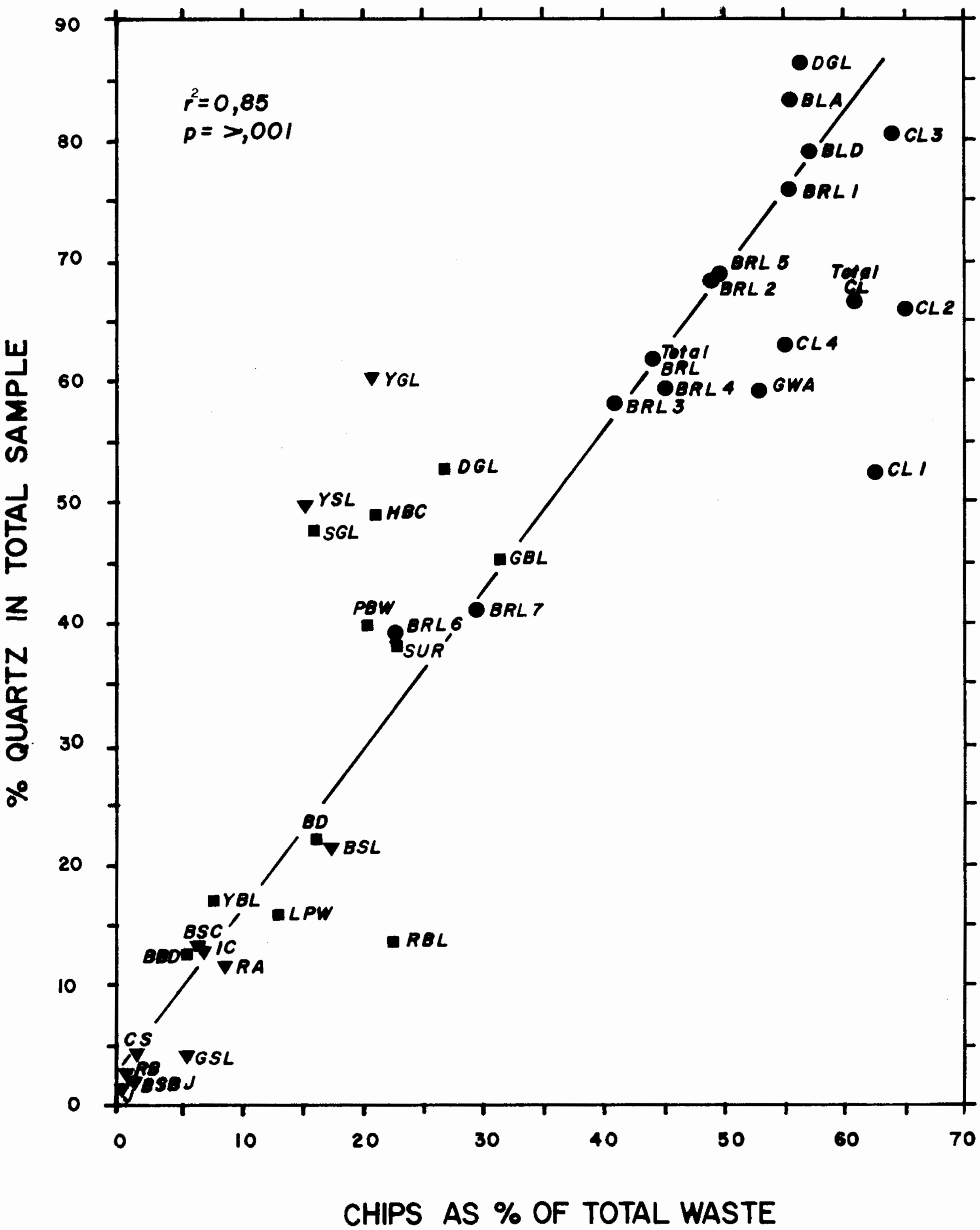


FIG. 42

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING CORRELATION BETWEEN THE PERCENTAGE OF QUARTZ AND THE RATIO OF CORES:CHUNKS IN A SAMPLE

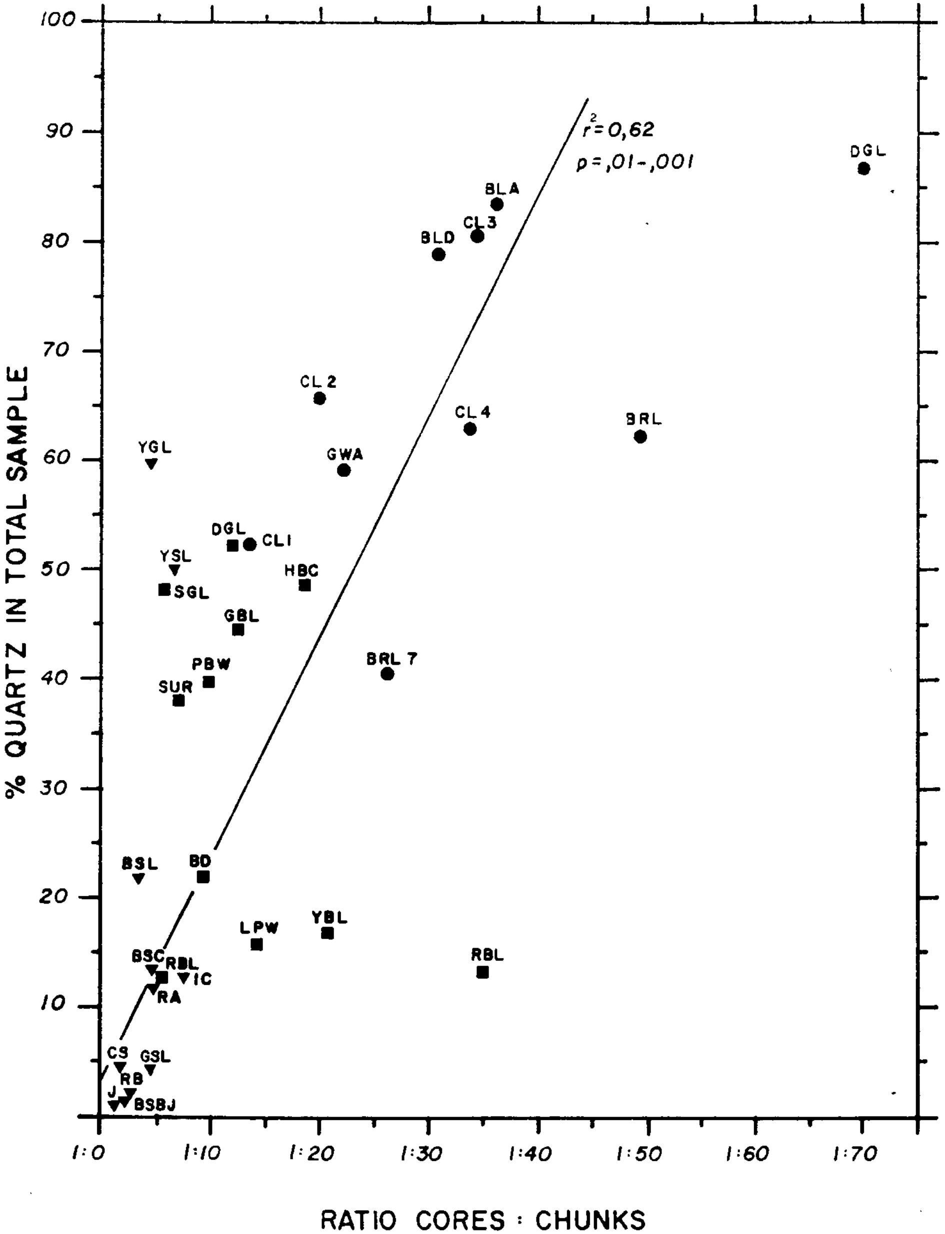
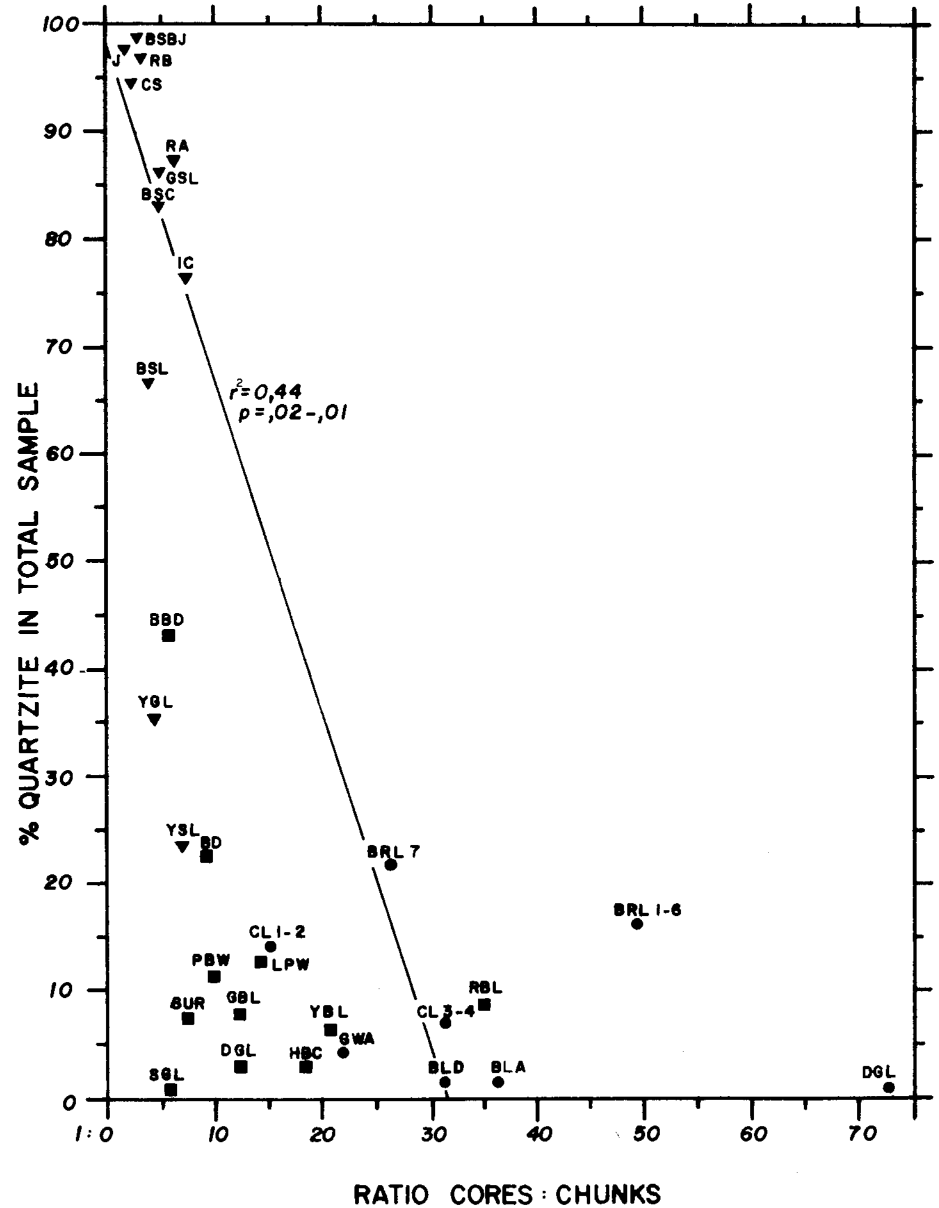


FIG. 43

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING WEAK CORRELATION BETWEEN THE PERCENTAGE OF QUARTZITE AND THE RATIO OF CORES:CHUNKS IN A SAMPLE



together account for about 50% or more of the cores. The radial cores tend to be more common in the middle and upper units and, with the exception of the YSL sample, are predominantly in quartzite. The most obvious shift in the core class occurs amongst bladelet cores which account for between 23% and 47% in the three lowest units, for 17% in the uppermost, and for less than 6,5% in the rest. These shifts correlate broadly with the incidence of non-quartzite raw materials and with the incidence of bladelets, but the correlation between a specific raw material, quartz, and the incidence of bladelet cores is weak (p=greater than .05; Fig. 44). Raw material appears to have a closer relationship to the incidence of bladelets, however, as can be seen in Fig. 45 which shows that at NBC the percentage of non-quartzite in the assemblage correlates highly (p=less than .001) with the incidence of bladelets. These data suggest that it is not one raw material that has been selected for bladelet production, but several, the most important of which are quartz, silcrete and chalcedony, depending on the site.

On the assumption that bladelet cores were the means by which bladelets were produced, we could expect a close correlation between the frequency of bladelet cores and the frequency of bladelets and for NBC at least this is certainly the case (Fig. 46) where p=less than .001. This diagram also illustrates the difference in the absolute frequency of both bladelets and bladelet cores in Holocene and late Pleistocene samples. It is likely that different flaking techniques are evidenced during these two time periods for the late Pleistocene bladelet core samples include a sub-class of flat bladelet cores that are absent in the Holocene. These small cores are often, but not invariably, made on quartz crystals and are 10 - 20 mm long and 5 - 10 mm wide. They show flake scars of bladelet dimensions and often have evidence of bipolar flaking. They differ from core reduced pieces in their more elongated shape and in the absence of the chisel-like striking platform so common on core reduced pieces. Core reduced pieces were not apparently used for producing bladelets for when they are included with bladelet cores and plotted against the frequency of bladelets, the ratio of bladelets to cores is so low as to suggest that core reduced pieces are in no way related to bladelet production. There is, however, some correlation in the timing of the occurrence of these and bladelets

FIG. 44

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE PERCENTAGE OF QUARTZ AND THE PERCENTAGE OF BLADELET CORES IN A SAMPLE

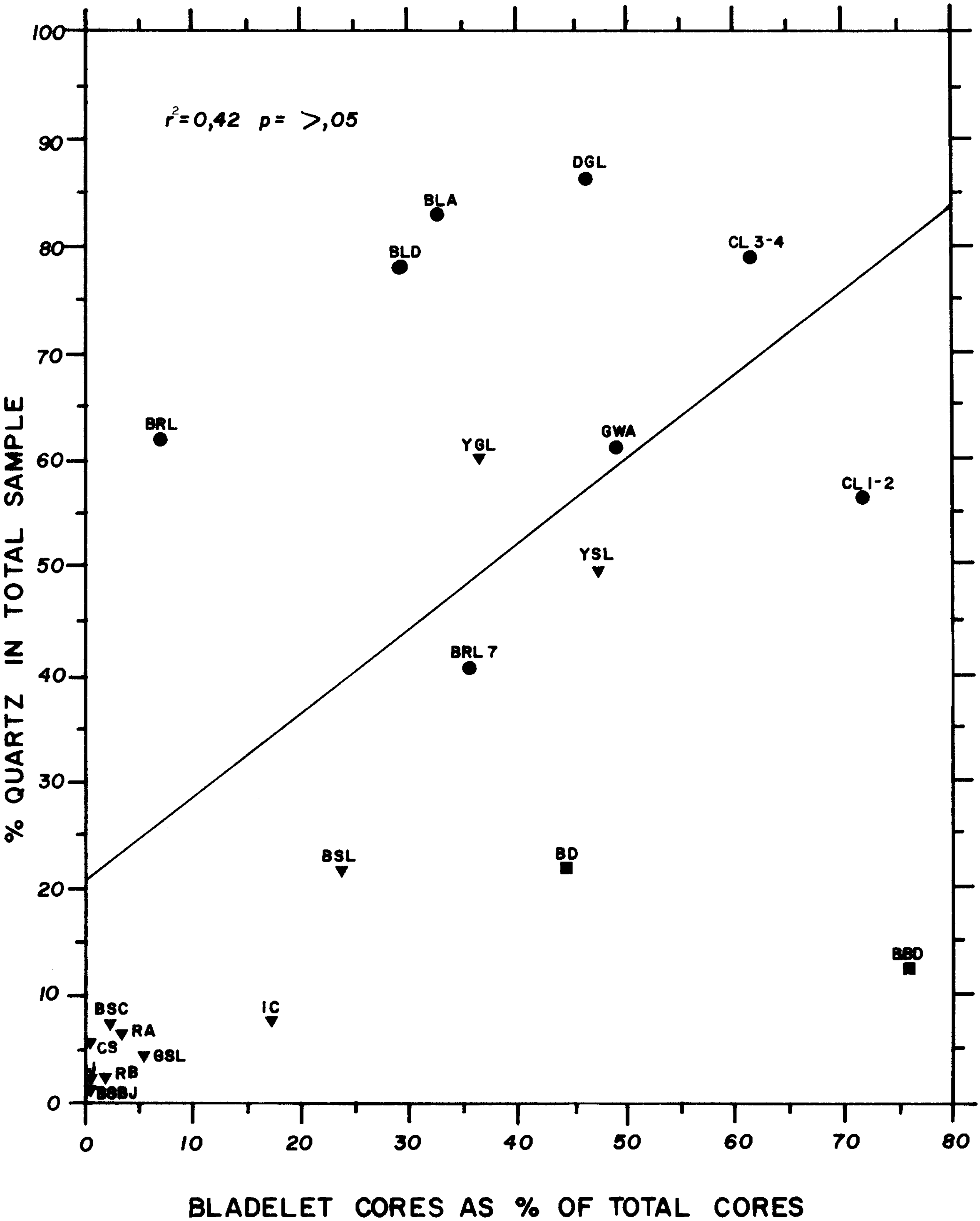


Fig. 45

NBC and BPA: Scatter diagram showing good linear correlation at NBC, but not at BPA between the percentage of bladelets and the percentage of non-quartzite raw materials

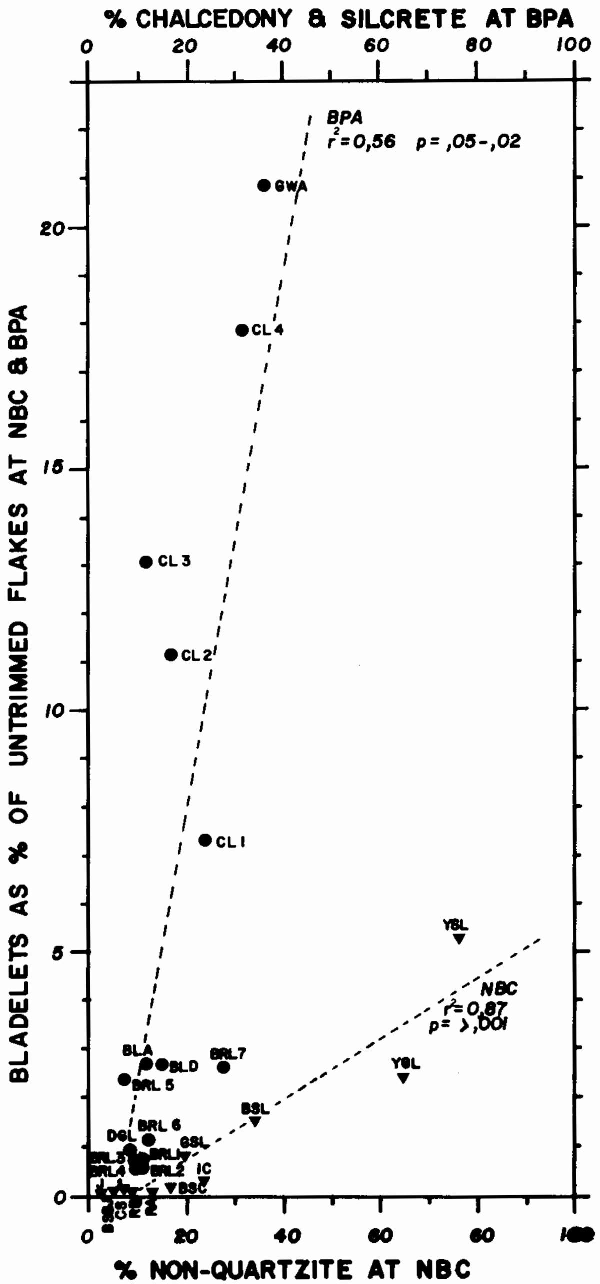
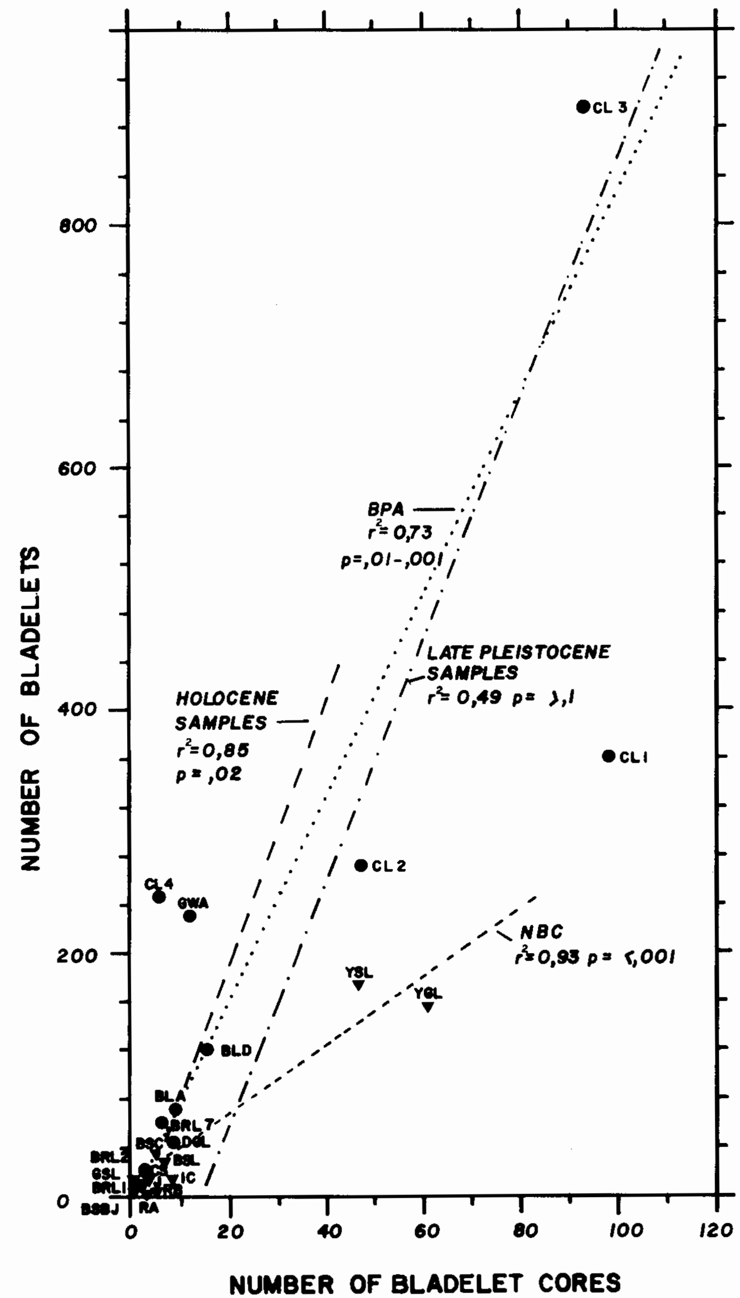


Fig. 46

NBC and BPA: Scatter diagram showing variable inter-site and temporal correlations between the number of bladelets and the number of bladelet cores



from bladelet cores suggesting that a similar method of holding the core for the production of flakes may have been used in both cases. An unusual flaking technique described by White & Thomas (1972) is used in New Guinea and produces similar bipolar core residues when the core is bound with fibre and struck at one end while resting on an anvil. The bladelets and flakes produced by this method tend to be longer and thinner than those produced on a hand-held bladelet core and the final core is considerably smaller than can be conveniently held in the hand and struck in the conventional way.

One of the most striking features of the NBC sequence is the high frequency of quartzite flakes, very few of which occur in the chips size range (less than 10 mm maximum dimension). With the exception of the lowest three assemblages (YGL, YSL and BSL), untrimmed flakes account for over 85% of the waste category and, in the site as a whole, for 85% of all classes in all categories. Of these untrimmed flakes from the site, 78% are made in quartzite. The result is that all the assemblages look basically similar because of the dominance of this one class. As in the case of the cores, however, it is the incidence of non-quartzite elements which signals change in the sequence and this is clearest in the size range of the untrimmed flakes.

Samples of whole untrimmed flakes from each unit were measured and descriptive statistics for length, width, height (thickness), width/length ratio and relative thickness were calculated. The method of measurement is detailed in Appendix 2. The data are summarized in Tables 21-25 and Figs 47-51 and show a clear shift towards longer flakes in the middle units where quartzite is dominant, with the shortest flakes in the late Pleistocene units and those of intermediate length in the uppermost units. The late Pleistocene flakes are also narrower, thinner and more blade-like than those in the overlying units. These trends are visible in all raw materials individually and in the sample as a whole. There is also some truth in the assumption that the changes in core sub-types and the nature of the toolmaking debris are related to changes in the size and shape of the flakes produced. In Fig. 52 this can be seen in the reasonable correlation at an inter-site level ($p=.02-.01$) between the incidence of bladelet cores and the mean length of all untrimmed flakes, the shorter flakes occurring in samples where bladelet cores are relatively common.

Fig. 47

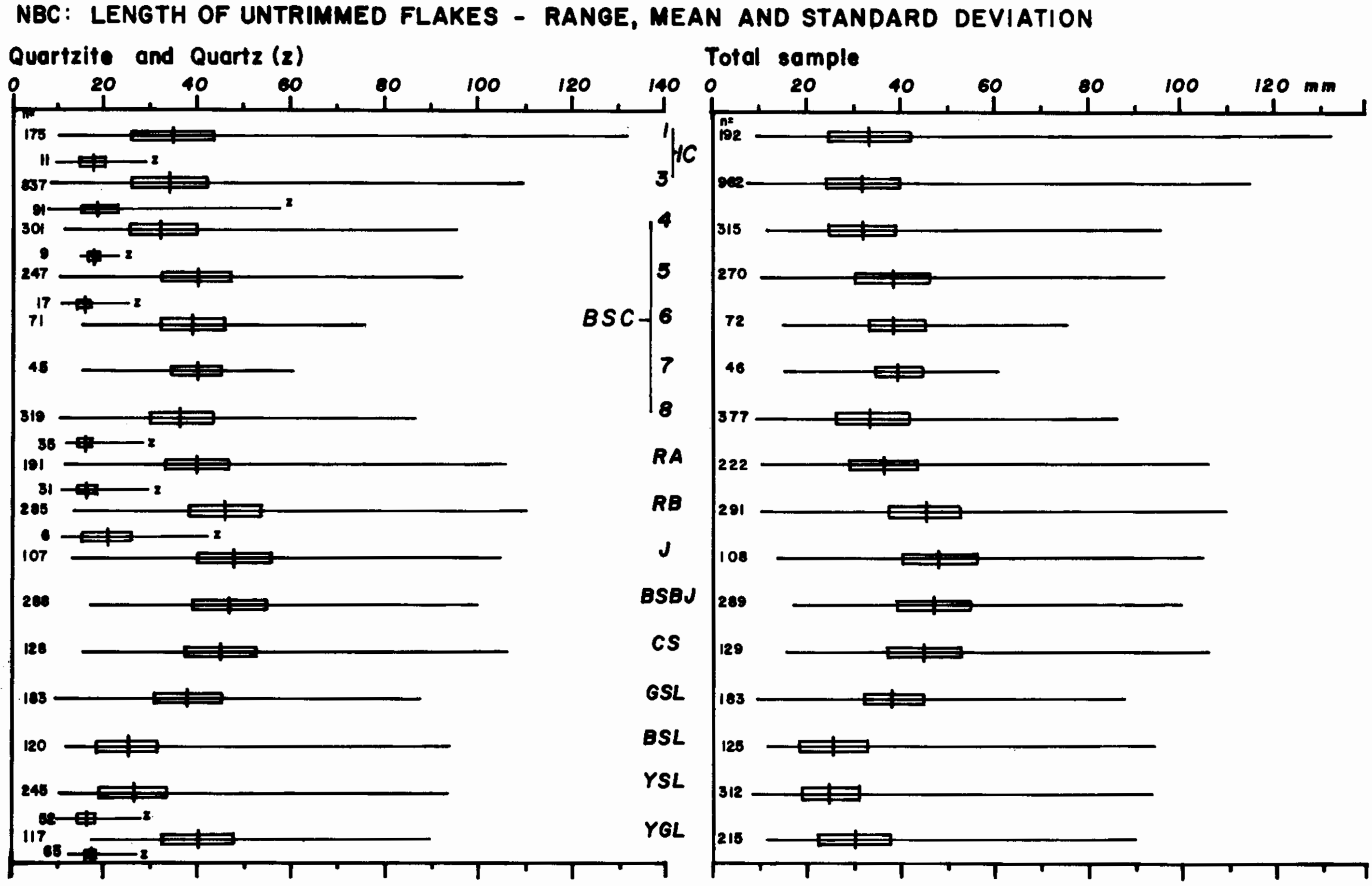
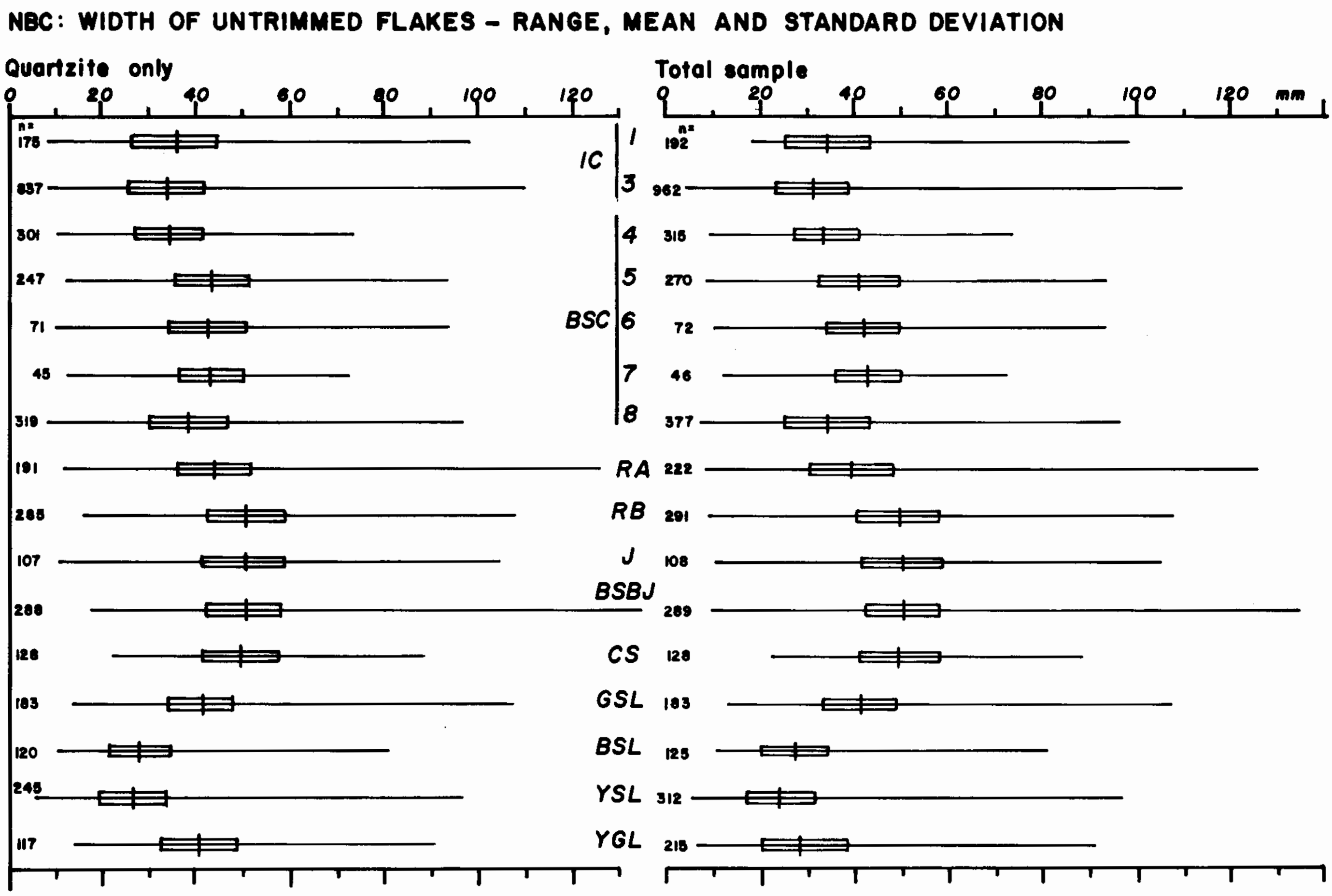

NBC: LENGTH OF UNTRIMMED FLAKES - RANGE, MEAN AND STANDARD DEVIATION
Quartzite and Quartz (z)
Total sample
0 20 40 60 80 100 120 140
0 20 40 60 80 100 120 mm
IC 1 3
BSC 4 5 6 7 8
RA
RB
J
BSBJ
CS
GSL
BSL
YSL
YGL

Fig. 48


NBC: WIDTH OF UNTRIMMED FLAKES - RANGE, MEAN AND STANDARD DEVIATION
Quartzite only
Total sample
0 20 40 60 80 100 120
0 20 40 60 80 100 120 mm
IC 1 3
BSC 4 5 6 7 8
RA
RB
J
BSBJ
CS
GSL
BSL
YSL
YGL

NBC: W/L RATIO OF UNTRIMMED FLAKES - RANGE, MEAN, STANDARD DEVIATION

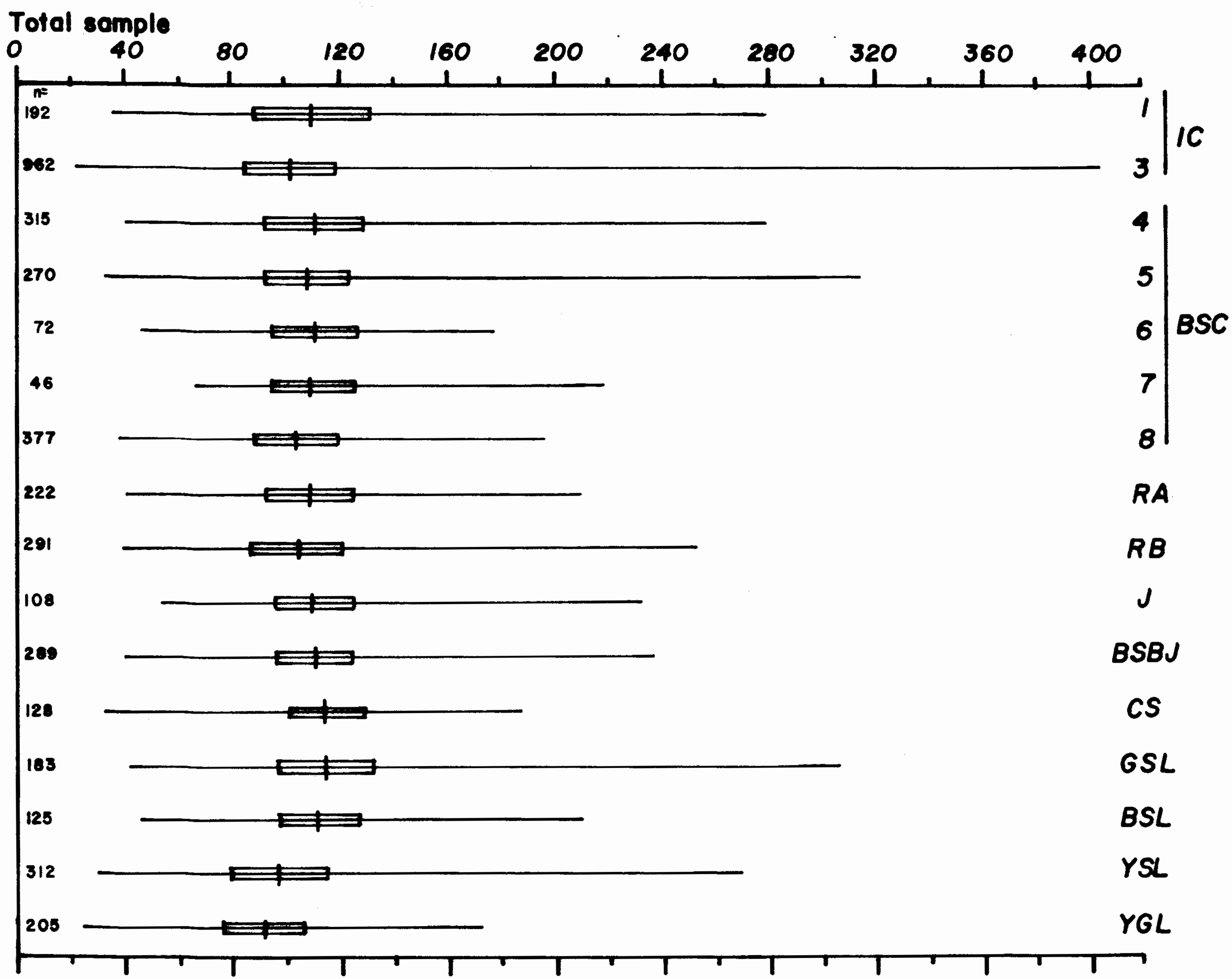


FIG. 50

NBC: HEIGHT OF UNTRIMMED FLAKES - RANGE, MEAN AND STANDARD DEVIATION

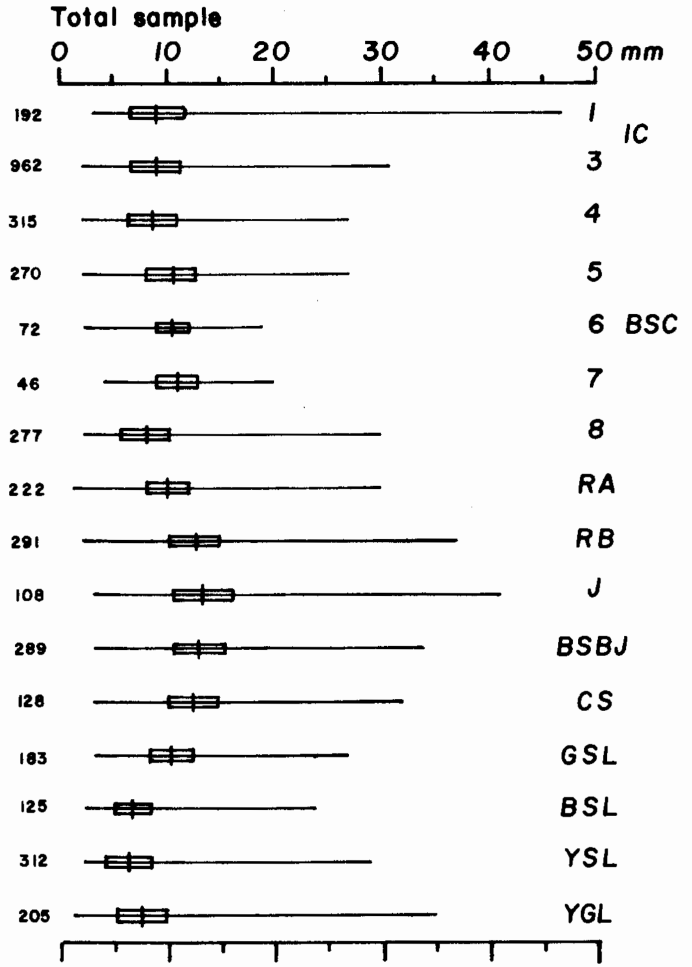


FIG. 51

NBC: REL T OF UNTRIMMED FLAKES — MEAN, RANGE AND STANDARD DEVIATION

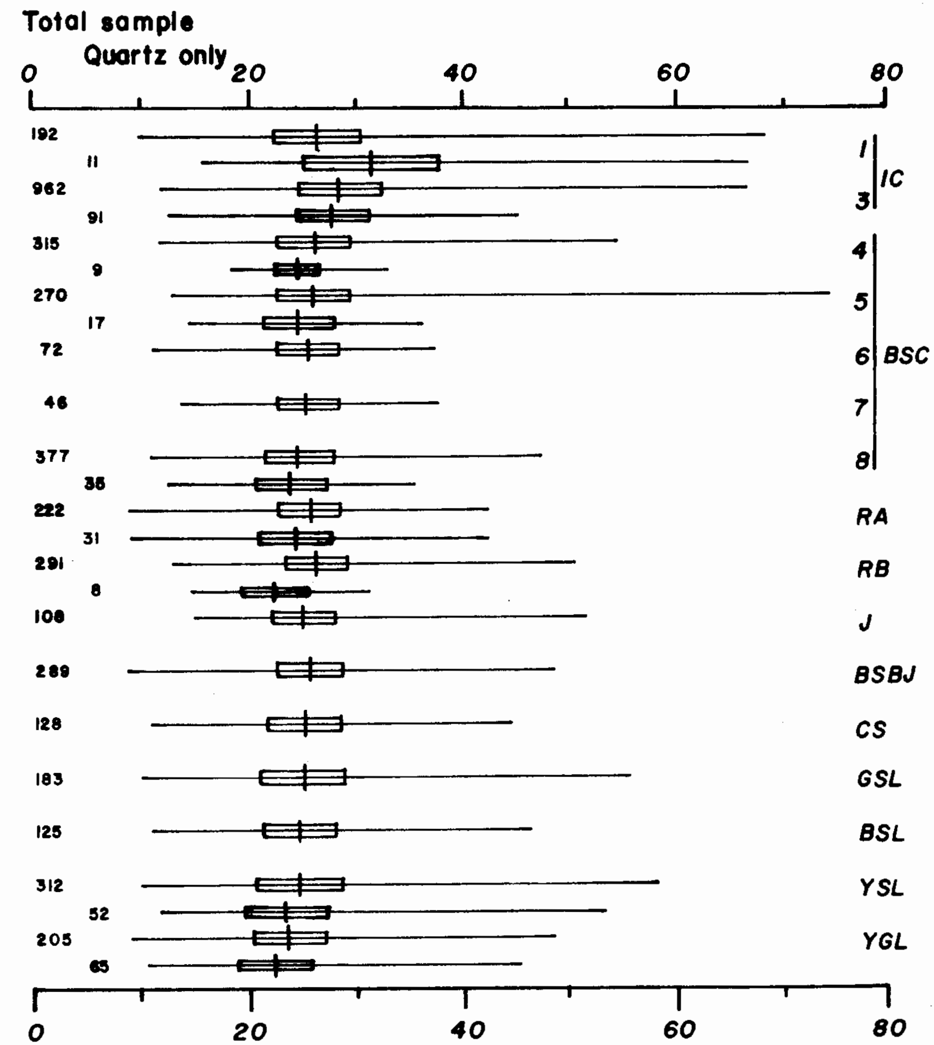
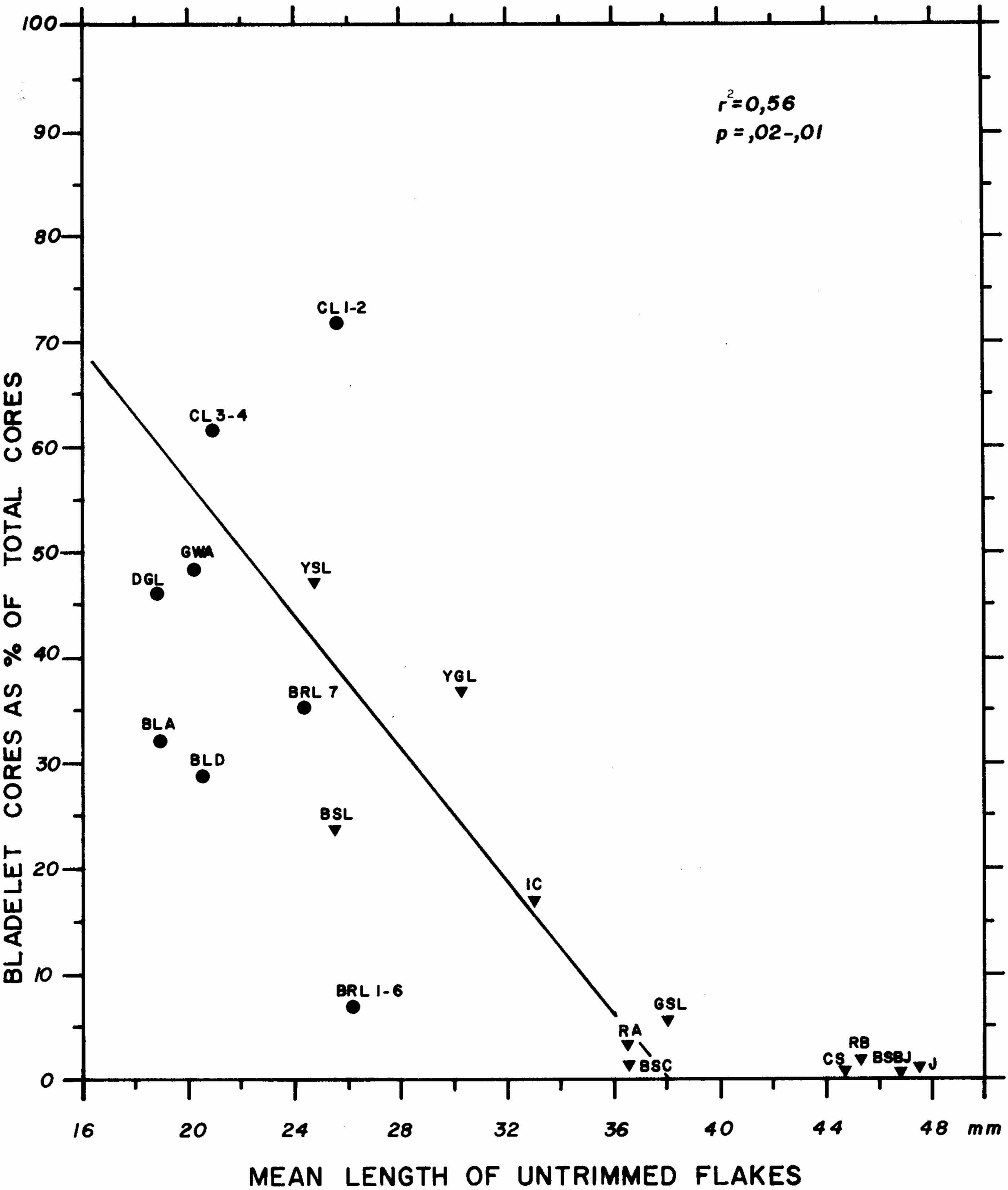


FIG. 52

NBC AND BPA: SCATTER DIAGRAM SHOWING WEAK LINEAR CORRELATION BETWEEN THE PERCENTAGE OF BLADELET CORES AND THE MEAN LENGTH OF UNTRIMMED FLAKES



Kangkara

Because of the limited sample size drawn from the Kangkara deposit it was considered unwise to measure the relatively small number of whole flakes for data on changes in size and shape as these may not be representative of the site as a whole. Several trends observed at NBC and BPA, however, are apparent at Kangkara which occupies an intermediate position between the other two sites in many instances.

Bladelet cores are present only in the lowest two assemblages and it is only in these units that bladelets occur as well. The number of flakes per core (including chunks) is much lower than at NBC (Fig. 39) ranging from 1 core to two flakes to 1:4,8, but there is a tendency for more flakes to occur in assemblages with higher quartzite frequencies. The relative frequency of chips is again correlated with the percentage of quartz (Fig. 41) confirming the relationship between toolmaking debris and raw material noted at NBC.

Boomplaas

At BPA the incidence of quartz is again correlated with the incidence of chips, although in the CL Member (BRL 7, CL 1-4, GWA) the number of chips is higher than would be expected (Fig. 41). This is the reverse of the situation at NBC where chips are less numerous than would be expected from the quartz content in the lower units. This difference could be explicable in the higher frequency of chips in materials other than quartz at BPA showing that the incidence of chips is only partly due to the raw material; the other part is due to the flaking method used.

In correlating the incidence of flakes with quartzite, on the other hand, the BPA samples have a low incidence of both quartzite and flakes when seen in the perspective of all three sites. Within the site, however, there is no linear correlation between the two. Even when all non-quartz materials are considered, there is no linear correlation between their relative frequency and that of untrimmed flakes. The relationship between a particular raw material and the nature of the toolmaking debris is therefore only a gross one that may be influenced by other factors within a site sequence.

Bladelet cores are more evenly distributed through the BPA sequence than at either NBC or Kangkara, but they nevertheless follow the same pattern in being more numerous in the late Pleistocene units than at any other time; they are also more standardized in shape and size than in those units overlying them (Table 26). The incidence of core reduced pieces is again closely related to that of bladelet cores and it would seem that both are by-products of a flaking technique favoured both in the late Pleistocene and in the mid-late Holocene. The high incidence of flat bladelet cores in the late Pleistocene, however, distinguishes the cores of this period from those of the Holocene (Table 26). There is a drop in the incidence of bladelets relative to flakes in the late Pleistocene that precedes the decrease in the relative frequency of bladelet cores by at least a thousand years at BPA (Figs 53 and 54); the fact that this does not occur at NBC may mean that it is the result of sampling, or that a real change in flaking technique occurred at the one site but not at the other.

That the late Pleistocene flaking method used at BPA was designed to produce more bladelets and smaller flakes than the method used in the overlying units can be seen in the shorter flakes, bladelet cores and low quartzite frequencies in the late Pleistocene samples. As can be seen in Fig. 55, there is a reasonably high correlation at BPA between the incidence of quartzite and the mean length of untrimmed flakes (p=.01 - .001). The lower correlation coefficient for the NBC sample is caused mainly by the aberrant position of the YSL and YGL samples which are affected by a relatively high incidence of non-quartzite materials and therefore correlate more closely with the BPA units. Fig. 56 shows a weak correlation between the ratio of cores:chunks and the mean length of untrimmed flakes demonstrating a tendency for samples with more chunks to have shorter flakes at BPA. The same pattern does not hold for NBC, however, where there is always a higher incidence of cores than chunks.

Descriptive statistics for untrimmed flake lengths, widths, heights, w/l ratios and relative thicknesses are summarized in Tables 28-32 and Figs 57-60. Raw materials are plotted separately in Fig. 57 and Fig. 60 to show that all materials follow a similar trend through time, confirming again the impression that changes in flaking technique and consequent flake size are only partly affected by the choice of raw material and that flaking technique contributed equally to the result. The trend

FIG. 53

PERCENTAGE FREQUENCY OF BLADELET CORES IN DATED SAMPLES

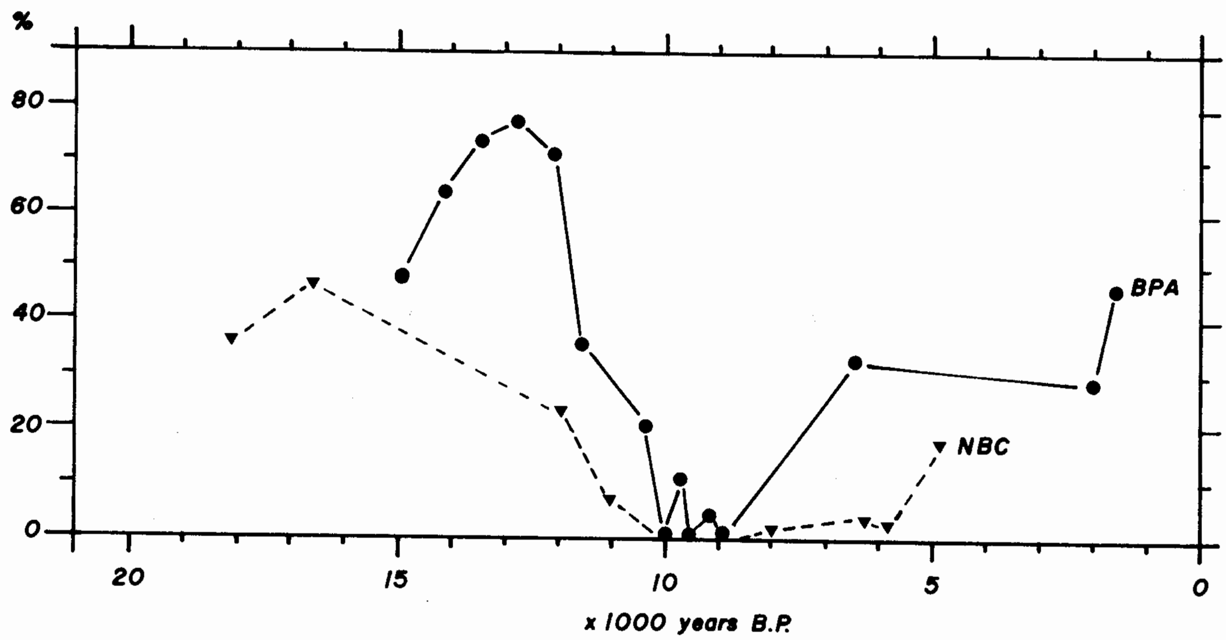


FIG. 54

BLADELETS AS A PERCENTAGE OF UNTRIMMED FLAKES IN DATED SAMPLES

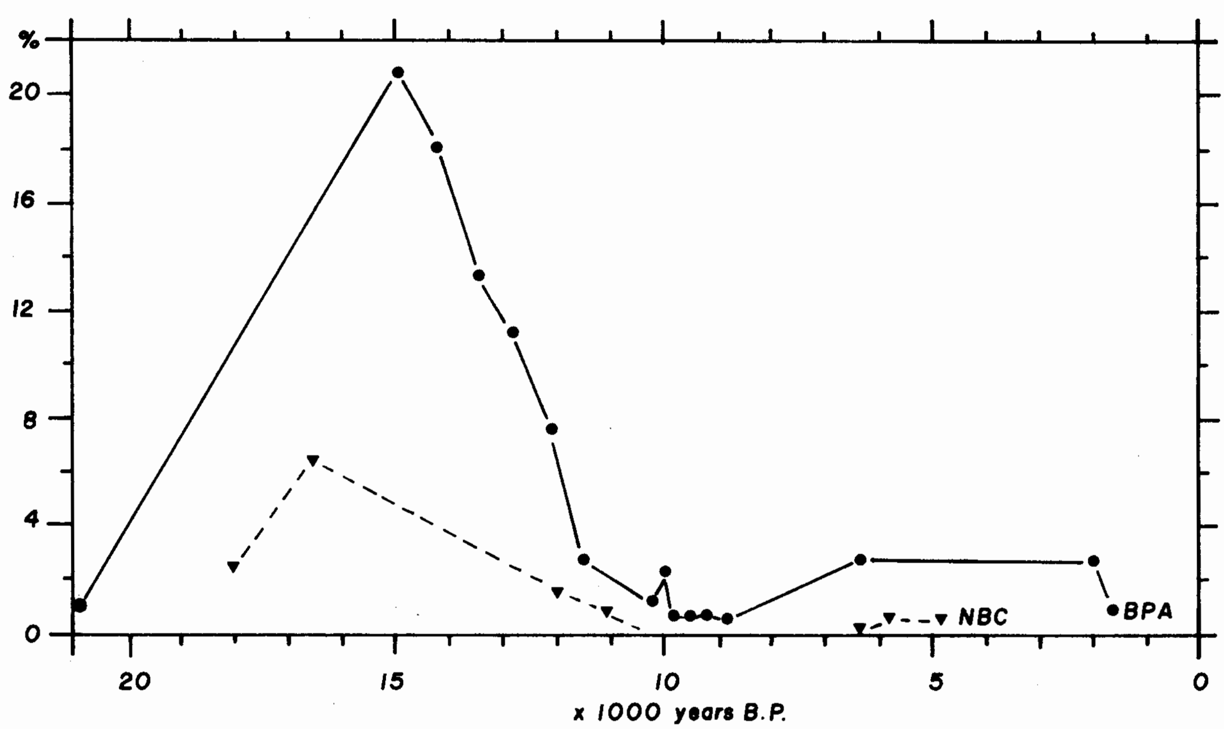


FIG. 55

NBC AND BPA: SCATTER DIAGRAM SHOWING LINEAR CORRELATION BETWEEN THE PERCENTAGE OF QUARTZITE AND THE MEAN LENGTH OF UNTRIMMED FLAKES

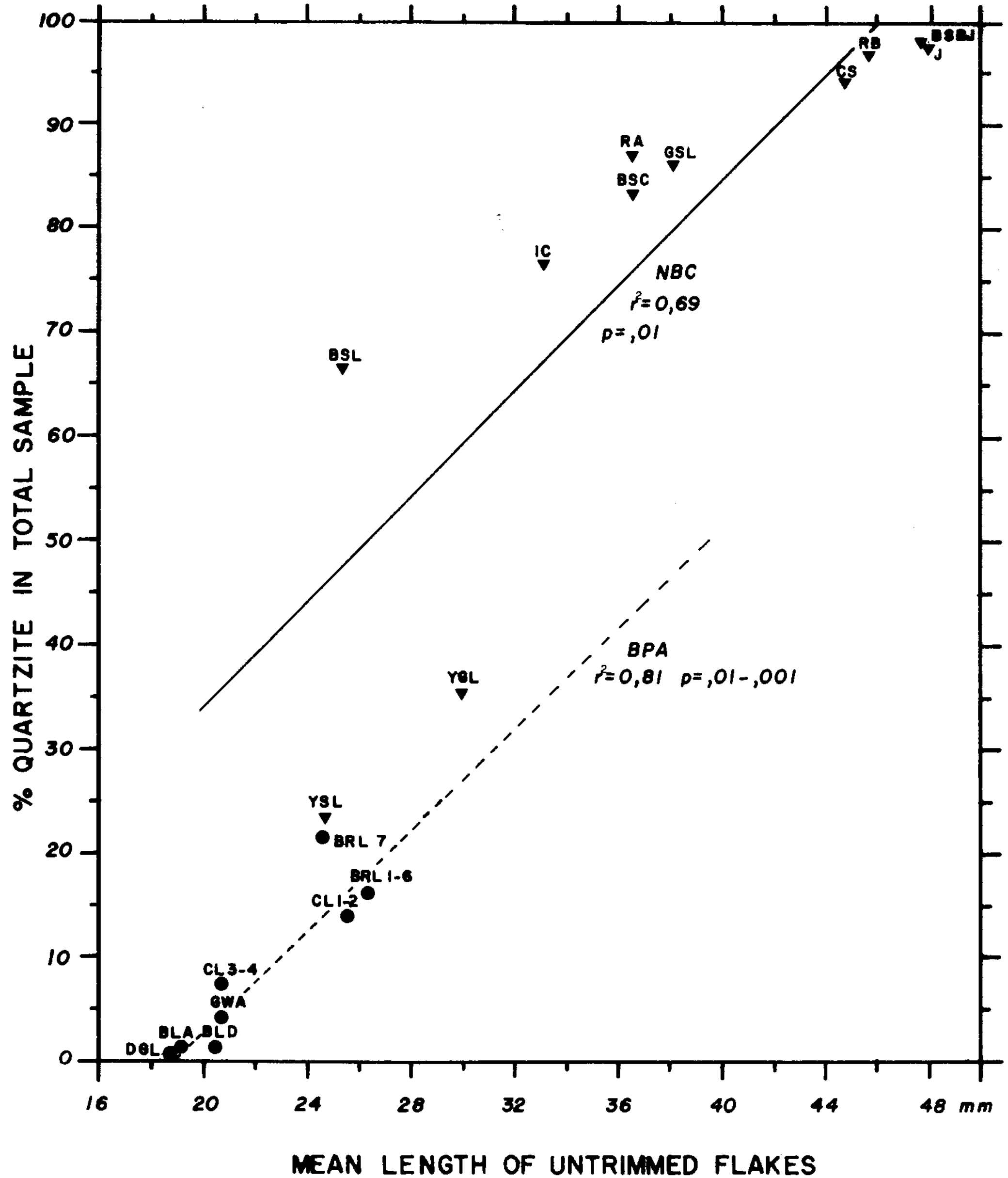
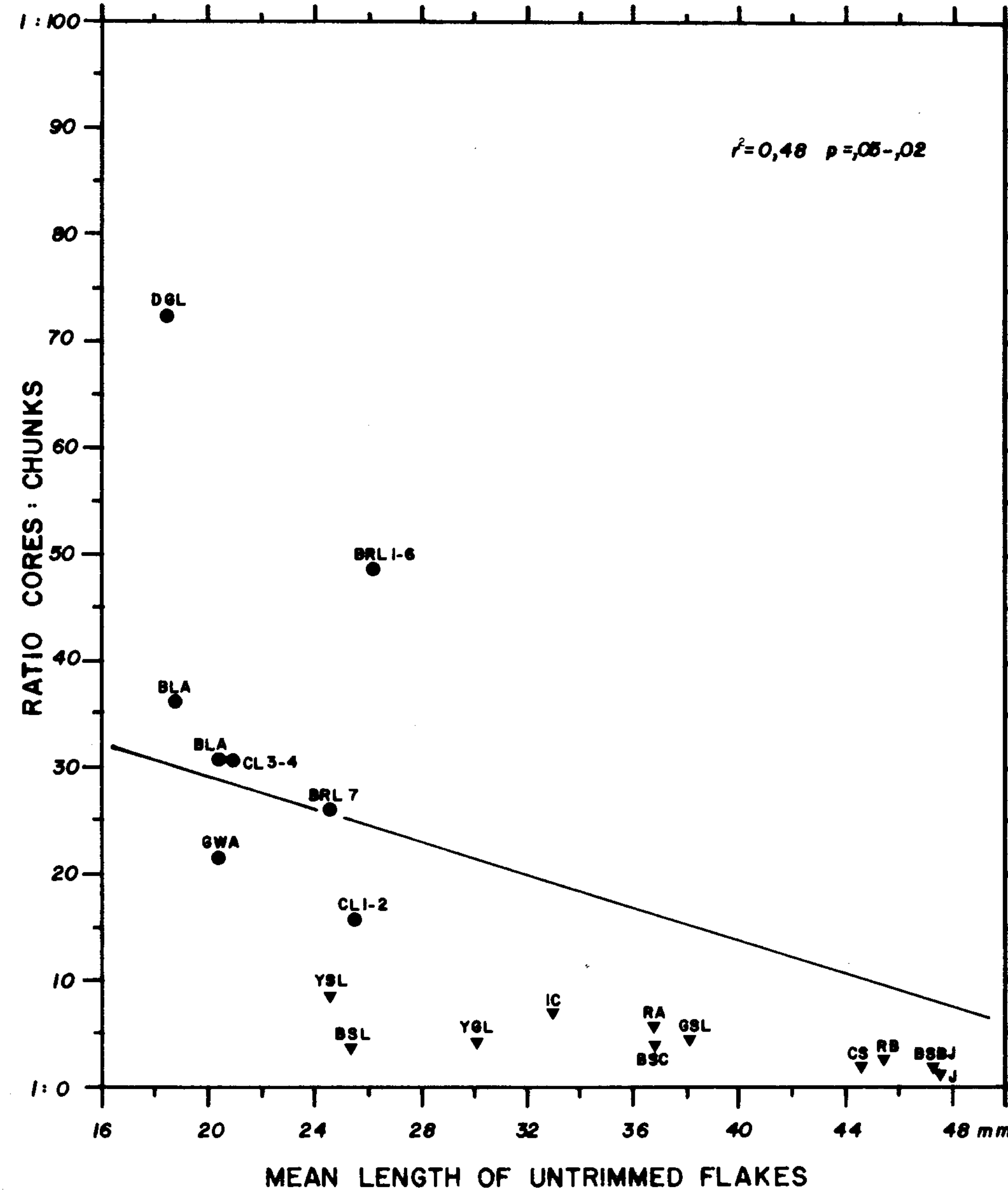


FIG. 56

NBC AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE RATIO OF CORES:CHUNKS AND THE MEAN LENGTH OF UNTRIMMED FLAKES



through time shows a distinct drop in flake length at ca 21 000 B.P. between LPC and LP that is mirrored also in flake width and height. These measurements are fairly constant through the next 8000 years until ca 12 500 B.P. when in the CL 1-2 samples the size increases and remains constant through to the top of BRL at ca 9000 B.P. Thereafter the size range reverts to that of the late Pleistocene in the mid-late Holocene samples in BLA, BLD and DGL. The w/l ratio, however, indicates a strong bladelet element in GWA and CL 3-4 only, the least blade-like shapes occurring in BRL. The relative thickness measurements are fairly stable throughout the sequence, with the exception of CL 3-4 which has more thinner flakes than any other sample.

Inter-site comparisons

Analysis of the variability within the waste category classes and changes through time at the three sites has shown that changes in flaking technique coincide with changes in the choice of raw materials suggesting some functional link, and that shifts in these parameters are broadly coincident at all three sites suggesting that the shifts are not site-specific but had some regional significance.

Figs 52, 53, 54, 61 and 62 have been drawn to demonstrate the coincidence in timing of changes in the incidence of bladelets, bladelet cores and the ratio of chips:untrimmed flakes, as well as the mean length of untrimmed flakes. Although the actual frequencies and measurements are not the same at each site, the general trend through time is similar. This helps to formulate some generalizations about toolmaking methods over the last 20 000 years in the southern Cape. The flaking method used between about 20 000 and 12 000 B.P. is characterized by a high incidence of bladelet cores that include a distinctive and highly standardized single-platform type (Fig 117:1-15;135:1-7) as well as a sub-class of small flat cores often made on quartz crystals (Fig 117:16-18; 135:8-13). These are correlated with the occurrence of bladelets (illustrated in Appendix 1) of which only a small proportion has been retouched, a high incidence of non-quartzite raw materials (silcrete, quartz, chalcedonies) and shorter, narrower and more blade-like flakes. Chips tend to be more common in these samples, regardless of whether quartz frequencies are high or not.

Between about 12 000 and 8000 B.P. chips are not as common,

FIG. 57

BPA: LENGTH OF UNTRIMMED FLAKES - RANGE, MEAN AND STANDARD DEVIATION

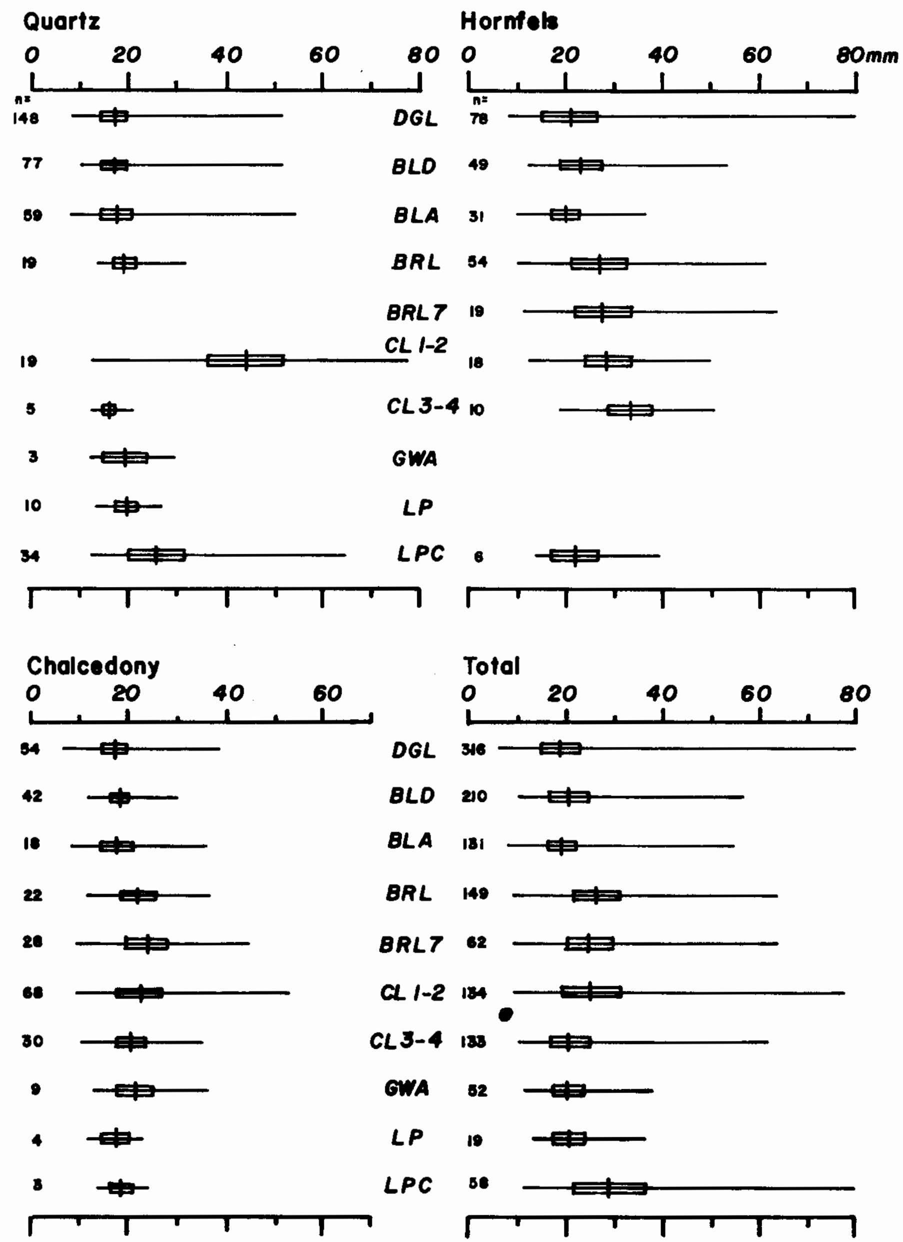
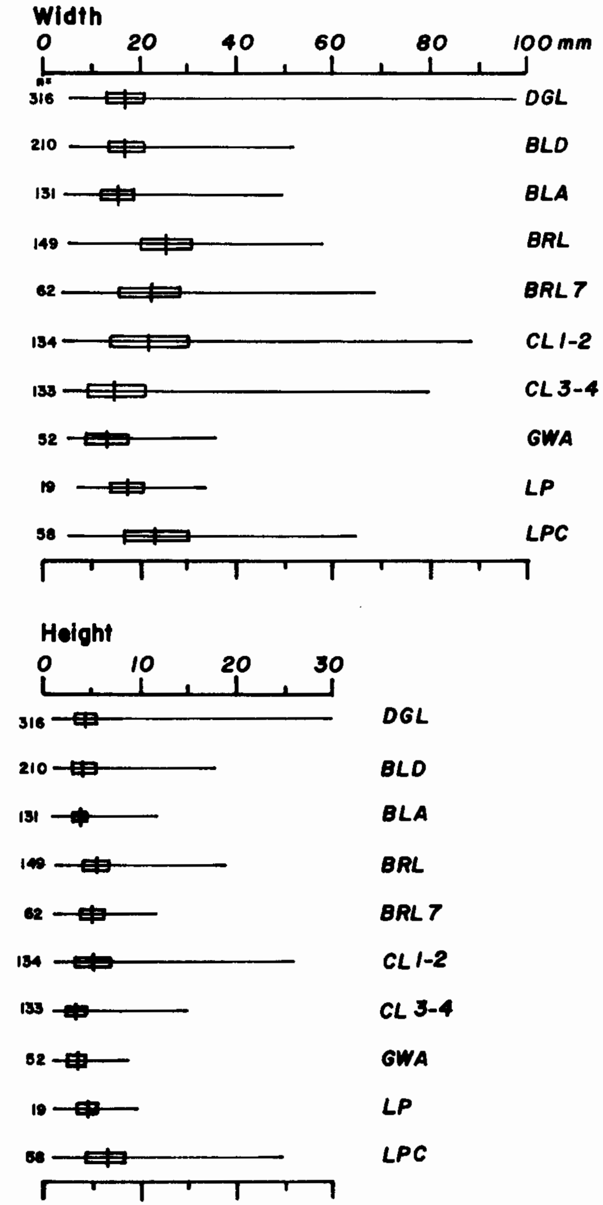


FIG. 58

BPA: UNTRIMMED FLAKES - RANGE, MEAN, STANDARD DEVIATION



bladelets and bladelet cores are rare, quartzite and hornfels are preferred raw materials and the untrimmed flakes are longer, wider and less blade-like than those in earlier or later assemblages. The increase in flake length occurs slightly earlier at BPA than at NBC and whether this is due to sampling or not will need to be tested by the analysis of similar materials from other sites. Of interest, too, is the fact that the incidence of bladelet cores at BPA persists longer than the high incidence of bladelets at both NBC and BPA. The reason why the cores should have been made after the bladelets were reduced in number may be that the bladelets were removed from the site after flaking, or that the cores themselves were curated for use as scrapers, a possibility that will be discussed again in the section on formal tools.

After about 8000 B.P. there is a general reduction in the length, width and height of flakes bringing them to dimensions comparable with those in samples older than 12 000 B.P., but the w/l ratios indicate that flakes of blade and bladelet proportions are not as common in these more recent units as they were in the late Pleistocene. This can be seen in Fig. 59. These factors suggest that the flaking technique used after about 8000 B.P. was geared toward a more intensive use of nodules of raw material that resulted in fewer formal cores, fewer unretouched bladelets, smaller flakes and a higher incidence of chunks. This is partly correlated with the choice of quartz as a preferred raw material in many of the samples. The fact that this pattern is correlated with a higher incidence of formal tools suggests that retouching after the flake was struck replaced more careful core preparation techniques and may have been preferred with the increased incidence of hafting which needed more standardized inserts. The change in flaking technique at ca 12 000 B.P. is less easy to account for, however. From the perspective of the present day it seems more like a regression from the microlithic mode than a logical step in an evolutionary process.

To view changes in flake size and shape in broader perspective, the relative thickness index, suggested by Beaumont (1978) to be the most sensitive to changes through time, was calculated for the NBC and BPA untrimmed flakes (Fig. 63). It shows that the thinnest flakes were made in the late Pleistocene samples and that they grew progressively thicker through the Holocene. However, when this curve is placed on the end of that drawn by Beaumont for MSA and early LSA samples in

FIG. 59

BPA : W/L RATIO OF UNTRIMMED FLAKES – MEAN, RANGE AND STANDARD DEVIATION

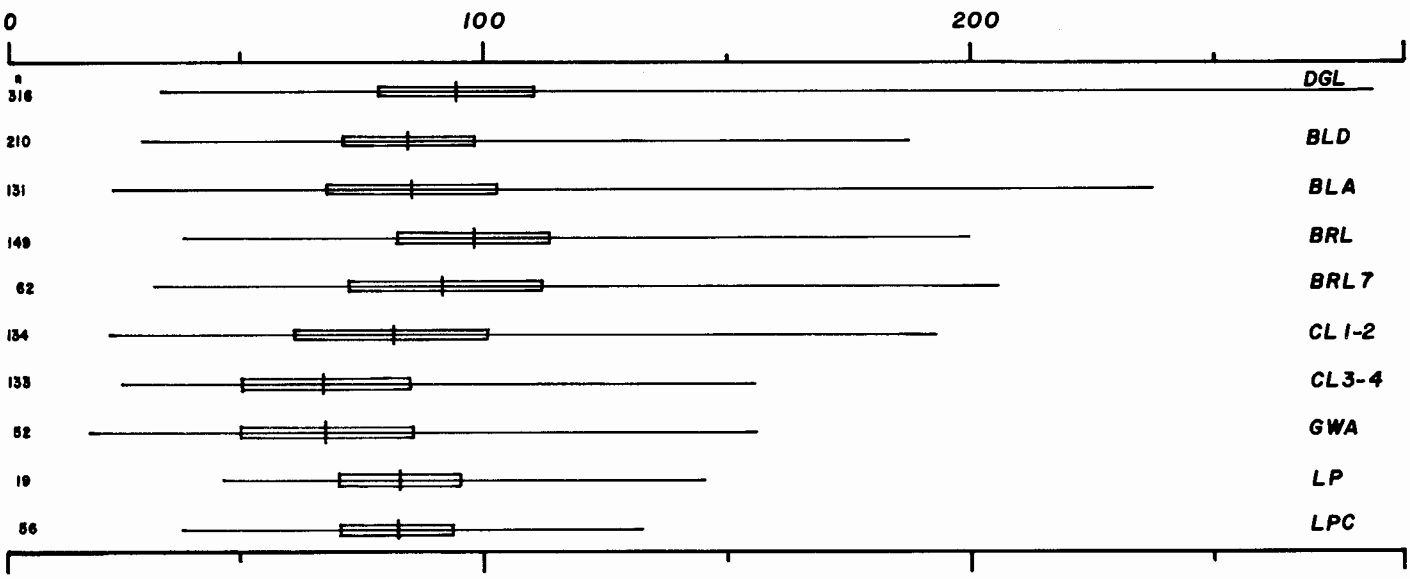


FIG. 60

BPA : REL T OF UNTRIMMED FLAKES – MEAN, RANGE AND STANDARD DEVIATION

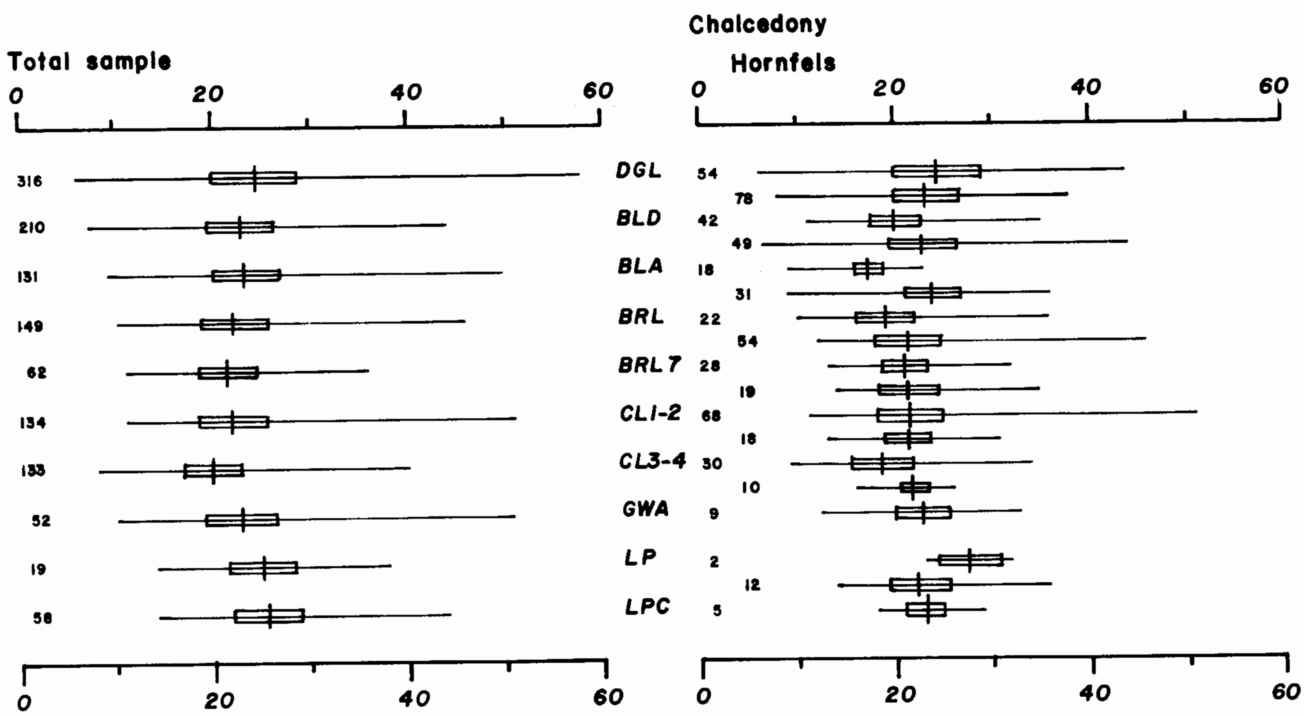


FIG. 61

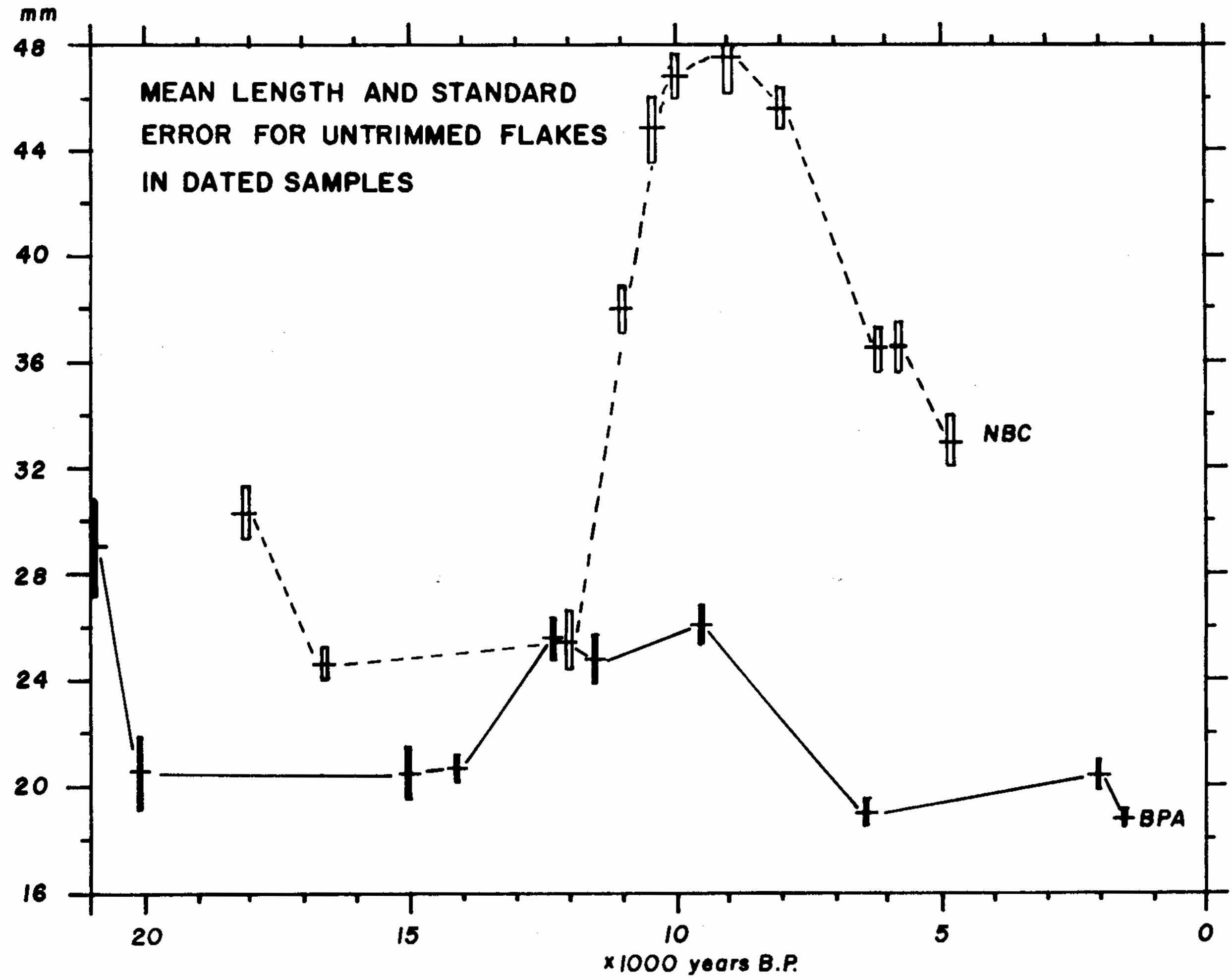


FIG. 62

RATIO OF CHIPS : UNTRIMMED FLAKES IN DATED SAMPLES

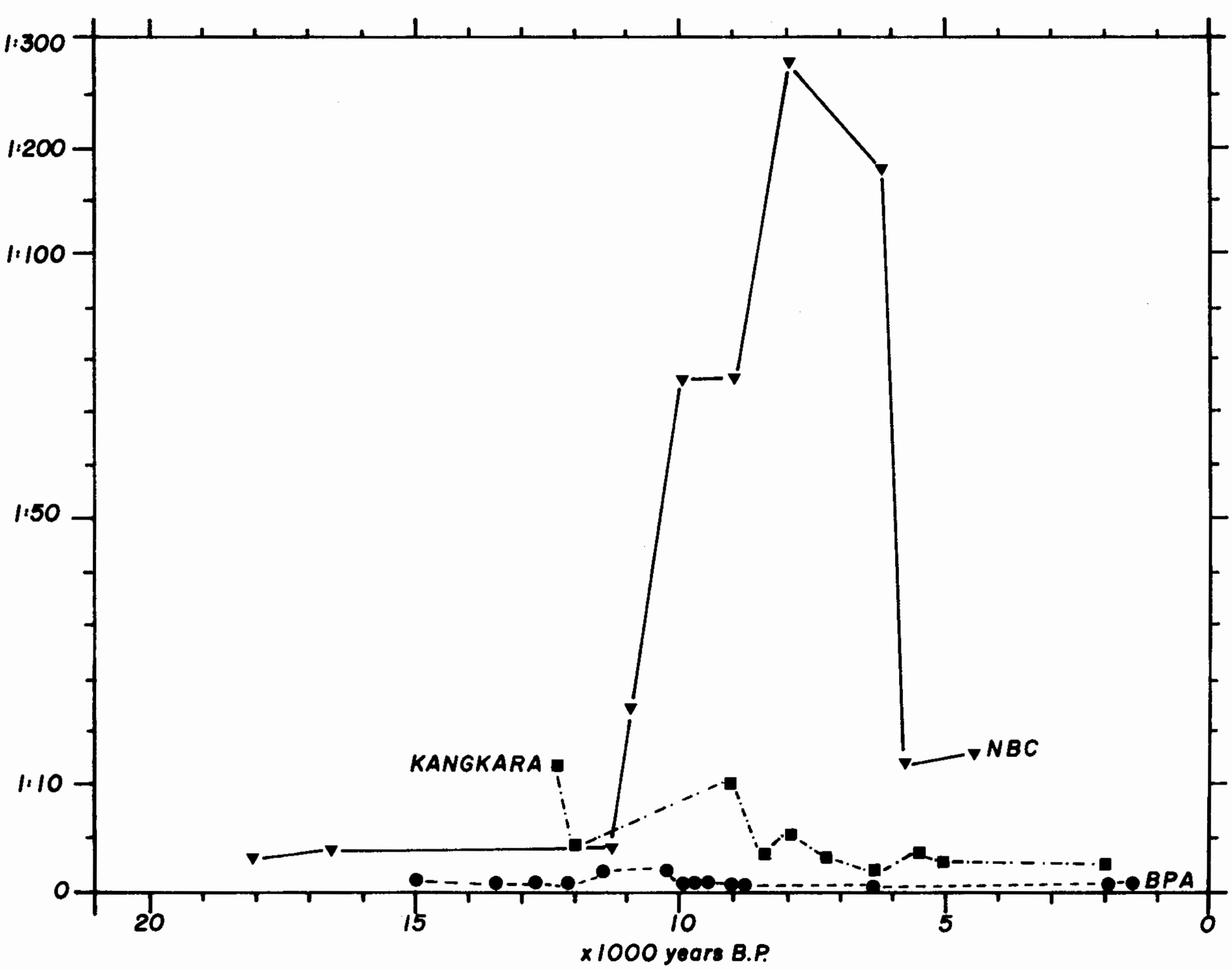


FIG. 63

NBC AND BPA: CHANGES THROUGH TIME IN THE RELATIVE THICKNESS OF UNTRIMMED FLAKES IN DATED SAMPLES

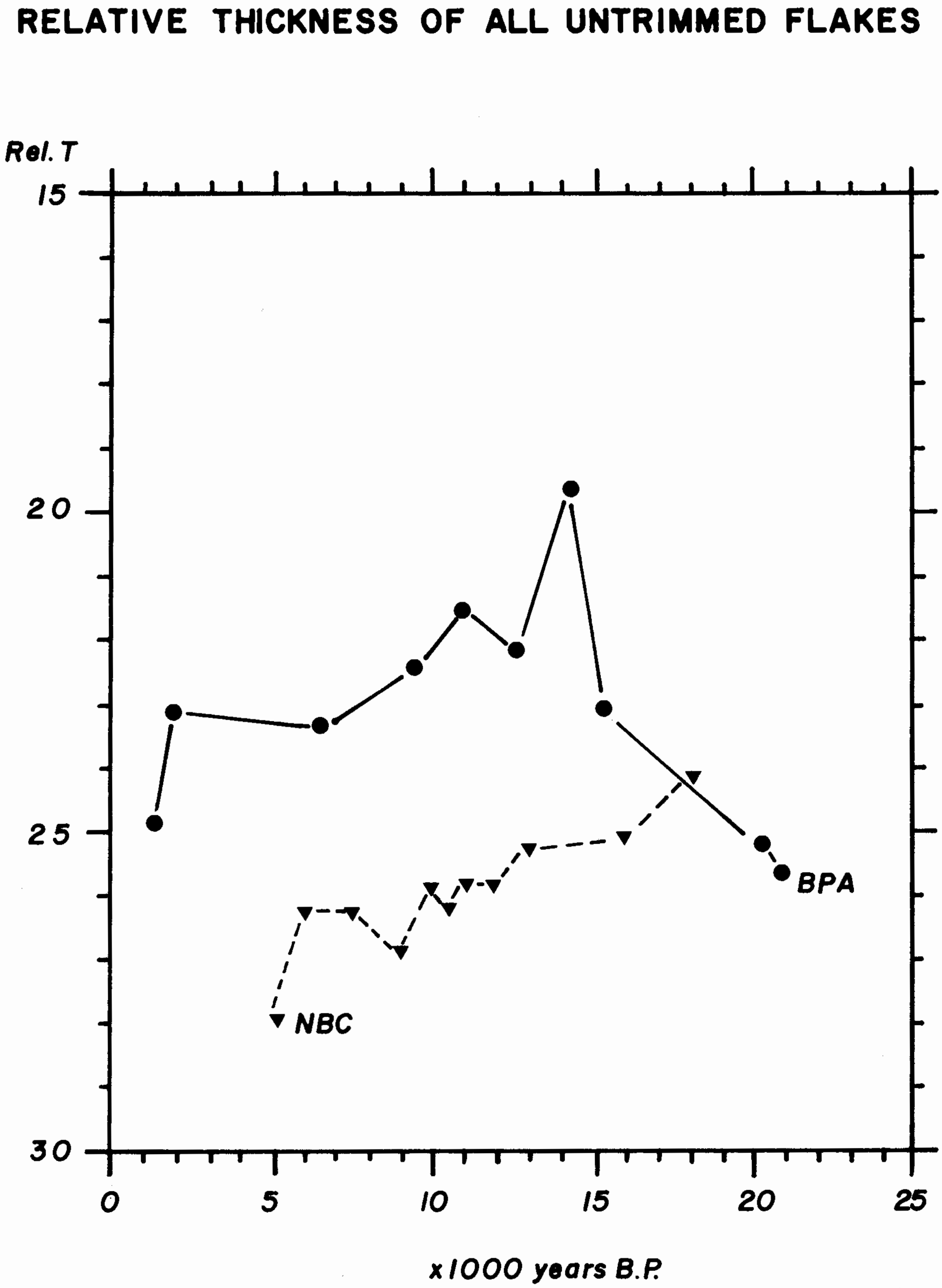


FIG. 64

RELATIVE THICKNESS OF UNTRIMMED FLAKES IN DATED SAMPLES TO 120 000 B.P.

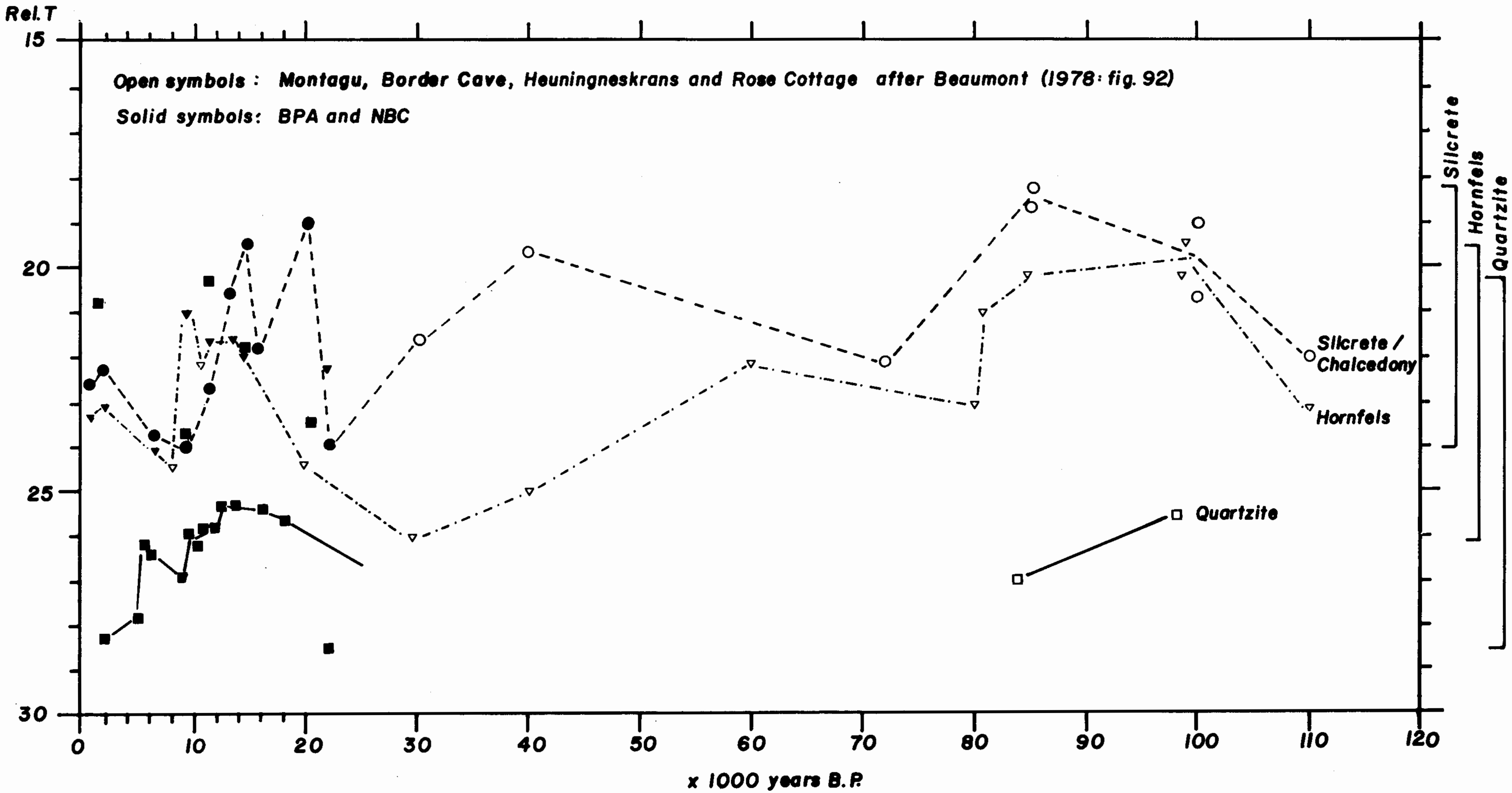


Fig. 64 and raw materials are plotted separately, it can be seen that the relative thickness of flakes is a cyclic phenomenon that oscillates within limits apparently set by raw materials. Quartzite flakes tend to be thickest (although there is considerable variability and some of the smaller samples of thinner flakes are not joined by the curve on the diagram to facilitate the following of the general trends), and silcrete flakes tend to be the thinnest. Of interest is the fact that they all tend to follow much the same trend through time indicating once more that flaking technique has as much influence on the size and shape of flakes as does the raw material used, and that particular materials were deliberately selected for particular flaking methods. This long term perspective also illustrates, however, that one size or shape index cannot be used to distinguish artefacts of a particular period except over a relatively short time span. The relative thickness index for flakes dating between 100 000 and 80 000 B.P., for example, is essentially similar to that for samples dating between ca 20 000 and 10 000 B.P.

CHOICE OF PIECES FOR UTILIZATION

Odell (1979) lists the size, shape and qualities of prehension and the suitability and shape of the edge for the task as the criteria assessed in the choice of a piece for utilization. Ideally, these qualities could be measured and descriptive statistics calculated, but there is so little obvious change through time in the relative frequencies of the various classes and sub-classes of utilized pieces at the three sites described here that it is assumed that these items were not as subject to changing habits and preferences as those in the formal tools category or some of the waste classes. Measurements of the size and shape of utilized flakes taken at other sites, for example Wilton (Deacon, J. 1969) and Wonderwerk (Thackeray, A. 1981) show that the upper end of the size range was consistently selected for utilization amongst the flakes. Visual inspection of the utilized flakes from NBC, KRA and BPA confirms this.

Artefacts included in the utilized category are utilized flakes with edge, steep or notched damage to the laterals that is visible to the naked eye, heavy edge-flaked pieces that may have been utilized cores and are specific to the use of quartzite cobbles, and a variety of cobbles used for hammerstones, grindstones, rubbers and combinations of these functions. Although some core reduced pieces may have been utilized for their chisel-like edges (i.e. pièces esquillées), and indeed a small number show wood polish on this edge (Fig.137:12, 13), they have not been included as a separate class within the utilized category because of the difficulty of being certain, without microwear analysis, that the damage is indeed due to utilization. For the moment, then, these pieces are regarded as having been discarded at an earlier stage in the reduction process than utilized pieces although this stance may need to be modified in future.

Because the utilized category includes only those pieces with damage visible to the naked eye, it represents only a portion of the total and unknown number of pieces that were utilized. This problem will only be resolvable once microwear studies are fully operational and problems of detecting microwear on coarse materials such as quartzite and highly siliceous ones such as quartz (which make up the bulk of the materials at the three sites discussed here) have been overcome.

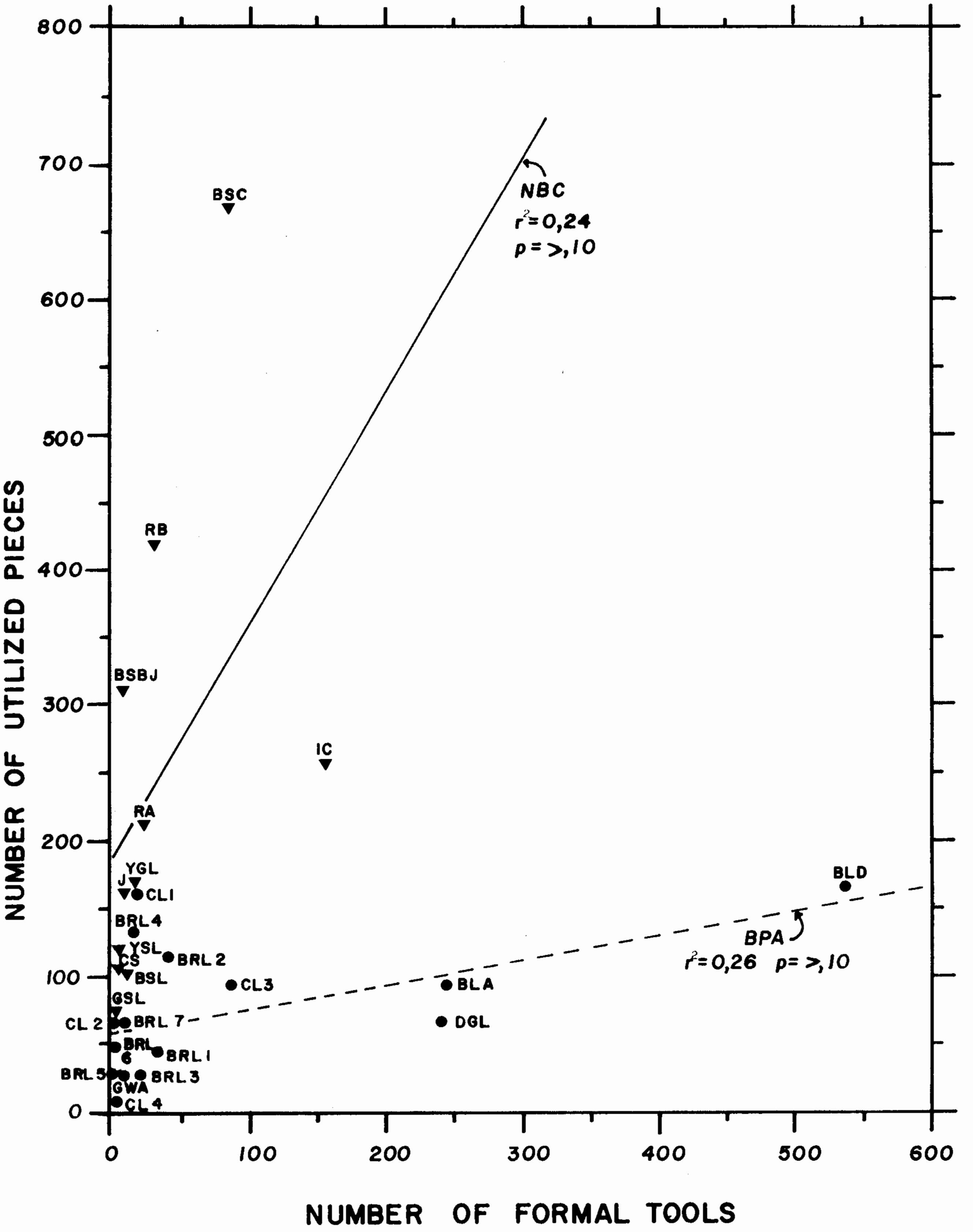
Nelson Bay Cave

The most common class in the utilized category is that of utilized flakes (Table 12). Edge-damaged flakes are consistently more numerous than either of the other two sub-classes and may account for as much as 60% of all utilized flakes. To demonstrate the remarkably constant frequency of utilized flakes, the ratio of utilized to untrimmed flakes is listed in Table 33. Regardless of raw material changes, one out of every 25-30 flakes produced at NBC was utilized sufficiently to show damage visible to the naked eye and was discarded on the site. In BSL the ratio is higher with one out of every 13 flakes utilized, while in YGL it is lower with one in 37 flakes utilized. Fig. 65 shows no correlation between the incidence of formal tools and utilized flakes suggesting that there is no clear linear relationship between the development of formal tools and the incidence of utilization on a more casual basis. This supports the contention that the development of highly patterned formal tools is independent of the range of activities undertaken.

Heavy edge-flaked pieces are made almost exclusively from quartzite cobbles (one exception is a silcrete example from RA). Although

FIG. 65

NBC AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE NUMBER OF UTILIZED PIECES AND THE NUMBER OF FORMAL TOOLS



they were used for the production of flakes, they were placed in the utilized category because of the heavy damage to the edge that is more sustained than on a normal core and this utilization damage sometimes extends around two sides of the artefact to form a retouched 'tip'. In this sense they could be regarded as similar to pièces esquillées in that they are cores which have been subsequently utilized, but the utilization is much clearer and unequivocal than it is on the pièces esquillées class and they have therefore been placed in the utilized category. Their occurrence is limited in units where quartzite cobbles have not been used to any great extent (as, for example, in the lower three units, YGL, YSL and BSL).

Lower grindstones have been found in the four uppermost units only at NBC, but the occurrence of one upper grindstone (rubber) in YGL suggests that grindstones were in use in the late Pleistocene. Hammerstones and combination hammer/rubbers are also more common in the upper units and here may again relate to the increased use of quartzite cobbles in those units.

Kangkara

Utilized flakes at Kangkara are not invariably more numerous than formal tools as was the case at NBC (Table 15). The ratio of utilized flakes to untrimmed flakes in listed in Table 34 and shows a more variable pattern than that at NBC with nine out of the eleven units having between 13 and 45 untrimmed flakes per utilized flake. The two lowest units have both the highest (1:69) and lowest (1:7) values, but the fact that the sample is drawn from a single 1 m^2 precludes any speculation about the significance of these figures. By the same token, the low frequencies of grindstones and rubbers must also be seen as the result of sampling. Heavy edge-flaked pieces are not as common here as at NBC, presumably again because of the lower incidence of quartzite cobbles brought to the site.

Boomplaas

Although there is a trend through the BPA sequence for utilized pieces to become less important relative to formal tools in the mid- and late Holocene samples (Tables 18 & 19; Fig. 65), there is no statistical correlation between the number of utilized and formal tools.

There is some variability in the ratio of utilized to untrimmed flakes with a mean value for the site of 1:35 and a standard deviation of 26,75. The lowest values occur in the late Pleistocene CL 3 and 4 assemblages (Table 35) and the highest in the BRL Member.

Hammers, rubbers and grindstones occur sporadically throughout the sequence with one grindstone from the CL Member confirming that they were used in the late Pleistocene. These utilized artefacts are made almost exclusively in quartzite and some are stained with ochre. A single piece of ground shale with a perforation in it was found in DGL (Fig.120:37).

When utilized pieces are considered as a percentage of the total assemblage (Table 18) they are more common in the units of the BRL Member and in BLA than in the late Pleistocene or late Holocene units, but it is clear that it is the incidence of utilized flakes rather than utilized cobbles which makes up this total. Heavy edge-flaked pieces are absent at BPA where the use of quartzite cobbles is rare.

Inter-site comparisons

The ratio of utilized : untrimmed flakes at the three sites is not dissimilar. The means for the three sites are 1:27 for both NBC and Kangkara and 1:35 for BPA. Taking the three sites together, the mean is 1:31 with a standard deviation of 20. Samples which fall outside one standard deviation are the uppermost (DGL) and two of the lowest (CL 3 and 4) at BPA and the lowest at Kangkara (YBL and BBD) indicating that the oldest and more recent samples tend to be more variable than those dating between about 12 000 and ca 2000 B.P. There is no linear correlation between the ratio of utilized to untrimmed flakes and any particular raw material or group of raw materials, but as utilized pieces are those that were made, used and discarded over a relatively short span of time, they probably carry more information about activities carried out on the site than do formal curated tools. The identification of use wear on these artefacts should therefore be a priority for future research.

There is no linear correlation (either positive or negative) between the incidence of utilized and formal tools. This would therefore rule out the possibility that formal tools replaced utilized ones on any scale, and the incidence of utilized flakes should be seen as the result of the casual use of suitable pieces that were made and discarded at the living site and not of the purposeful design of tools to a set and repeated pattern.

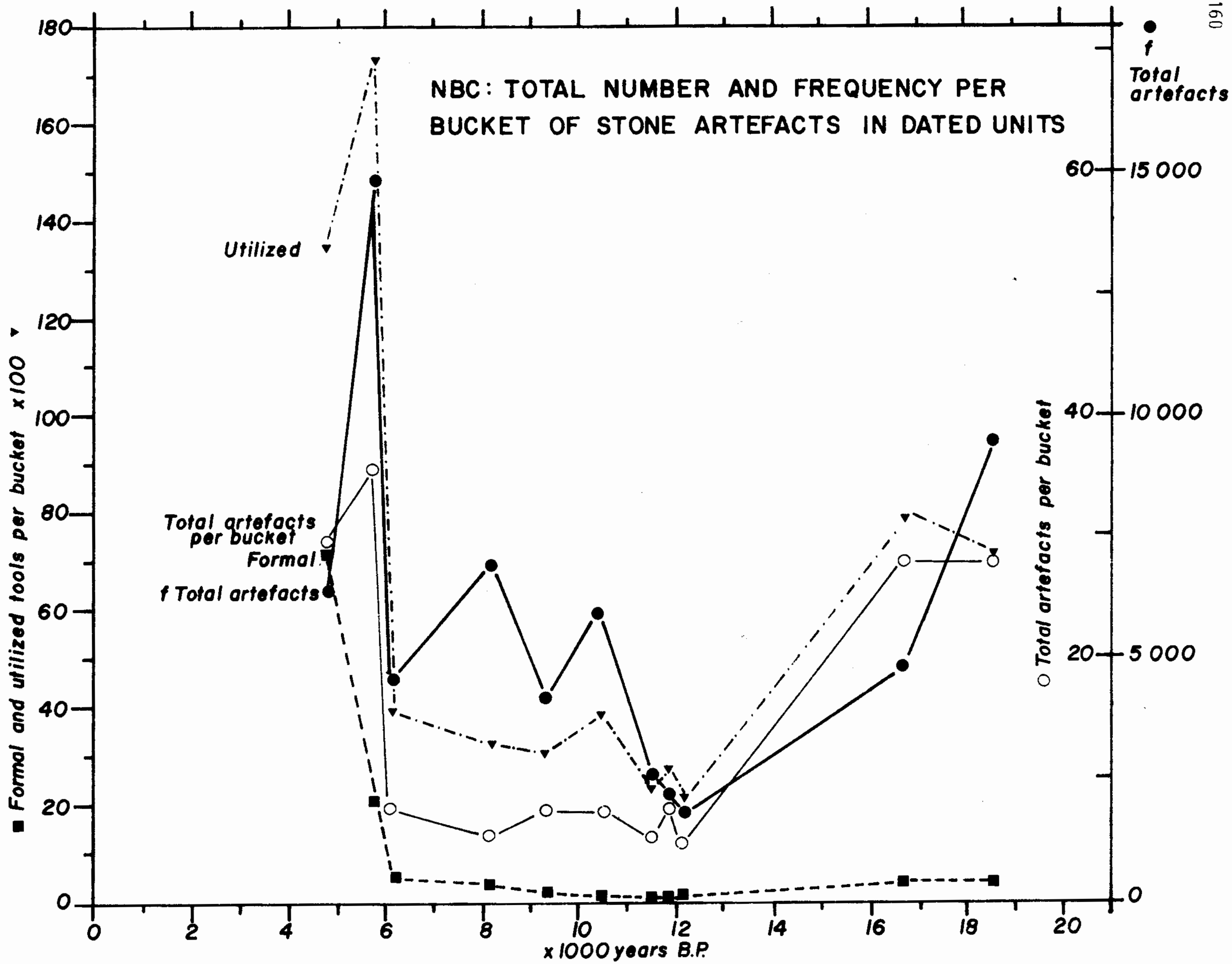
CHOICE OF PIECES FOR FORMAL RETOUCH

At most sites the formal tools category is of the least numerical importance, but nevertheless provides information on tool design that is unobtainable from untrimmed and utilized pieces because it is only formally retouched pieces that represent technological design and patterned behaviour on a measurable scale. The artefact classes included with formal tools are: scrapers (with sub-classes based on maximum dimension), backed microliths (with sub-classes based on plan form), borers, adzes, miscellaneous retouched pieces and two classes of ground stone tools: bored stones and sinkers. Definitions may be found in Appendix 1.

Although one may expect that the stone flaking method used at times when formal tools were made would be geared to the production of fairly standardized flakes that could be modified with the minimum of retouch into formal tools, comparisons between the frequencies of formal tools and classes in the waste and utilized categories have shown that there is no clear correlation between the range of cores and the size of flakes on the one hand, and the range of formal tools produced on the other, although there is a weak correlation between the length (but no other metric attributes) of untrimmed flakes and that of scrapers. Furthermore, although non-quartzite raw materials appear to be selected for the manufacture of formal tools in Holocene samples, neither the range nor the frequency of formal tools can be predicted from the raw material frequencies in the southern Cape. Thus the range of raw materials selected and the flaking methods used may partly account for the shape and size of the formal tools, but they do not account for the range and relative frequency of formal tools classes, particularly when late Pleistocene and Holocene assemblages are considered together.

The only factor which one can safely predict about an assemblage if only the incidence of formal tools is known, is the age of the sample. If an assemblage has a range of formal tools that comprises more than 2% of the total sample, there is a good chance that it dates within the last 7000 years.

FIG. 66



NBC: TOTAL NUMBER AND FREQUENCY PER
BUCKET OF STONE ARTEFACTS IN DATED UNITS
Utilized
Total artefacts per bucket
Formal
f Total artefacts
Formal and utilized tools per bucket x100
Total artefacts per bucket
f Total artefacts
x 1000 years B.P.
0
20
40
60
80
100
120
140
160
180
2
4
6
8
10
12
14
16
18
20
5 000
10 000
15 000

Nelson Bay Cave

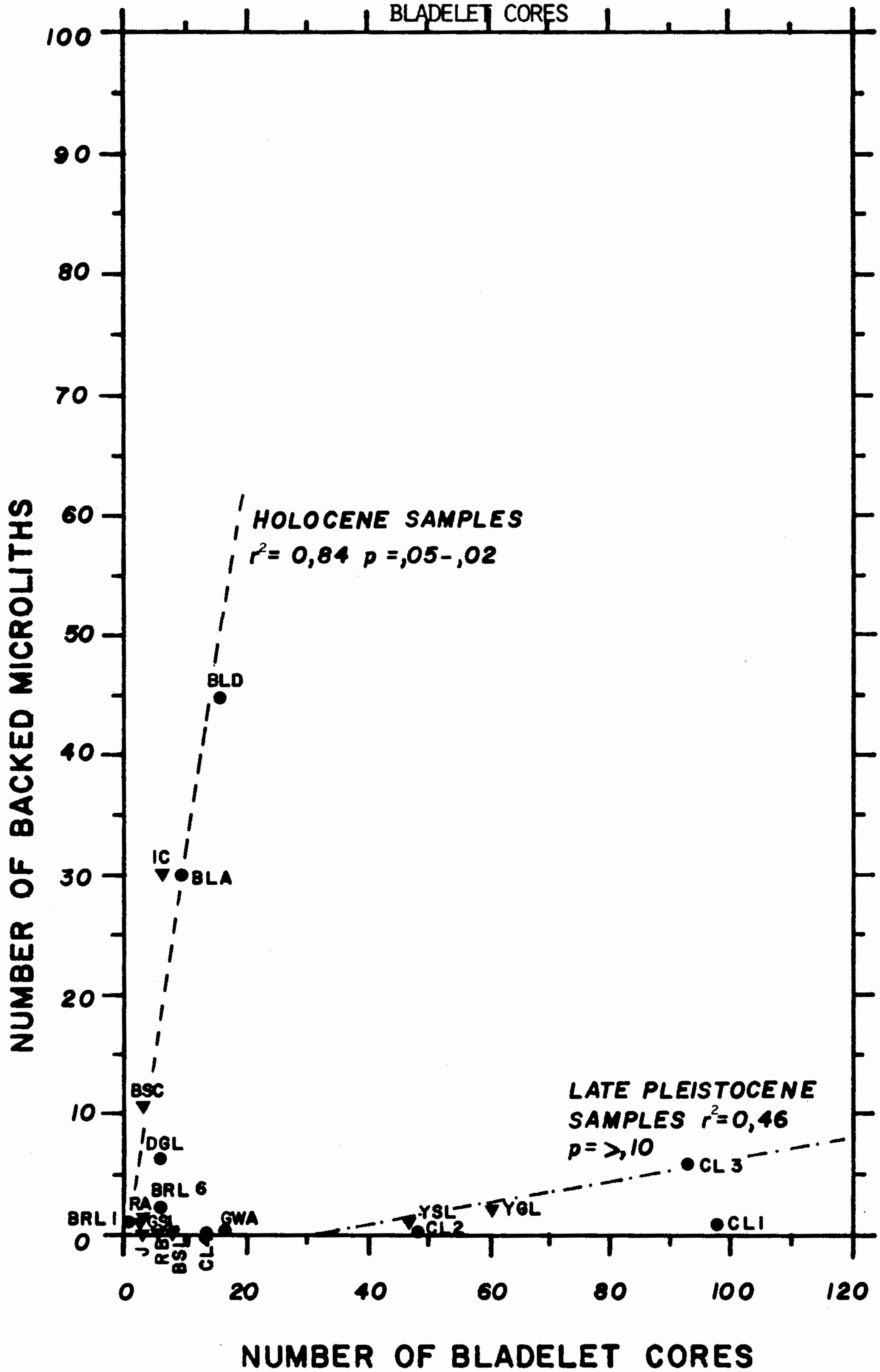
The relative frequency of formal tools in all the NBC units is low, ranging from 2,5% in IC to 0,04% in CS where there is only one formal tool, a quartzite scraper. IC is the only assemblage in which formal tools form more than 1% of the assemblage (Table 13). Scrapers, backed microliths and miscellaneous retouched pieces are found in the two lowest units, YGL and YSL, scrapers and miscellaneous retouched pieces occur in BSL through RB, and scrapers, backed microliths, borers, miscellaneous retouched pieces, bored stones and sinkers are found in the uppermost units, RA through IC. The bored stones are all broken portions and are too small to have been effective as digging stick weights. In the context of their association with sinkers and fish remains, they may have been used to weight nets, or they may have formed parts of traps (Goodwin 1947). Of interest is the fact that adzes are absent from the range of formal tools at NBC, fitting in with the observations made by Mazel & Parkington (1978, 1981) who note the absence or low frequency of adzes at coastal sites in the western Cape, and observations at inland sites generally which note a lower incidence of adzes in assemblages older than about 3500 B.P.

The low frequencies of formal tools other than scrapers do not allow us to draw firm conclusions about the range of activities undertaken at the site, although they do serve to link the technology with that at other contemporary sites. The most striking feature is the gross increase in formal tool frequencies at ca 6000 B.P. that persists at least through to ca 4000 B.P. (R R Inskeep, pers. comm.). This is not the result of a larger sample of excavated material in the upper units, as can be seen in Fig. 66 where the frequency of various artefacts per bucket of deposit has been calculated and plotted on three different scales to illustrate the similar patterning through time in these different variables. It demonstrates that while the frequency of utilized and total artefacts is similar through time, the incidence of formal tools is very low and increases only in the two uppermost units (IC and BSC) at ca 6000 B.P.

As illustrated in Figs 29 and 30, quartz was selected over quartzite for formal tools in the three uppermost units and in the lowest, YGL, but in all other assemblages quartzite formal tools predominate (Table 13) although there is no linear correlation between formal tools and the

FIG. 67

NBC AND BPA: SCATTER DIAGRAM SHOWING NO CORRELATION BETWEEN LATE PLEISTOCENE SAMPLES, BUT A WEAK LINEAR CORRELATION IN HOLOCENE SAMPLES BETWEEN THE NUMBER OF BACKED MICROLITHS AND BLADELET CORES



incidence of either raw material (Figs 37 and 38). There is thus no reason to suppose that quartz 'needs' retouch to be efficient, or that quartzite does not, but simply that hafted tools were retouched more often than unhafted ones.

Two variables that were shown in the analysis of the waste category to indicate changes in the methods of flaking, namely the relative frequency of bladelet cores and the metric attributes of untrimmed flakes, are summarized in Figs 67-69 to demonstrate that there is little or no correlation between them and the incidence of formal tools. In Fig. 46 a linear correlation was shown between the number of bladelets and the number of bladelet cores at NBC, but while the Holocene samples from both NBC and BPA showed some correlation, those from the late Pleistocene samples did not. A similar situation is present where the number of backed microliths is compared with the number of bladelet cores (Fig. 67). The Holocene samples again show some linear correlation and the late Pleistocene ones do not, but in this case there is no correlation amongst samples from the same site. The clustering is instead between Holocene, terminal Pleistocene/early Holocene and late Pleistocene samples. Thus, while the late Pleistocene flaking technique produced large numbers of bladelets, very few were retouched, while in the Holocene relatively few were produced and many more were retouched. This stresses the point made earlier that there is a different relationship between bladelet cores, bladelets and backed microliths in the late Pleistocene and Holocene samples.

In Figs 68 and 69 the relative thickness and mean length of untrimmed flakes are plotted against the incidence of formal tools. No linear correlation exists, but formal tools are more common in samples in which untrimmed flakes are at the lower end of the size range, and of medium to high relative thickness. This could be interpreted as indicating that the larger, thinner size range amongst the flakes was selected for formal retouch or utilization so that this size range is absent from the untrimmed flakes class, or is at least poorly represented, but the diagrams show that there are as many samples with the smaller thicker size range that have very few formal tools as there are with many formal tools so that such a generalization has no predictive value.

FIG. 68

NBC AND BPA: SCATTER DIAGRAM SHOWING NO CORRELATION BETWEEN THE MEAN REL T FOR UNTRIMMED FLAKES AND THE PERCENTAGE OF FORMAL TOOLS

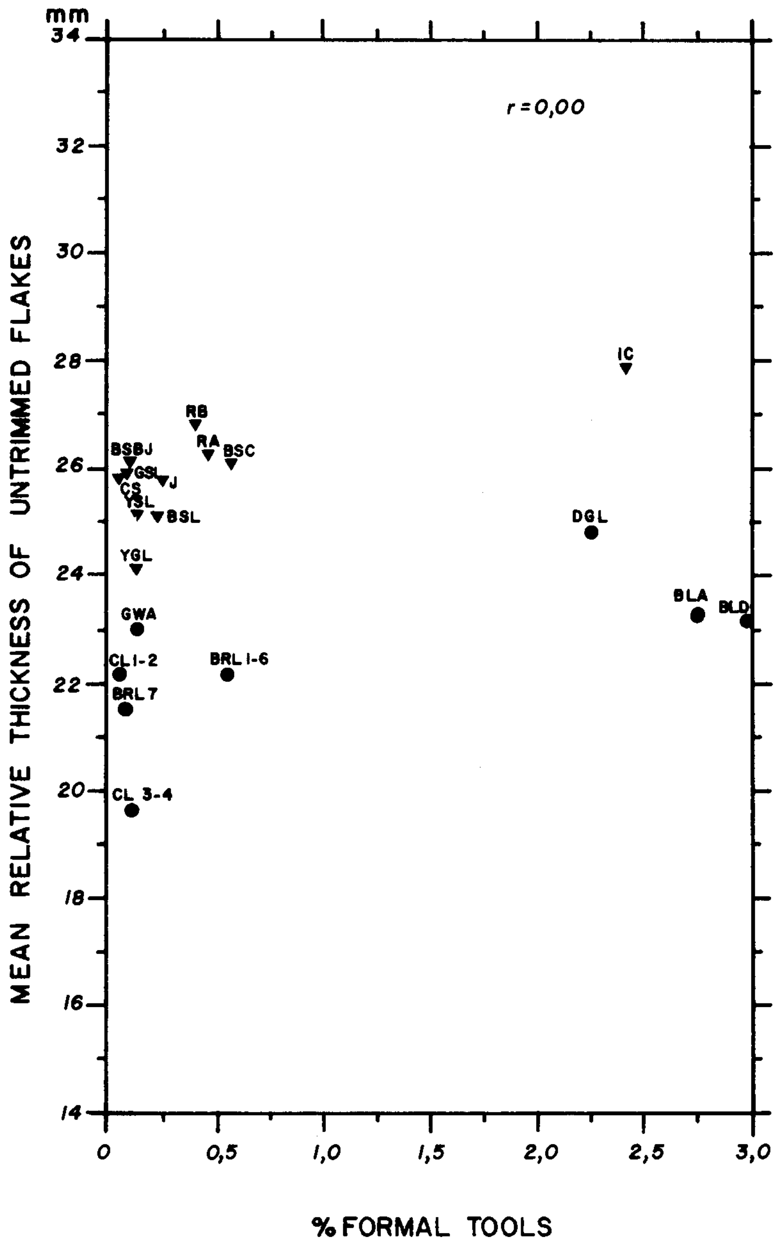
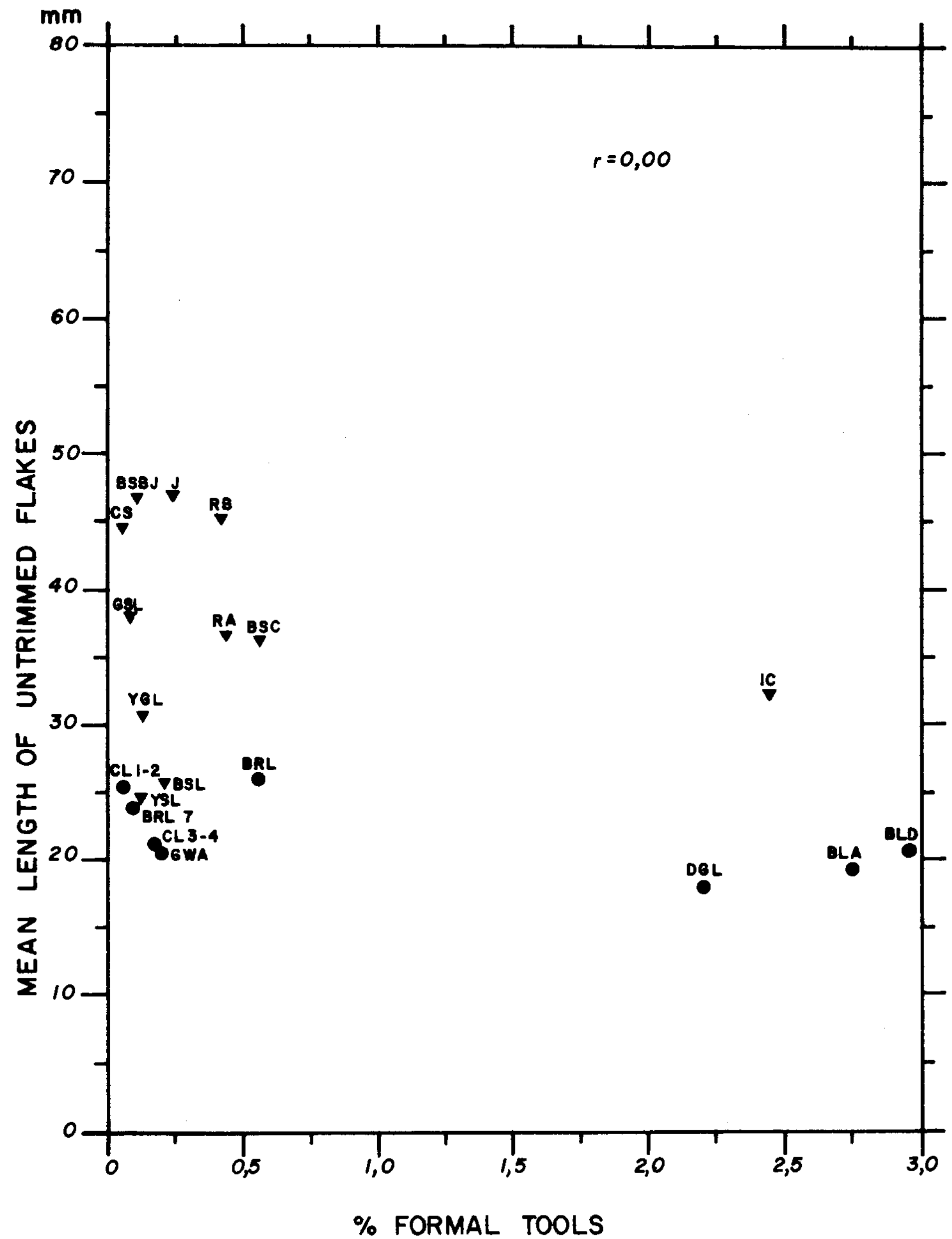


FIG. 69

NBC AND BPA: SCATTER DIAGRAM SHOWING NO CORRELATION BETWEEN THE MEAN LENGTH OF UNTRIMMED FLAKES AND THE PERCENTAGE OF FORMAL TOOLS



Metric attributes. The attributes measured for formal tools are defined in Appendix 2. Continuous variables were analyzed and descriptive statistics for scrapers are summarized in Tables 36-41 and Figs 70-76. From these data it can be seen that there are distinct shifts in scraper parameters through time, the most obvious being that in length as summarized below:

Approximate date B.P.	Stratigraphic unit	Mean length (mm)	Sample size
4800	IC	9,57	120
5800	BSC upper	12,12	33
6000	BSC lower	16,27	33
7000	RA	21,75	16
8000	RB	41,64	28
9000	J	46,78	9
10 250 - 12 000	BSBJ-GSL	59,25	8
12 000 - 18 700	BSL-YGL	18,44	9

The frequency distributions in Fig 72 show that there is a bi-modal length distribution indicating that scrapers longer than 25 mm form a different sub-class from those that are shorter. There is a constant presence of short scrapers in all the assemblages and the shift in mean length is coincident with the high or low frequency of larger scrapers, rather than with a change in the modal length of small scrapers which shifts only slightly. The large scrapers which markedly increase the mean length of samples dating between about 12 000 and 8000 B.P. are not only longer than those which precede and succeed them, but they are also wider, more elongated and are more commonly made in quartzite. Retouch is most common at the end of the piece, but in samples dating between about 9000 and 8000 B.P., retouch also occurs down the sides or the piece has naturally steep sides. Some of the side retouch is adze-like. In the late Pleistocene samples the gross difference between the small scrapers and the large one is particularly striking. The large scraper in this sample is the widest of all scrapers at the site and is typical of the D-shaped Smithfield A type described by Van Riet Lowe in 1929. The mid-Holocene scraper sample from IC and upper BSC is characterized by particularly small specimens with a remarkably standardized form (low variance) and limited range that is clear in

FIG. 70

NBC: LENGTH AND WIDTH OF SCRAPERS — MEAN, RANGE AND STANDARD DEVIATION

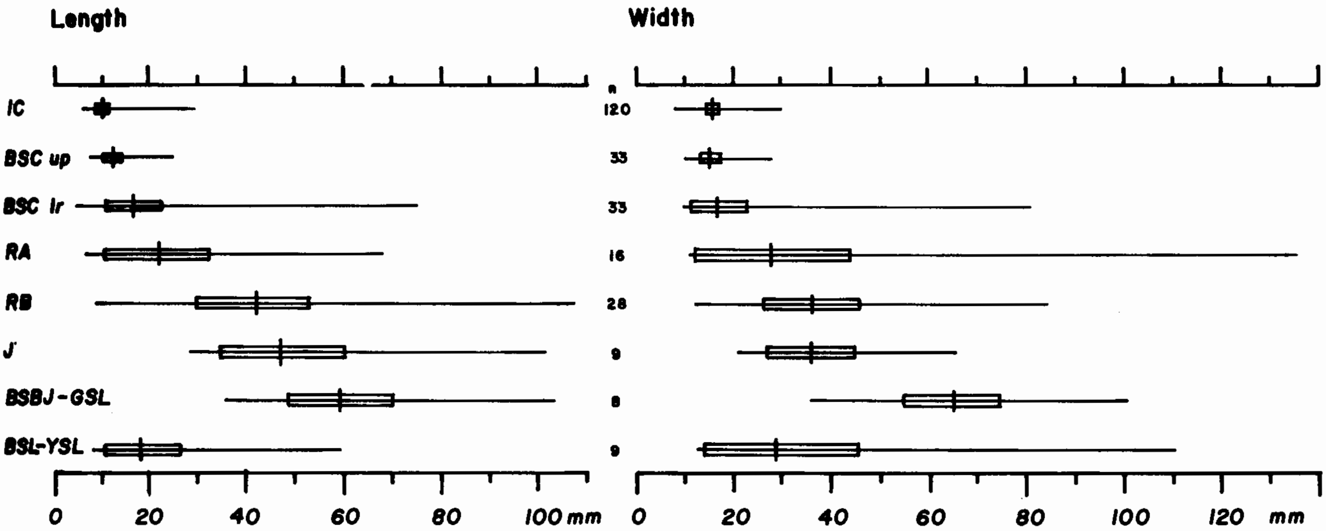


FIG. 71

NBC : W/L RATIO AND HEIGHT OF SCRAPERS - MEAN, RANGE AND STANDARD DEVIATION

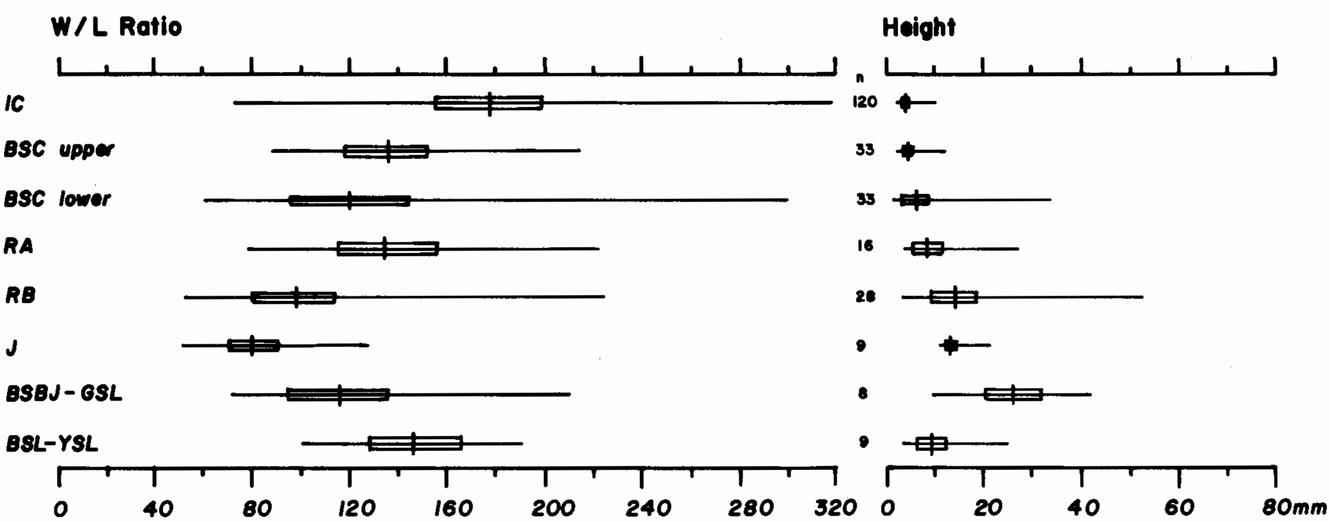


FIG. 72

NBC: FREQUENCY DISTRIBUTION OF SCRAPER LENGTHS

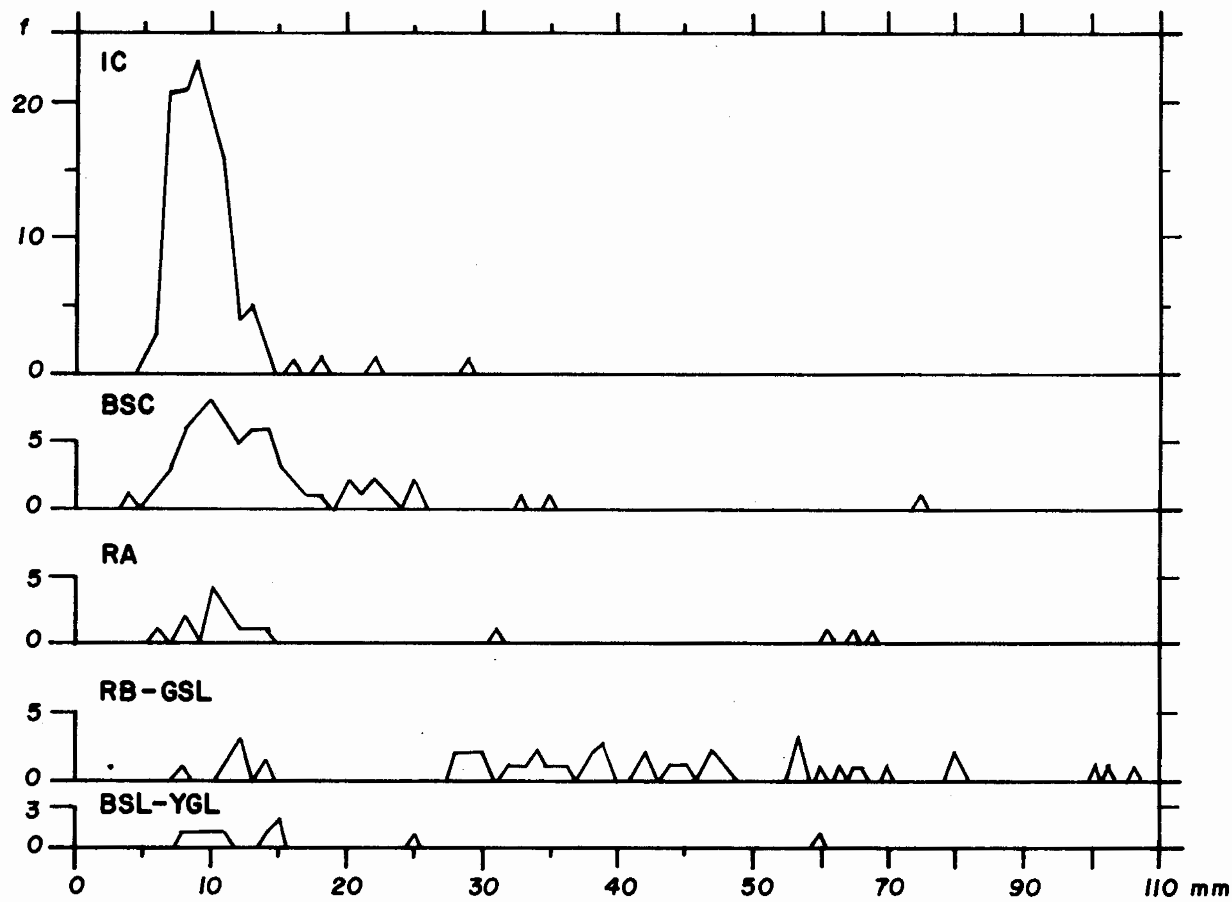


FIG. 73

NBC: FREQUENCY DISTRIBUTION OF SCRAPER WIDTHS

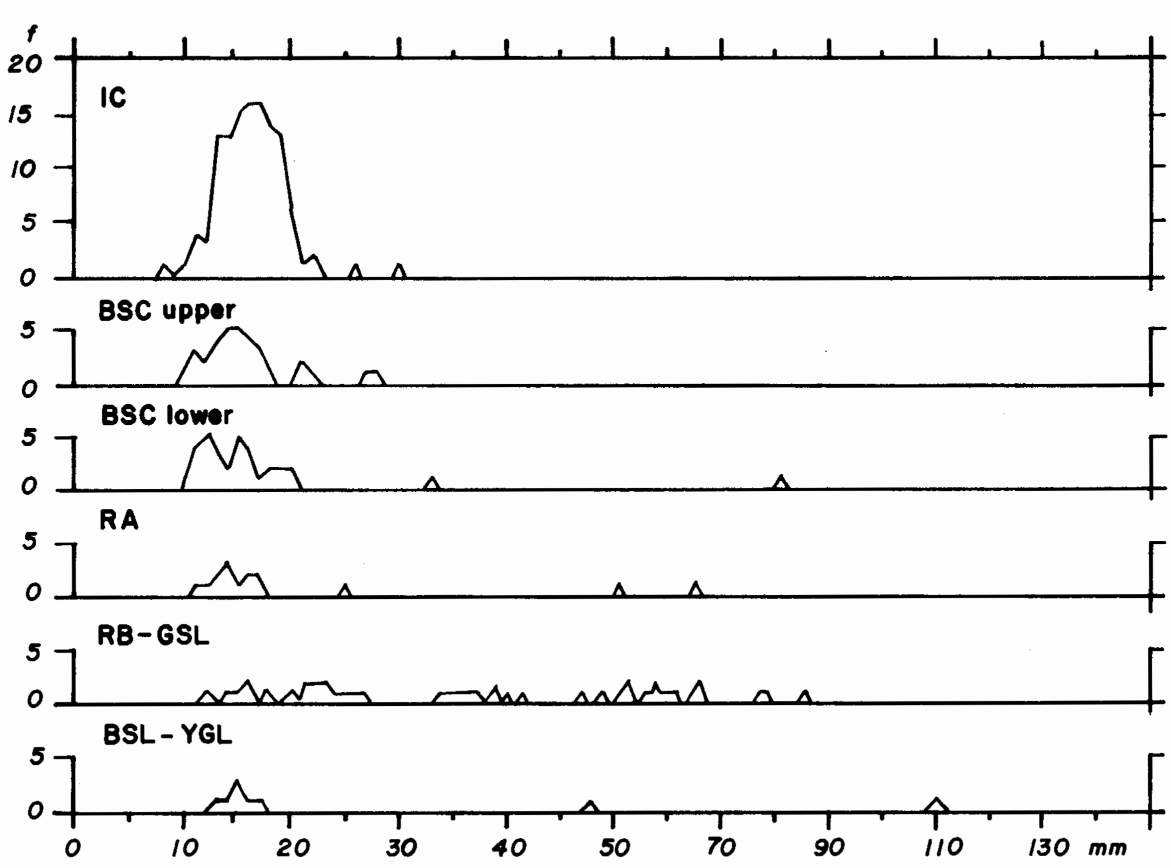


FIG. 74

NBC : FREQUENCY DISTRIBUTION OF SCRAPER HEIGHTS

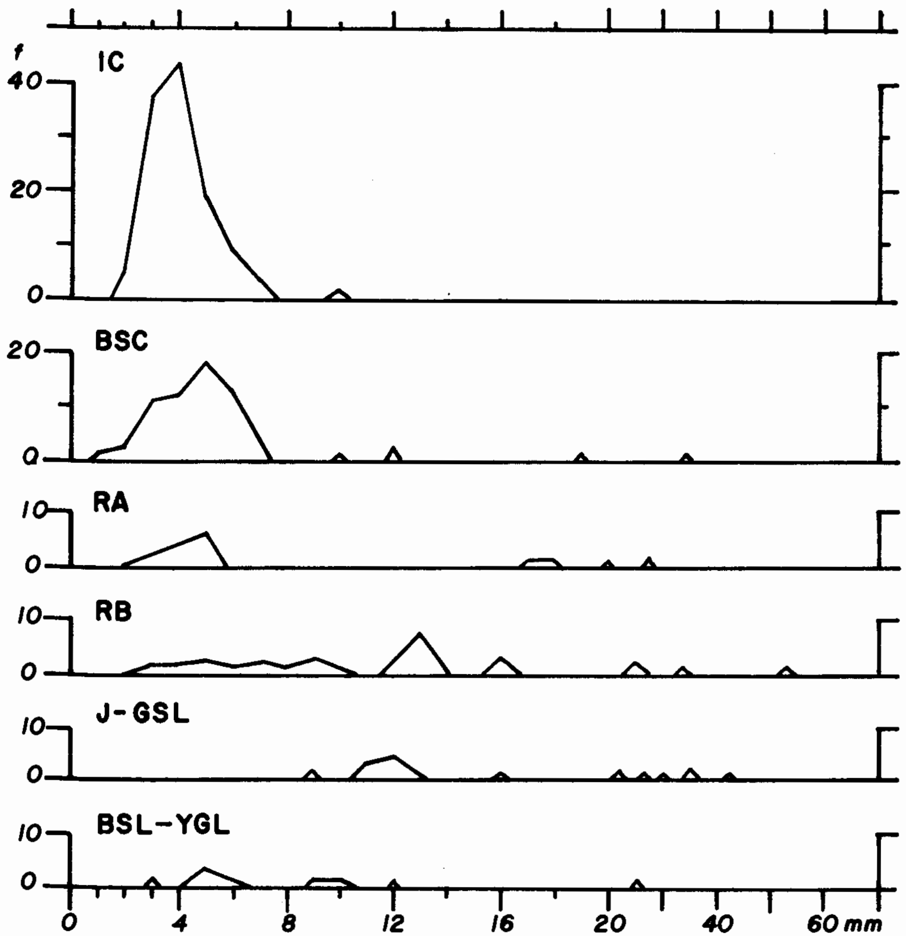
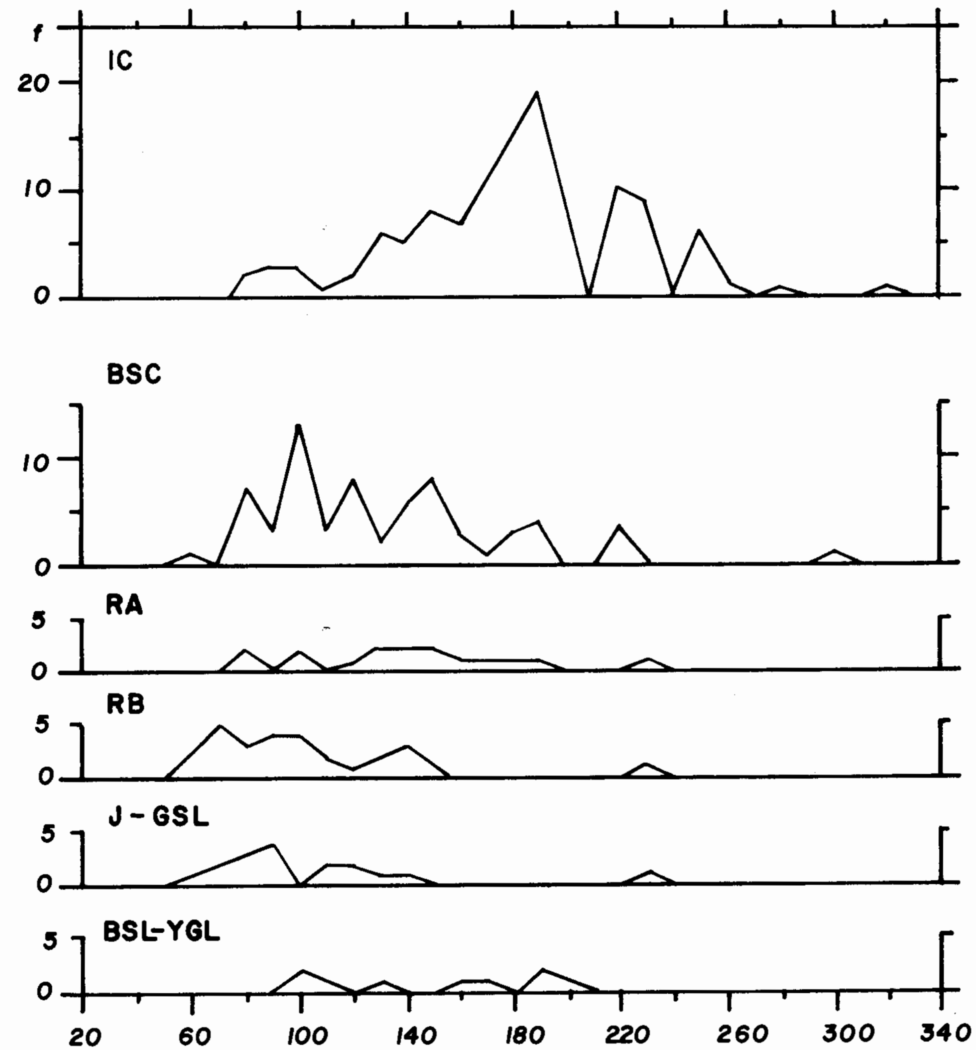


FIG. 75

NBC : FREQUENCY DISTRIBUTION OF SCRAPER W/L RATIOS



Figs 70 to 75. In the width/length ratio frequency distributions, however, the range is somewhat greater with an emphasis on short wide forms with a w/l ratio of around 2:1. The wider range of shapes is also clear in Fig.75 which summarizes the percentage frequencies in various plan form sub-classes, and in the position of retouch sub-classes the dominance of the short wide scraper (class 9) is particularly evident (Fig.76).

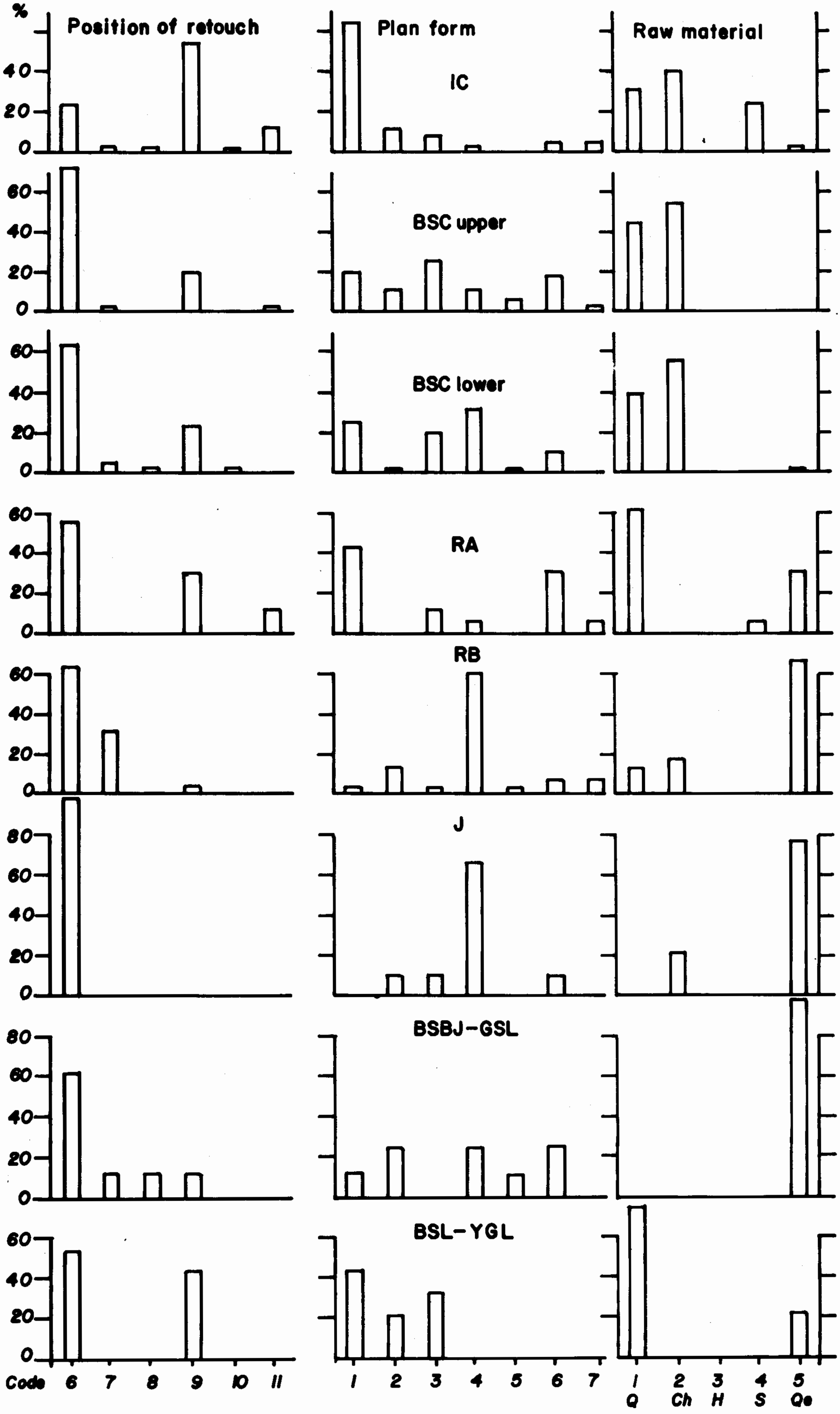
The continuous variables in each sample were compared against every other sample using the Mann-Whitney and Kolmogorov-Smirnov non-parametric tests (Siegel 1956; Deacon, J. 1969, 1972) and the results are summarized in the matrices in Tables 42-49. They show that the samples with relatively large numbers of large scrapers (RB-GSL) are significantly different in all respects from all other samples at the site. The late Pleistocene samples from BSL, YSL and YGL show some similarities with IC at the top of the sequence and are similar in all respects to BSC and RA which are in turn not significantly different from each other. Here again it is the 'mix' of large and small scrapers which accounts for these similarities. In the data summarized below, the number of times that two samples have been found to be not significantly different from each other (p=.05) in the two tests on length, width, height and w/l ratio is given. Zero values indicate that samples are significantly different at p.05 on all tests, while the maximum possible score is 8 signifying no significant difference in all eight tests.

	IC	BSC	RA	RB-GSL	BSL-YGL
IC					
BSC	1				
RA	3	8			
RB-GSL	0	0	0		
BSL-YGL	4	8	8	0	

The results of the metric analyses of scrapers show an increasingly standardized form through time with the lowest range and variance in IC. The high w/l ratio reflects the fact that many small scrapers have

FIG. 76

NBC: FREQUENCY DISTRIBUTION OF SCRAPER RETOUCH POSITION, PLAN FORM AND RAW MATERIAL CLASSES



been retouched back as far as possible before being discarded. This shift towards narrow limits for manufacture and discard occurred within BSC because the upper units in this sample lack the larger scrapers present in the lower units. It can therefore be dated to between about 6000 and 5800 B.P. at NBC.

The metric attributes for backed microliths are summarized in Table 50. They show that the frequencies are too low to make inter-sample comparisons significant, but here as at other sites in the southern and eastern Cape, the smallest segments are found in the older Holocene samples (ca 6000 B.P.). The size range of the late Pleistocene backed microliths is at the upper end of the Holocene sample and of interest is the find of a large segment similar to one found in the late Holocene units at BPA (compare Fig.116:11 with Fig.121:1).

Kangkara

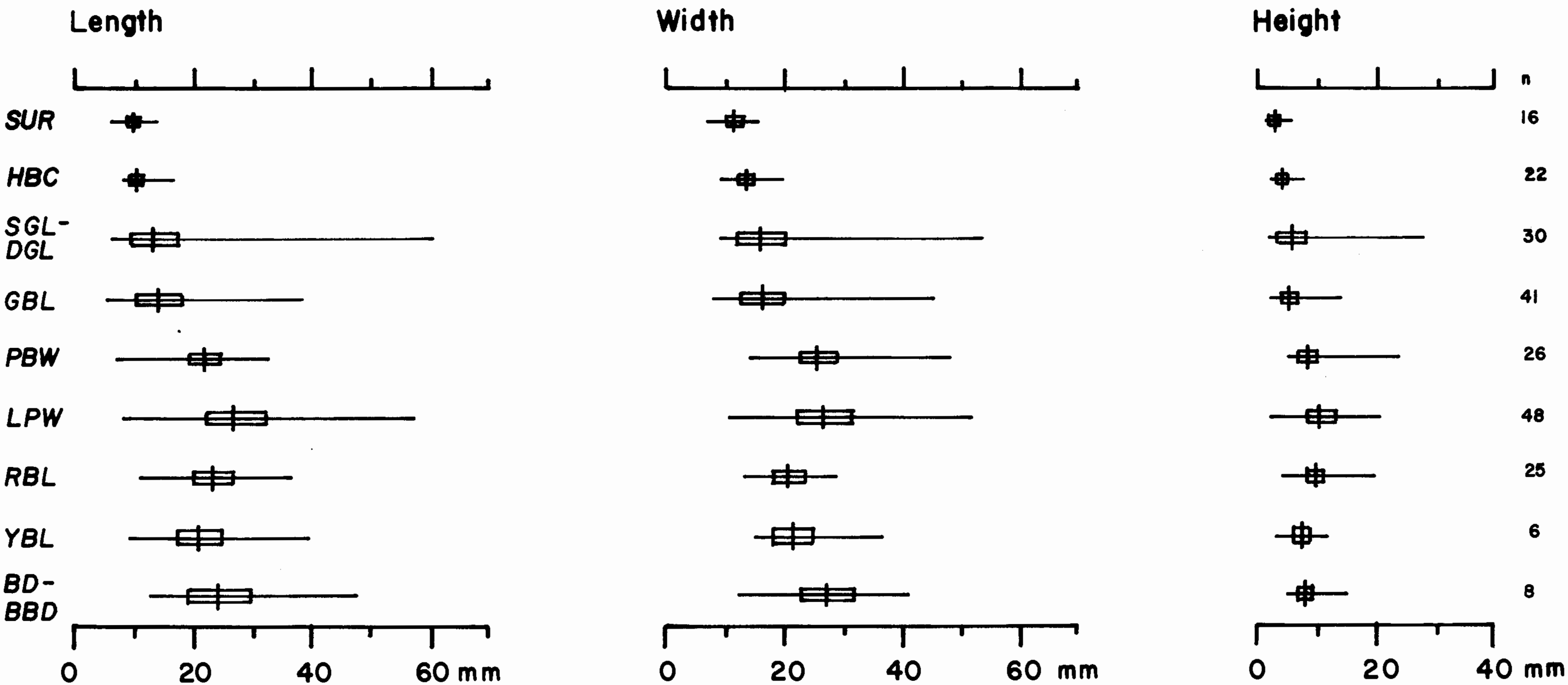
Frequency distributions. The numbers and percentage frequencies of formal tools at Kangkara are summarized in Table 16. The relative proportion of formal tools is high, ranging from 4% at the top of the sequence to 0,13% in the second lowest unit. In seven out of the eleven units, formal tools account for more than 2% of the total assemblage. This is notable in view of the fact that the sample is drawn from a single m^2 suggesting that on the whole formal tools may be more common here than at either NBC or BPA. The general trend towards an increase in formal tool frequency in the mid-Holocene is present here as at the other sites.

As is clear in Figs 31-33, quartz was selected for formal tools in the units post-dating 7000 B.P., while silcrete was favoured in the units dating between 12 000 and 7000 B.P.

The formal tool category at Kangkara is dominated by scrapers which account for between 70% and 100% of all formal tools, being most prominent percentage-wise in the samples dating between 9000 and 7330 B.P. In the older units dating between 12 000 and 9260 B.P. the formal tool numbers are low and the relative importance, but not frequency, of miscellaneous retouched pieces is consequently higher than is usual for the site. In the more recent units post-dating 7000 B.P., backed microliths and a small number of adzes and borers are added to the formal tool category. No backed microliths were found in the older samples

FIG. 77

KANGKARA: SCRAPER DIMENSIONS — MEAN, RANGE AND STANDARD DEVIATION



although bladelets and bladelet cores occurred in BBD. In the samples dating between 6600 and 5000 B.P. segments are the most common sub-class amongst the backed microliths and backed bladelets were found in the uppermost SUR and DGL units only.

Metric attributes. The attributes measured for scrapers were the same as those for NBC and are detailed in Appendix 2. The data are summarized in Tables 51-56 and Figs 77-83 and again show a distinct change in scraper length through time as summarized below:

Approximate dating B.P.	Stratigraphic unit	Mean length (mm)	Sample size
4500	SUR	9,9	16
5355	HBC	10,6	22
6000	SGL/DGL	13,5	30
6600	GBL	14,3	41
7330	PBW	21,8	26
8000	LPW	27,1	48
8500	RBL	23,2	25
9260	YBL	21,3	6
11-12 000	BD/BBD	24,38	8

When the frequency distributions in Figs 79-82 are compared with those from NBC there is less of a bi-modal distribution in the lengths of Kangkara scrapers, but it is nevertheless clear that the incidence of scrapers longer than 25 mm is much lower in post-7000 B.P. samples than in the older ones. The incidence of smaller scrapers is not as consistent in the lower units at Kangkara, however. Whether this is the result of sampling at Kangkara, or whether it reflects the size distribution of the site as a whole would need to be tested with further excavated samples. As at NBC it is the samples post-dating 6000 B.P. that have the smallest range in length, width and height with a low variance (Tables 51-54), but a relatively wide range in the scraper shapes as evident from the w/l ratios.

The results of the Mann-Whitney and Kolmogorov-Smirnov non-parametric tests are given in the matrices in Tables 42-49 and are summarized below with the number of times two samples are shown to be not

FIG. 78

KANGKARA: W/L RATIO OF SCRAPERS – MEAN, RANGE AND STANDARD DEVIATION

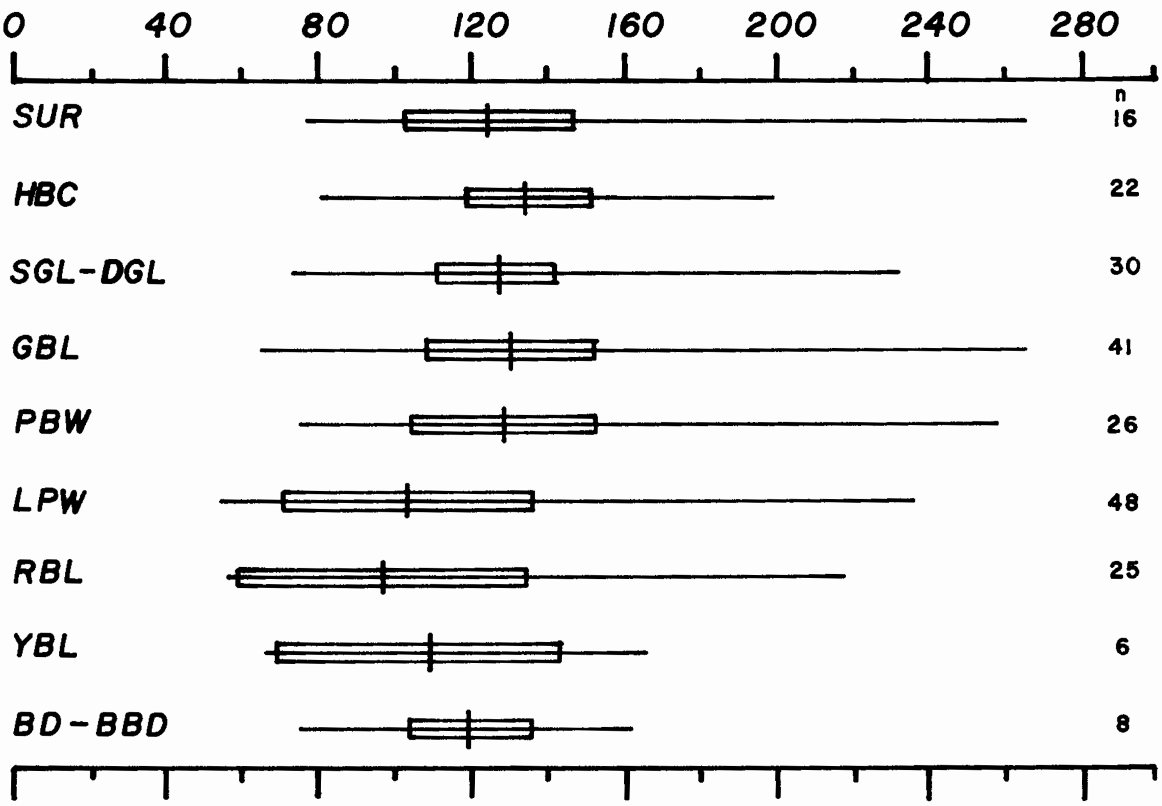


FIG. 79

KANGKARA : FREQUENCY DISTRIBUTION OF SCRAPER LENGTHS

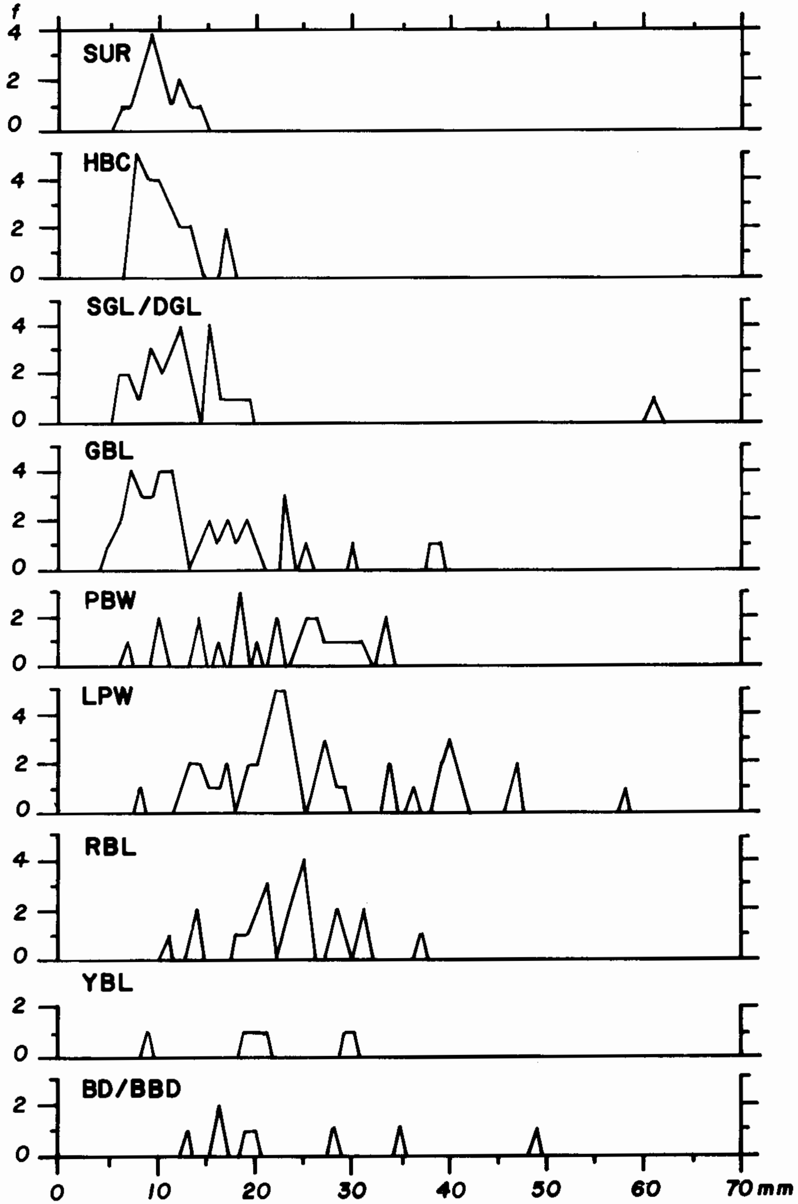


FIG. 80

KANGKARA : FREQUENCY DISTRIBUTION OF SCRAPER WIDTHS

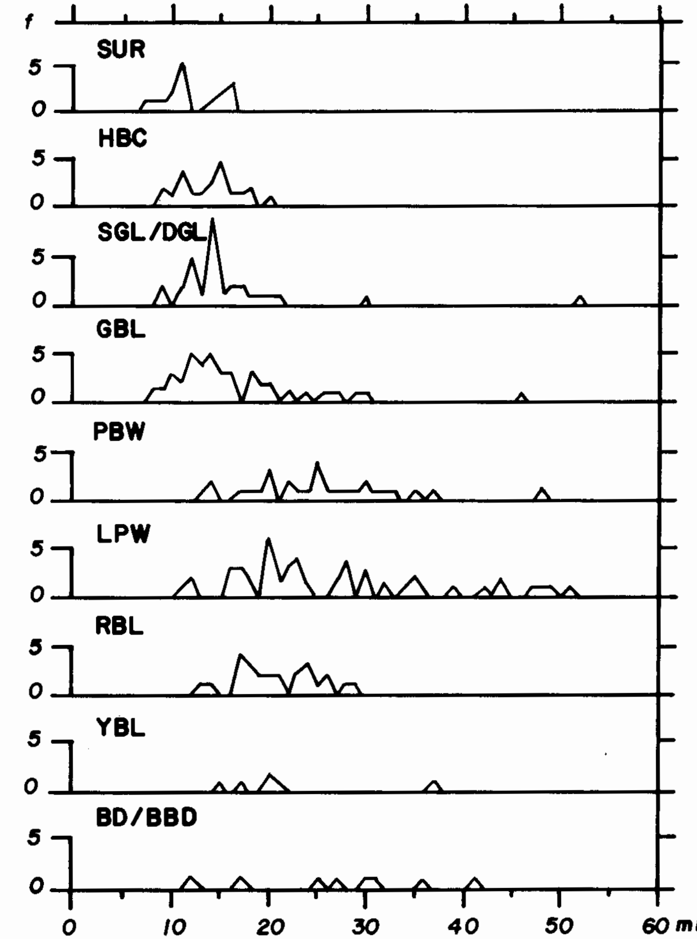


FIG. 81

KANGKARA: FREQUENCY DISTRIBUTION OF SCRAPER HEIGHTS

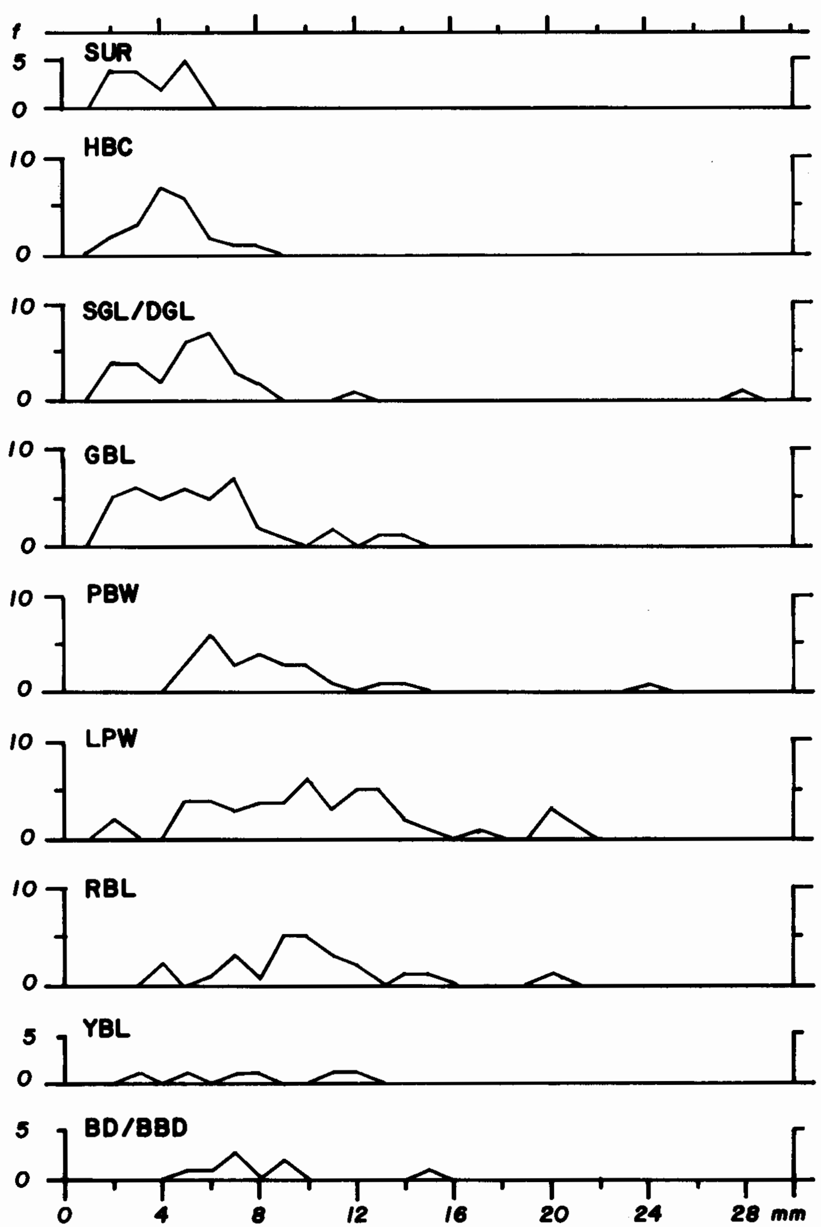


FIG. 82

KANGKARA: FREQUENCY DISTRIBUTION OF SCRAPER W/L RATIOS

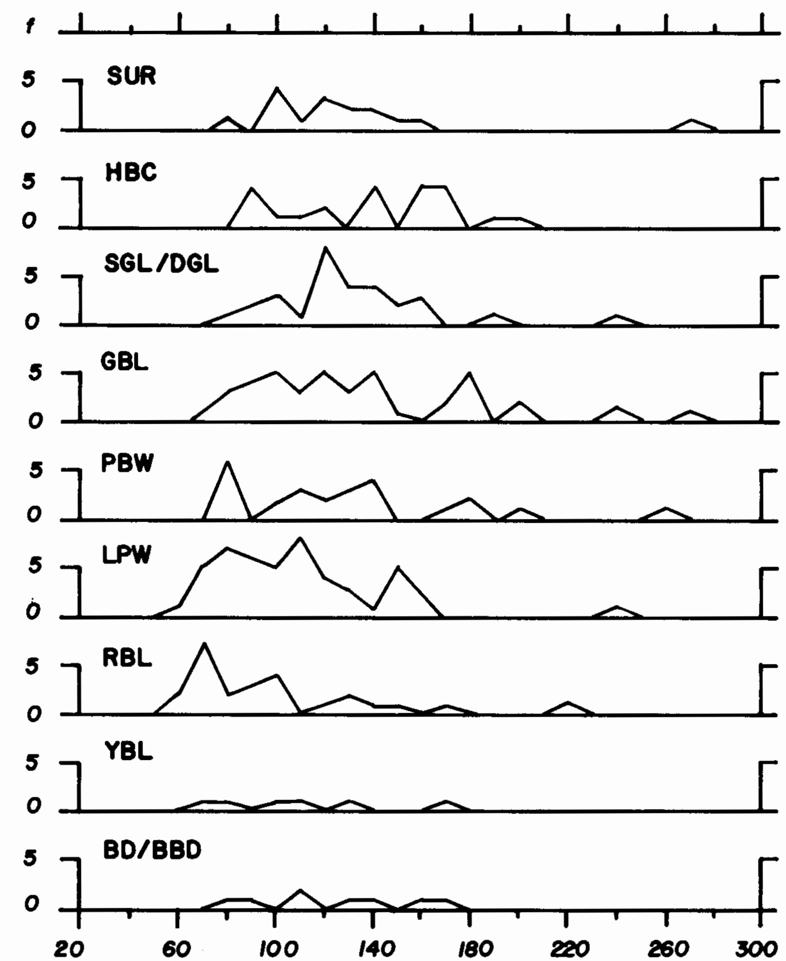
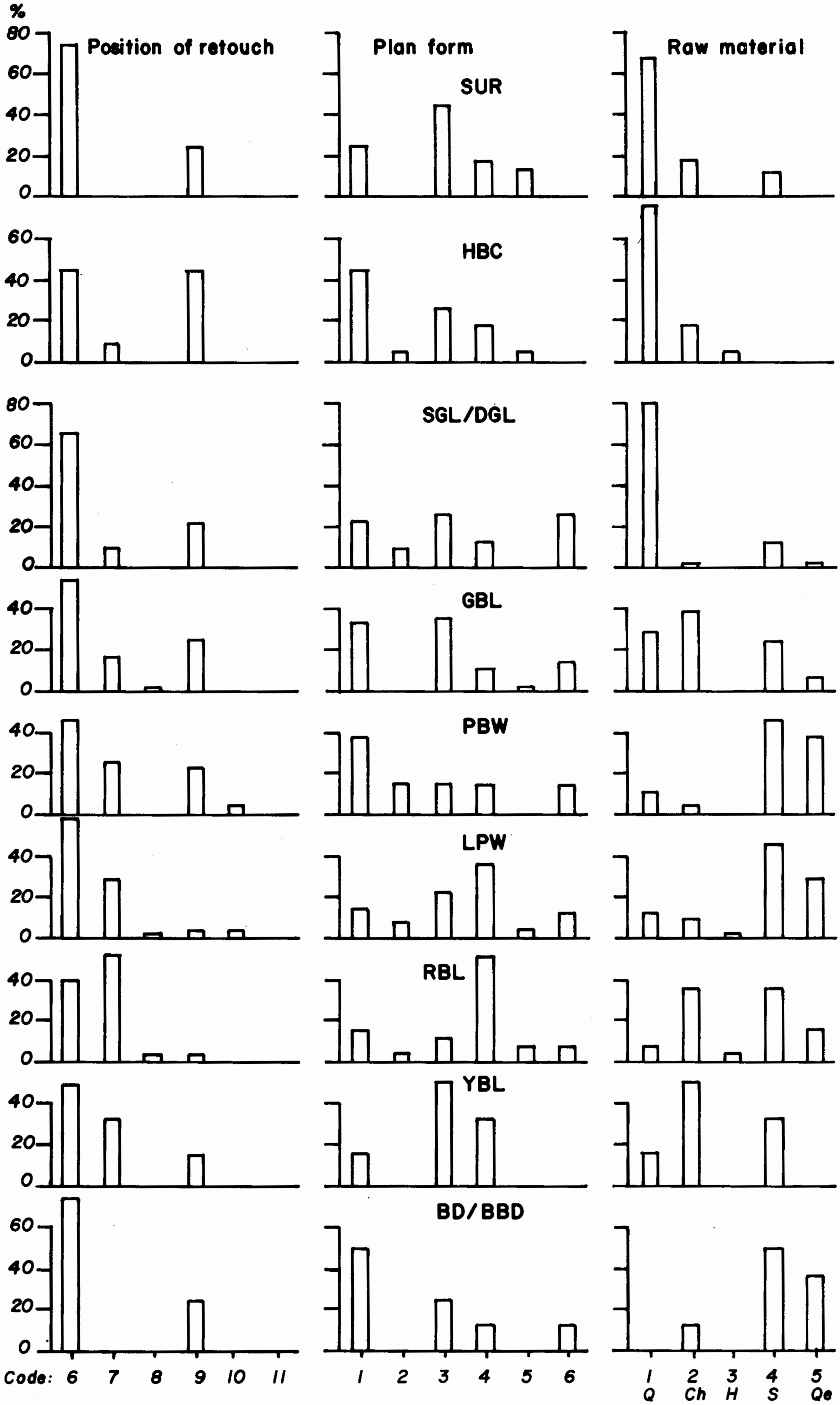


FIG. 83

KANGKARA: FREQUENCY DISTRIBUTION OF SCRAPER RETOUCH POSITION, PLAN FORM AND RAW MATERIAL CLASSES



significantly different at p.05.

	SUR	HBC/ GBL	PBW/ RBL	YBL/ BBD
SUR				
HBC/ GBL	5			
PBW/ RBL	2	0		
YBL/ BBD	2	2	8	

What these results suggest is a significant break between GBL and PBW with the upper samples forming one group and the lower samples another. The relatively low comparative score between SUR and HBC/GBL reflects the absence of large scrapers in SUR and the smaller size and variance of this sample that is similar in many respects to that from IC at NBC.

The small size of the sample of backed microliths at Kangkara made it impractical to measure the artefacts, but the size range of the segments is similar to that from the other two sites.

Boomplaas

Frequency distributions. The percentage frequency of formal tools at BPA is intermediate between that at NBC and Kangkara with a range from 3% in BLD to 0,07 in CL 1 (Table 19). Five out of fifteen units have more than 1% formal tools. There is a marked difference between samples older and younger than 9000 B.P., but the accurate dating of this shift is not possible because of the absence of deposits dating between 9100 and 6400 B.P. at the site. The range of formal tools through time is similar to that at NBC and Kangkara. As can be seen in Table 19, scrapers are the most common formal tools and backed microliths occur in both late Pleistocene and mid-late Holocene assemblages. Unlike NBC, however, adzes are found throughout the sequence and borers occur in both the Holocene and late Pleistocene assemblages.

Figs 34-36 have shown that quartz is the most common raw material in all assemblages, but that hornfels and chalcedony were selected for formal tools in disproportion to their total incidence in the BRL and CL members respectively. As was demonstrated in Fig. 67 for NBC, the BPA samples also show no correlation between the incidence of bladelet cores and the incidence of backed microliths and the use of standardized bladelet and flat bladelet cores to produce bladelets is therefore not correlated with the occurrence of backed microliths.

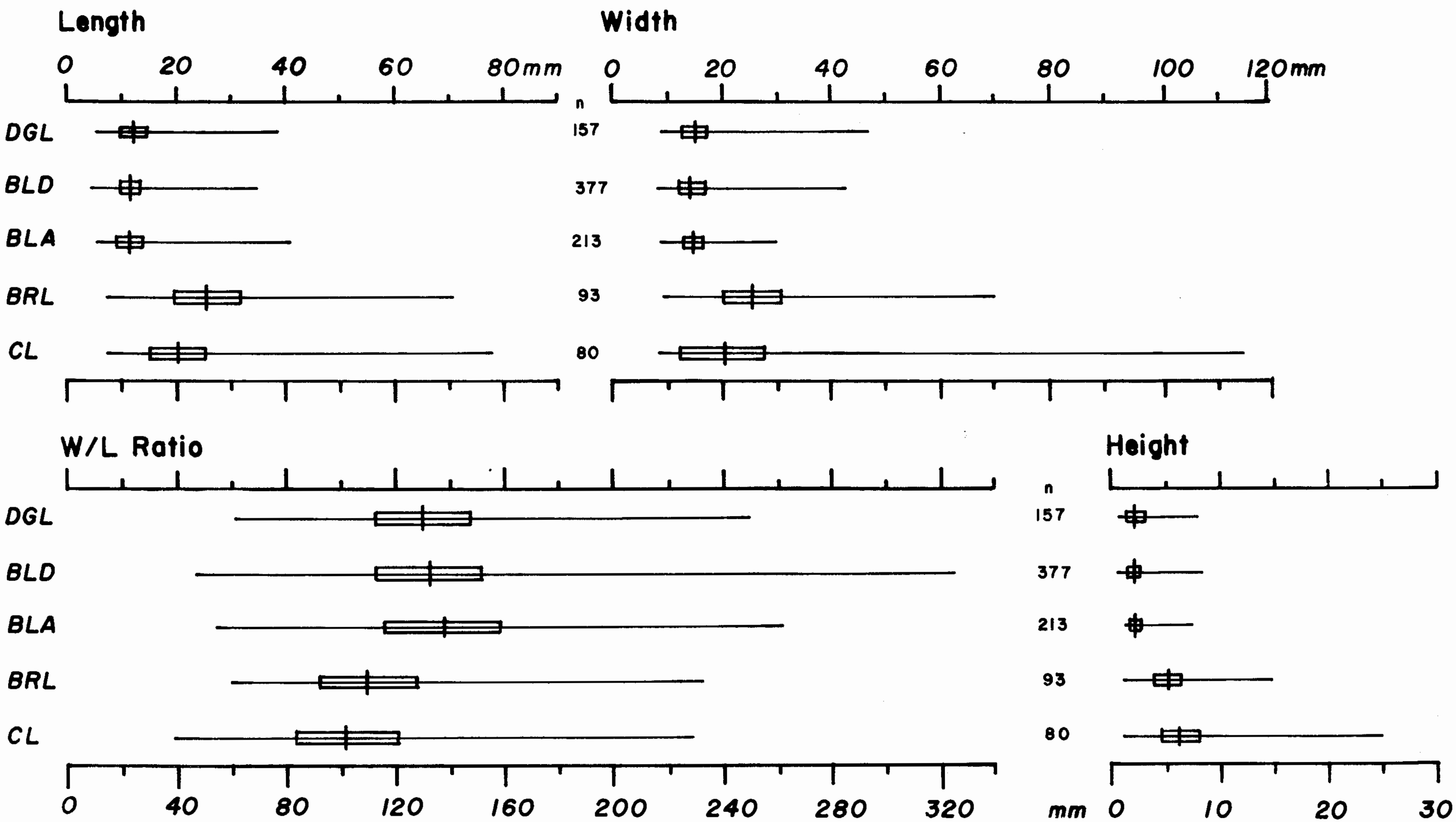
Figs 68 and 69 show that high formal tool frequencies at BPA occur in samples with relatively short and thick untrimmed flakes. It is interesting to note that the MSA units at Border Cave (Beaumont 1978) showed quite the opposite: a correlation between thinner flakes and high formal tool frequencies, stressing again that the flaking method as evident from core sub-types and untrimmed flake dimensions has no predictive value in estimating the relative frequency of formal tools in an assemblage.

With the exception of three units in which formal tool frequencies are low overall (BRL 6, BRL 7 and CL 4), scrapers account for between 61% and 100% of all formal tools, being on the whole more prominent in the BRL Member where other formal tools are rare. Relative frequency and absolute frequency of scrapers do not always coincide, however, for scrapers are found in large numbers only in the mid-late Holocene assemblages.

Backed microliths account for between 0 and 12,5% of all formal tools except in BRL 6 where one broken backed piece and one segment in a sample of only nine formal tools account for 22,2% of the formal tools. Backed microliths are otherwise most common in the mid-Holocene BLA unit and are relatively well represented in the late Pleistocene CL 3 unit (8.2%). This is the largest sample of backed microliths from a late Pleistocene assemblage in South Africa. There are more segments (five) than backed bladelets (two) and one backed bladelet from CL 1 is of particular interest because the edge opposite to the backed one has been retouched with six deliberate denticulations along its 11 mm length (Fig.132:1). As the illustrations in Fig.132 show, these late Pleistocene backed microliths are similar in design to the Holocene ones (Figs 121,126), but are less geometric in plan form and the segments have rounded rather than sharp tips where the chord meets the arc. Their small size, in particular that of the denticulated piece, suggests that they were probably hafted but the designs do not seem well suited for

FIG. 84

BPA: SCRAPER DIMENSIONS - MEAN, RANGE AND STANDARD DEVIATION



arrowhead inserts.

The continuity between the late Pleistocene and Holocene formal tool designs is seen in the finds of two borers in BRL 7 (Fig.132:8,9) and in adzes, scrapers and backed tools. Adzes are far more common generally at BPA than they are at Kangkara or NBC (where they are entirely absent). They are particularly common in the uppermost units at BPA where they date within the last 2000 years. Late Pleistocene specimens are of interest in that they include two very large adzes made on slab-like pieces of hornfels and quartzite(Fig.132:14, 15); similar pieces are not found in the more recent units. In other examples, however, the design features of late Pleistocene adzes are essentially similar to those of the Holocene (Figs 122,126,132). Adzes range from 4,88% to 18,48% of formal tools through the BPA sequence (Table 19) and their distribution pattern through time is similar to that of scrapers with small numbers in the lower units and much larger numbers in the mid- and late Holocene.

Miscellaneous retouched pieces are present in small numbers in all members, but are not always present in individual units within members. In the member totals they range from 1,75% of all formal tools in BLA to 7,3% in CL. This constant but low incidence does not follow the same pattern as the more formal retouched pieces, presumably because they were the result of a range of relatively casual behaviour rather than representing specialized and highly standardized tools for specific purposes. Their incidence therefore corresponds more closely to that of utilized pieces than formal tools.

Metric attributes. The metric data for scrapers are summarized in Table 57 and in Figs 84-89. The changes in scraper length are summarized below to demonstrate the similarity in the timing of changes to the NBC and KRA samples.

Approximate date B.P.	Stratigraphic member	Mean length (mm)	Sample size
1700	DGL	12,41	157
2000	BLD	11,81	377
6400	BLA	11,54	213
9100 - 10 425	BRL	25,83	93
12 000 - 14 200	CL	20,21	80

FIG. 85

BPA: FREQUENCY DISTRIBUTION OF SCRAPER LENGTHS

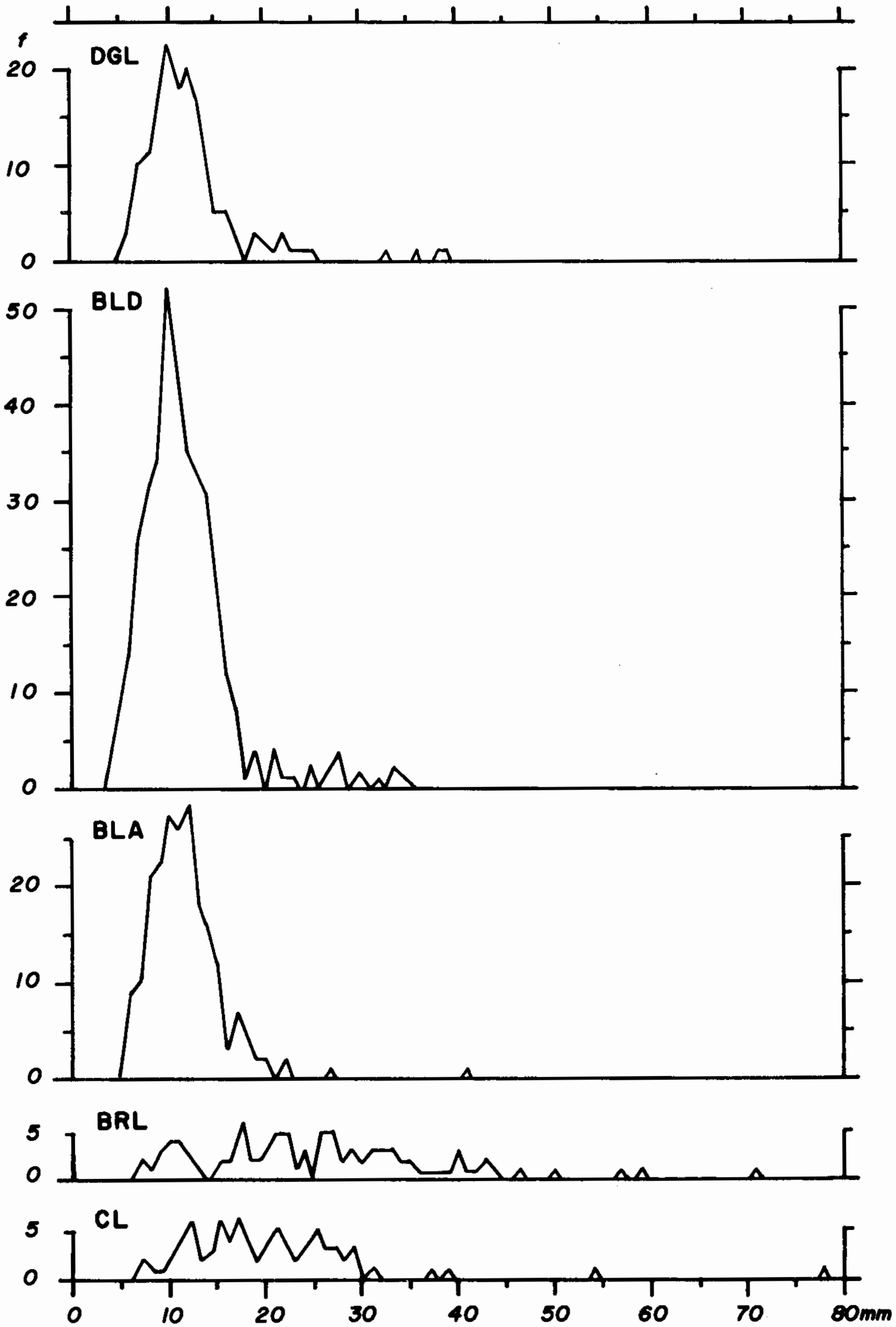
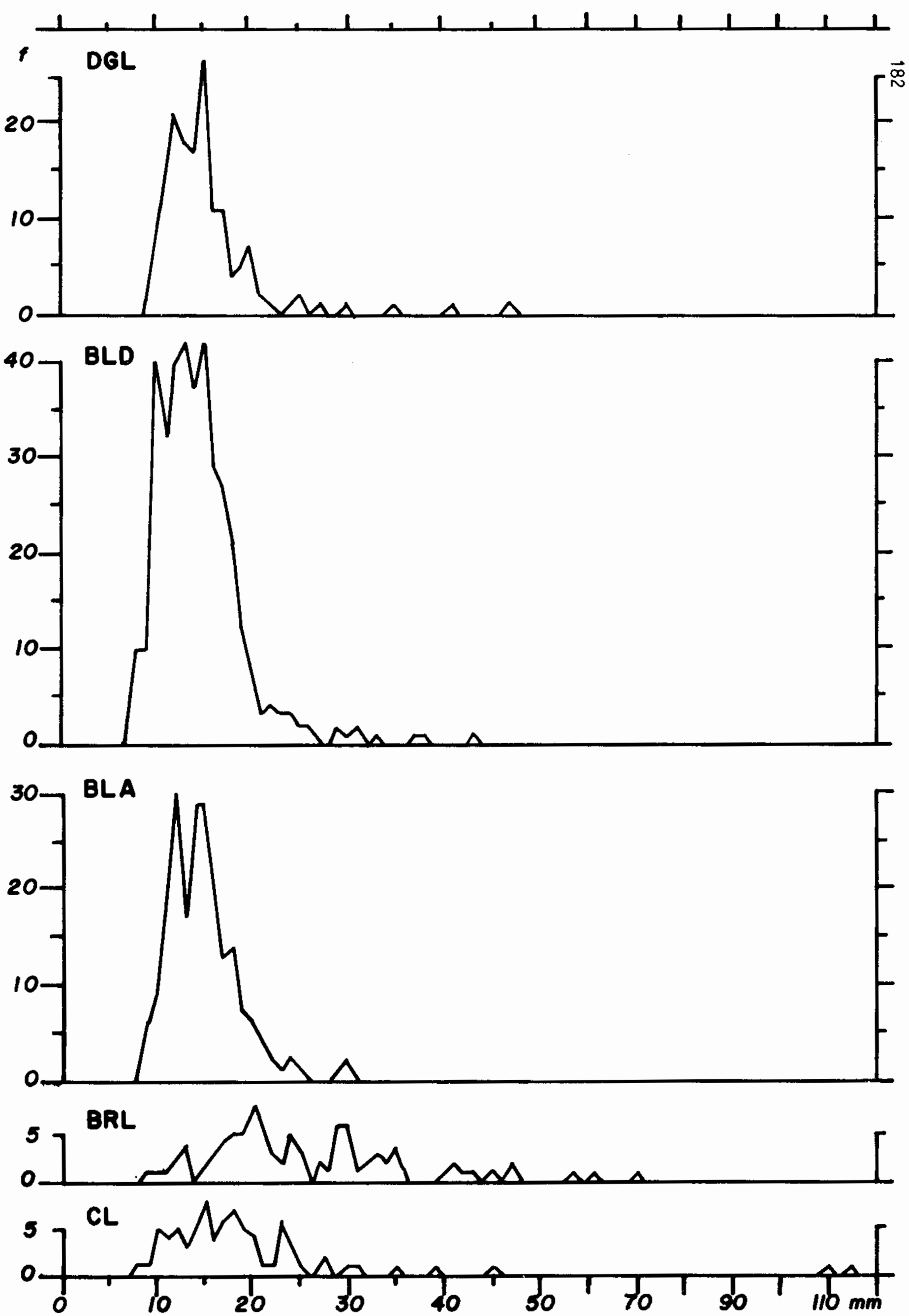


FIG. 86

BPA: FREQUENCY DISTRIBUTION OF SCRAPER WIDTHS



The length distribution in Fig. 85 demonstrates a less clearly bi-modal curve than was apparent at NBC but, as at Kangkara, there is nevertheless a distinction between samples with significant numbers of scrapers longer than 25 mm and those without. As at other sites, it is the early Holocene sample (BRL) that has the largest mean for width, length and height and the most elongated shapes as evident from the relatively small range and low values for w/l ratio and the plan form distribution (Figs 88 and 89). There is a larger percentage of hornfels scrapers in this sample than in any other from the site, although quartz still predominates. The incidence of small scrapers through the sequence is still marked, but it is interesting to note that even when the sample size is increased in CL over the late Pleistocene samples from NBC, the variance is still high indicating that the wide range and variability in these late Pleistocene scrapers is a feature of the samples from this time period and is not the result of small sample size only. The large samples from the mid-late Holocene are, as at the other two sites,highly standardized with low variances and only a small percentage of the total exceeding 25 mm in length and width or 8 mm in height. The w/l ratio again shows a higher incidence of short wide forms in these upper units.

The range of scraper sub-classes noted at NBC in YGL and YSL is also present at CL in the late Pleistocene samples. The Smithfield A-type concavo-convex D-shaped scraper is represented by two specimens from CL, both in quartzite (Fig.134). More numerous at BPA, however, are single platform bladelet cores that have been clearly used as scrapers because they exhibit skin polish around the edge of the platforms (Binneman 1982). Their presence is clear in the higher mean values and frequency distributions for height in Fig. 87. End scrapers with steep sides, sometimes with adze-like retouch/utilization/blank shaping, are also noted in the early Holocene units (upper BRL) at BPA and are illustrated in Fig.128 . Their incidence can be seen in the frequency of retouch position class 6 and plan form 4 in Fig. 89.

The continuous variables in each sample were compared against every other using the Mann-Whitney and Kolmogorov-Smirnov non-parametric tests and the number of times two samples were shown to be not significantly different at the .05 confidence level is listed below:

Fig. 87

BPA : FREQUENCY DISTRIBUTION OF SCRAPER HEIGHTS

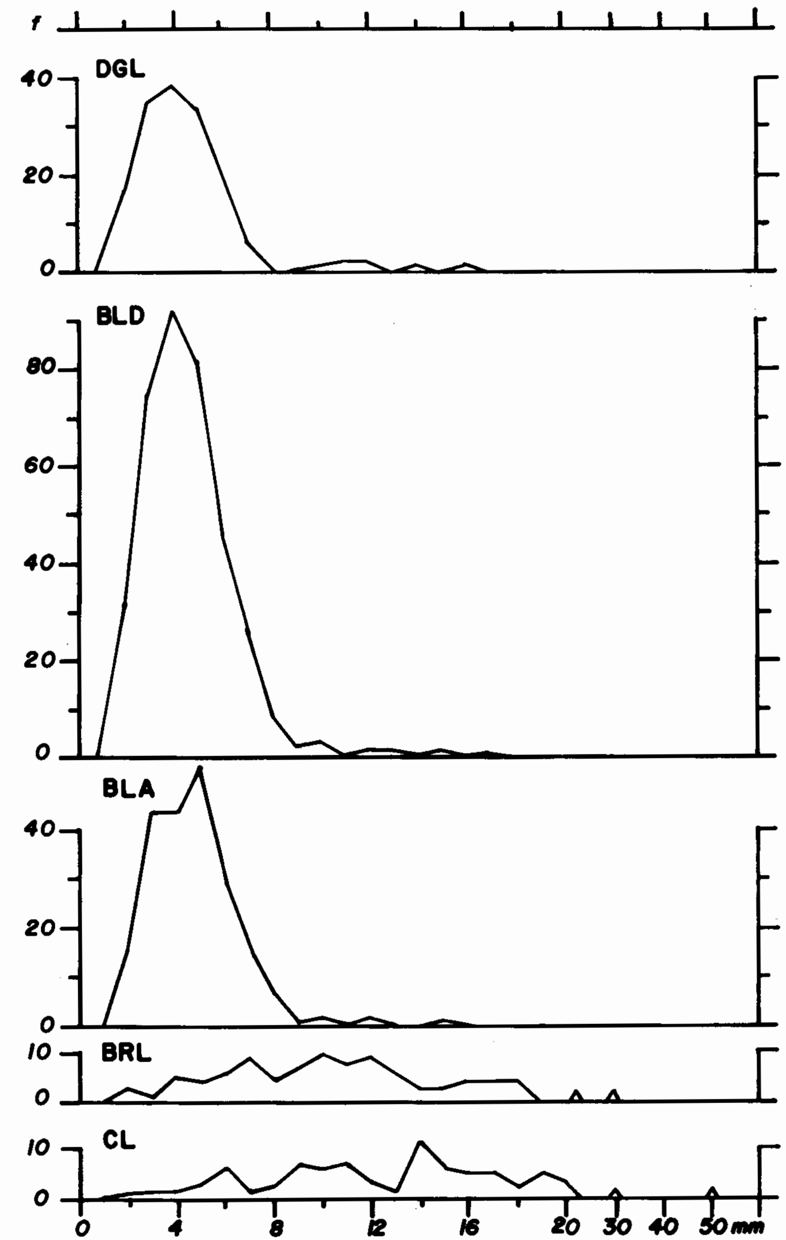


Fig. 88

BPA : FREQUENCY DISTRIBUTION OF SCRAPER W/L RATIOS

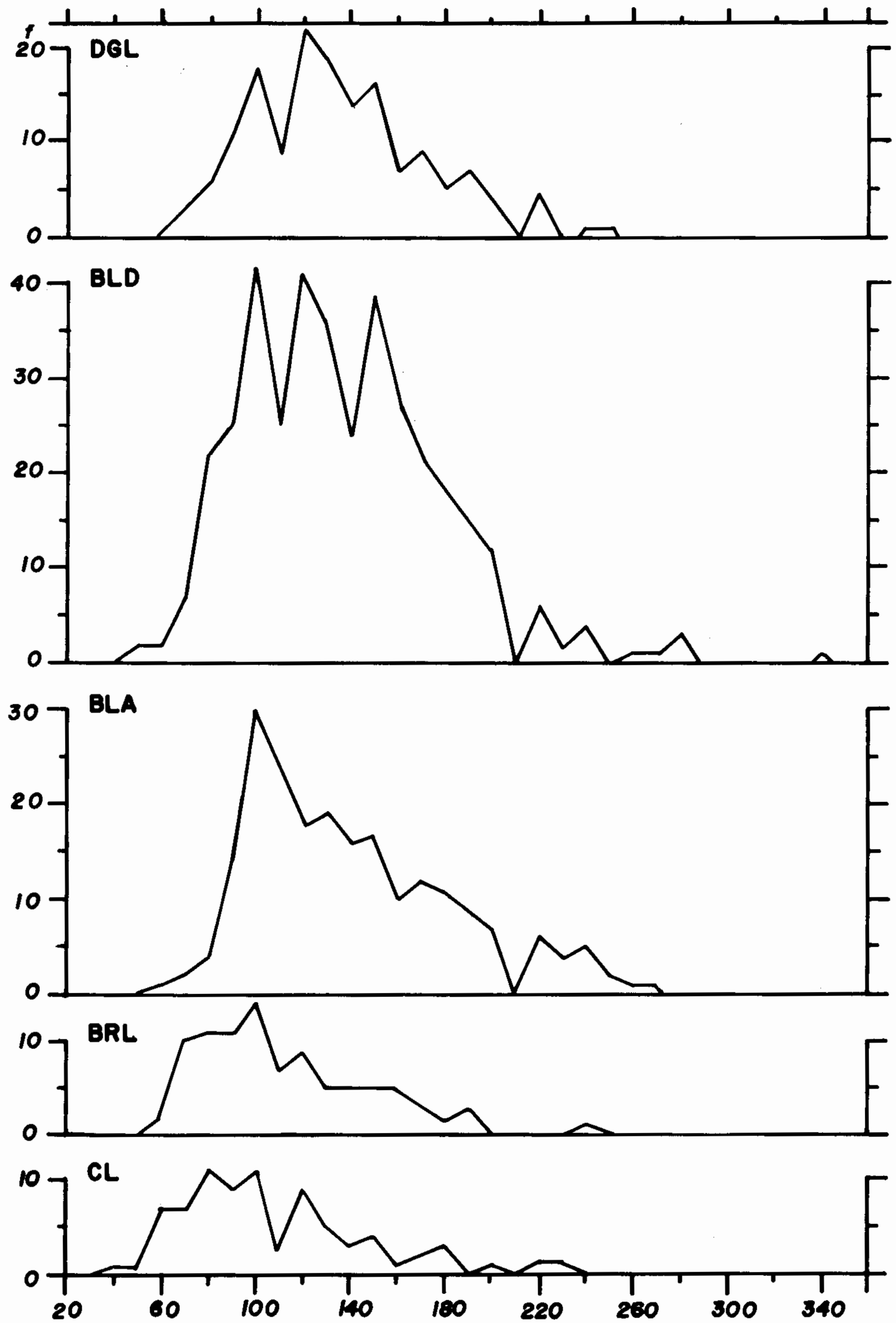


FIG. 89

BPA: FREQUENCY DISTRIBUTION OF SCRAPERS IN POSITION OF RETOUCH, PLAN FORM AND RAW MATERIAL CLASSES

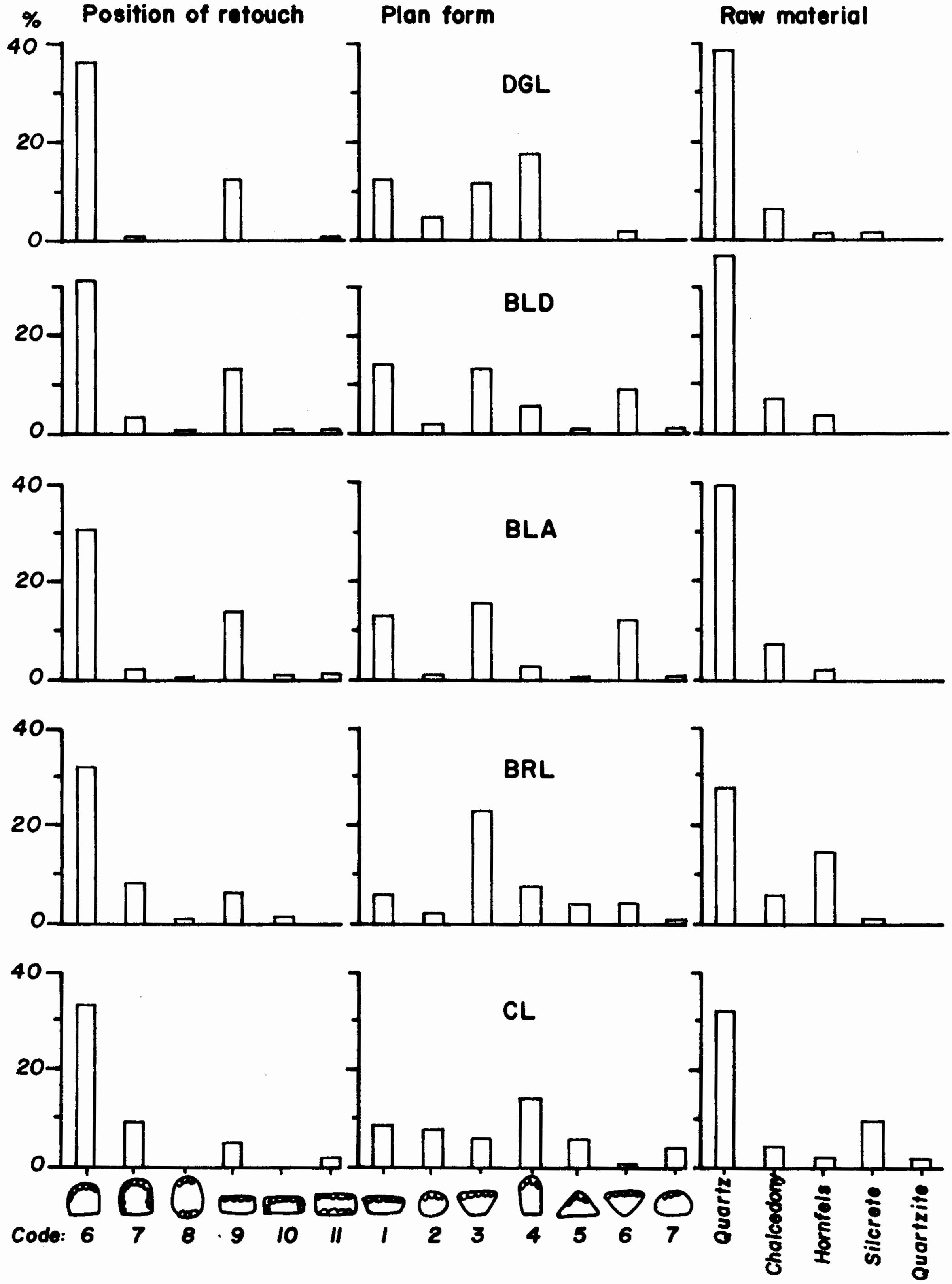
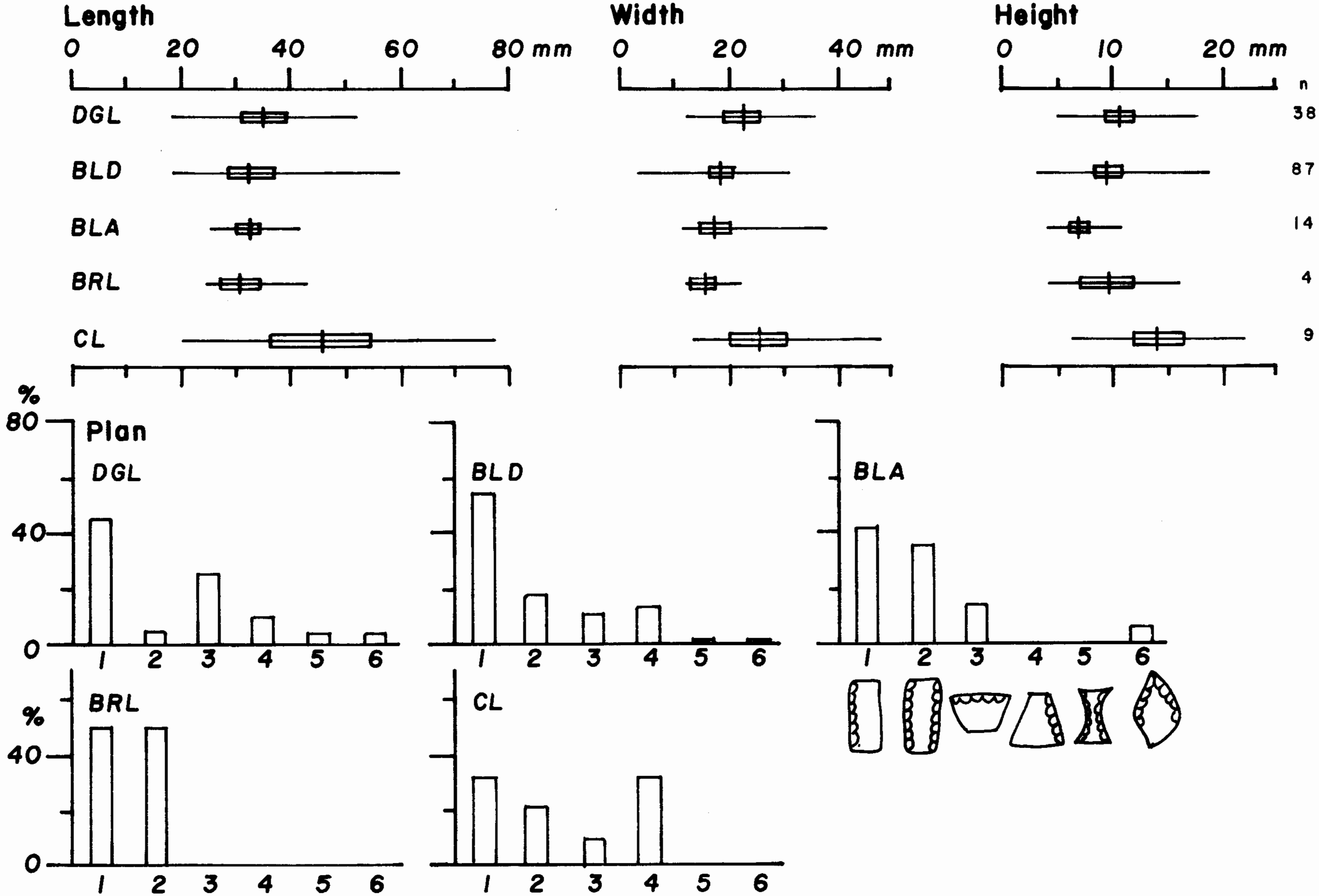


FIG. 90

BPA : ADZE DIMENSIONS AND % FREQUENCY OF PLAN FORMS



	DGL	BLD	BLA	BRL	CL
DGL					
BLD	8				
BLA	8	8			
BRL	0	0	0		
CL	0	0	0	2	

The three uppermost members dating to the mid-late Holocene form a tight cluster of significantly similar scraper assemblages while they are different on all counts from those in BRL and CL. CL and BRL are similar in both tests for w/l ratios, but are significantly different in all other respects. T tests for adjacent samples confirm this pattern using a parametric test for significance, both on the pooled and separate variance estimates.

The metric data for adzes are summarized in Table 58 and Fig. 90 and the changes in adze length through time are tabulated below:

Approximate dating B.P.	Stratigraphic member	Mean length (mm)	Sample size
1700	DGL	35,55	38
2000	BLD	32,70	80
6400	BLA	32,86	21
9100 - 10 425	BRL	31,00	4
12 000 - 14 200	CL	46,22	9

The sample sizes in BRL and CL make it difficult to assess the significance of the means, but there is a tendency for larger adzes to occur in the late Pleistocene sample, while those post-dating 12 000 are all shorter and relatively similar. As with the late Pleistocene scrapers, the late Pleistocene adzes also exhibit greater variability with very large and small specimens in the same sample. This can be seen in the values for variance in length and width in Table 58 which are three to five times larger than those for the other samples. The mean length of ca 33 mm for the samples post-dating 12 000 B.P. is slightly shorter that that from other southern and eastern Cape Holocene samples. Those from Wilton, for example, have a mean length of 39,16 mm, those from

Melkhoutboom are 38,43 mm and those from Highlands are 36,93 mm (Deacon, J. 1969, 1972; Deacon, H.J. 1976:210, 228). At BPA there is a clear preference for hornfels and chalcedony for the manufacture of adzes and, in DGL, for silcrete. This is a wider variety of raw materials than was used at the other sites and may account in part for the smaller size range. In all samples the rectangular plan form with retouch down one side is preferred (Fig. 90).

The metric data for backed microlith dimensions are summarized in Tables 59 and 60. Segments are the most common sub-class, but the samples are all small and conclusions drawn from them should be taken with due caution. Perhaps the most interesting observation is that the size range of segments through the last 14 000 years has remained remarkably constant, the means for the five samples ranging from 11,00 mm at the top of the sequence to 14,79 mm in the mid-Holocene. Thus the late Pleistocene segments are well within the range of the Holocene ones and are intermediate in length between the mid- and late Holocene samples. Quartz is the preferred raw material in all samples. Plan forms are also fairly standardized (Figs 132,126,121) and while the CL specimens may be slightly deeper, there are no samples with the range of deep segments found in Zimbabwe, for example. The large segment from BLD was not included in the metric analyses. Backed bladelets are common only in BLD, but they show a similar range of proximal and distal discards and segmented backed bladelets to that from other southern and eastern Cape sites (Deacon, H.J. 1976) with a mean length of 10,75 mm, showing that these pieces are significantly shorter overall than segments.

Inter-site comparisons

Frequency distributions. All three sites show a marked increase in the relative frequency of formal tools at ca 7-6000 B.P. After this time the formal tools are not only more numerous, but are also highly standardized in their metric attributes. When the frequency data from all three sites are pooled, it is evident that all the major formal tool classes found in the mid-late Holocene were made in the late Pleistocene as well, but in smaller numbers and, in the case of scrapers and adzes, with a significantly larger variance reflecting a wider range of sizes. Between about 12 000 and ca 8000 B.P. assemblages at all three sites tend to have a smaller range of formal tools, an increase in the size of scrapers, but not in adzes, and a change in the emphasis on particular raw materials.

Analysis of the incidence of raw materials has shown that some materials were preferentially selected for formal tools, but that these preferences were not the same at each site, and they changed through time. Two trends are clear: there was a fairly constant relationship between the relative use of the most abundant raw material in the waste, utilized and formal tool categories throughout the sequence in the case of quartz at BPA, but at KRA and NBC where quartzite is the dominant material, the frequency of this in the formal tool category declines markedly where the range of formal tools extends beyond scrapers and miscellaneous retouched pieces. The second noticeable trend is in the coincidental timing of changes in raw material usage at ca 12 000 and ca 9000 B.P. at all three sites. In the case of Kangkara there is a change from silcrete to quartz, in the case of NBC it involves the changes between quartzite and quartz/chalcedony and in the case of BPA it involves the increased use of hornfels between 12 000 and 9000 B.P. Although some materials were selected for the manufacture of particular formal tools, there is no reason for supposing that the choice of raw materials in any way determined or influenced the amount of formal retouch in an assemblage (Figs 37, 38, 91, 92 and 93).

Having established that raw material has no clear influence on the incidence of formal tools, the relationship between formal tools and flaking technique was tested. As has been demonstrated, a different flaking technique from the one used in the late Pleistocene was employed in the Holocene with the result that bladelets were struck from standardized bladelet cores in the late Pleistocene, but very small numbers of these were retouched. In the mid-late Holocene, on the other hand, the number of bladelet cores and unretouched bladelets is lower, but the incidence of backed microliths is much higher. This suggests that the desired size and shape of the bladelets was achieved by the flaking technique in the late Pleistocene, but by secondary retouch in the Holocene.

At all three sites scrapers are the most common formal tool. The units in which this is not the case have very small formal tool samples (fewer than 10) and are not numerous enough to warrant modification of this statement (Table 19). It is also evident that the assemblages

FIG. 91

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE PERCENTAGE OF SILCRETE AND THE PERCENTAGE OF FORMAL TOOLS IN A SAMPLE

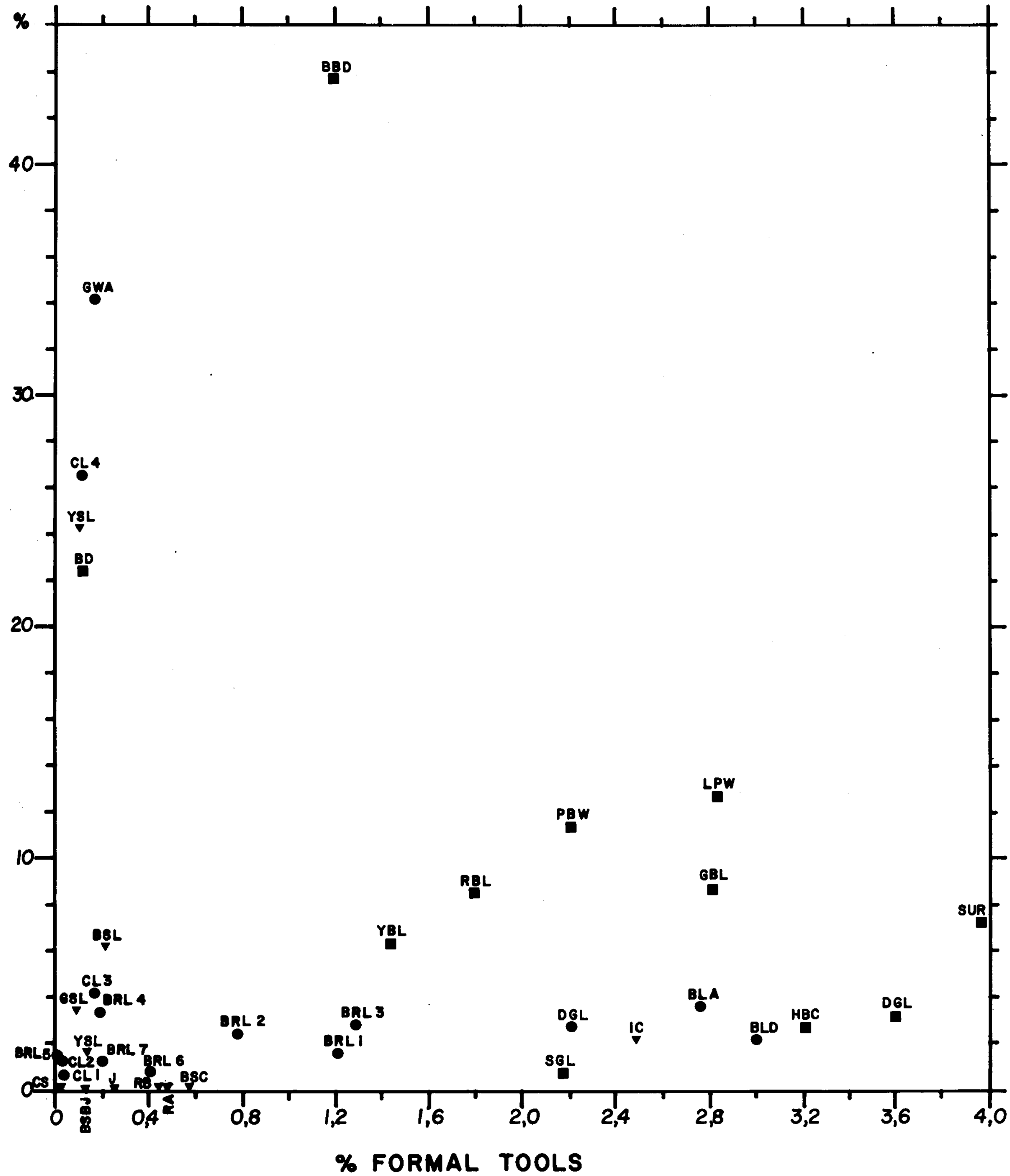


FIG. 92

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE PERCENTAGE OF QUARTZ AND FORMAL TOOLS

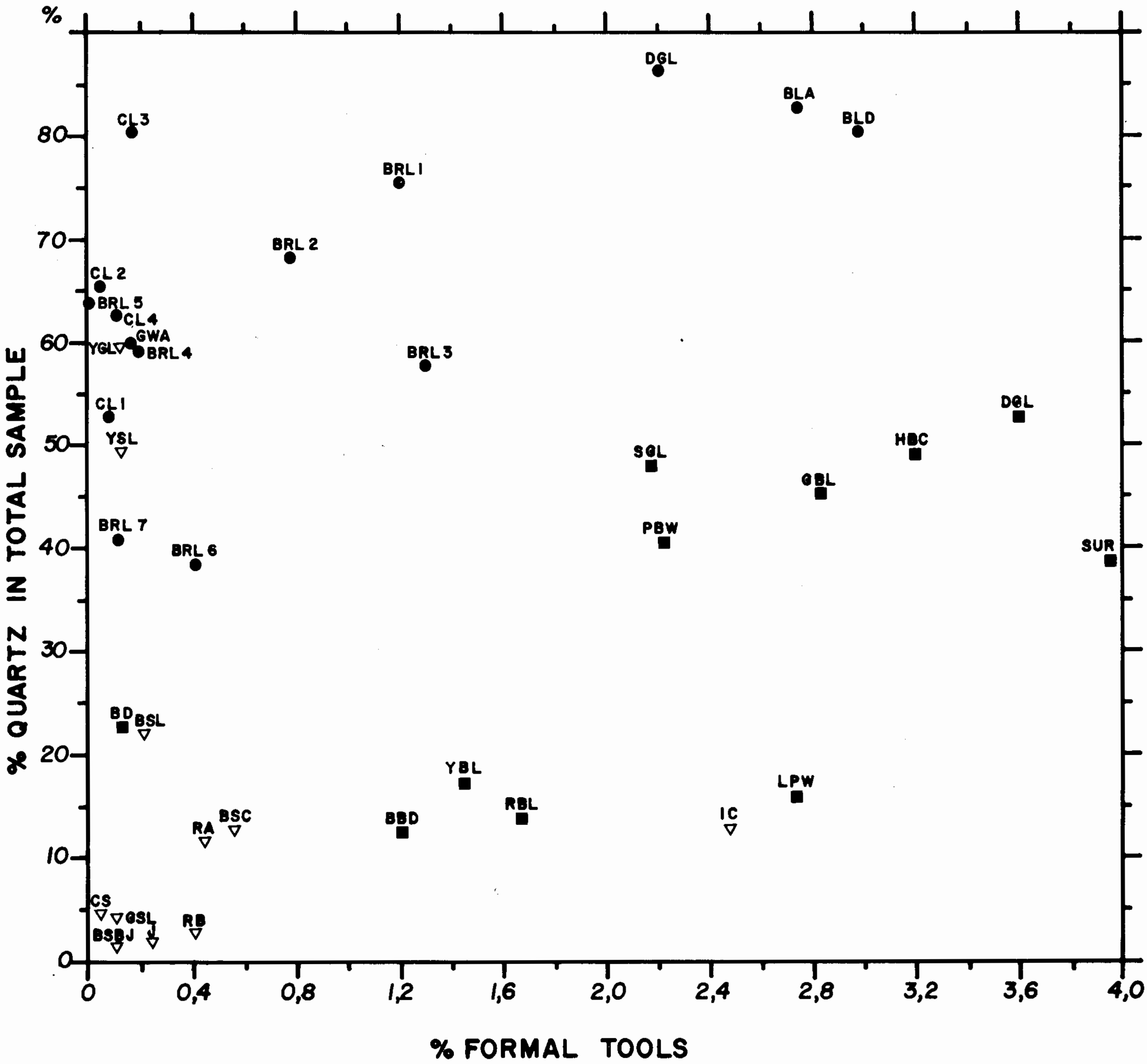
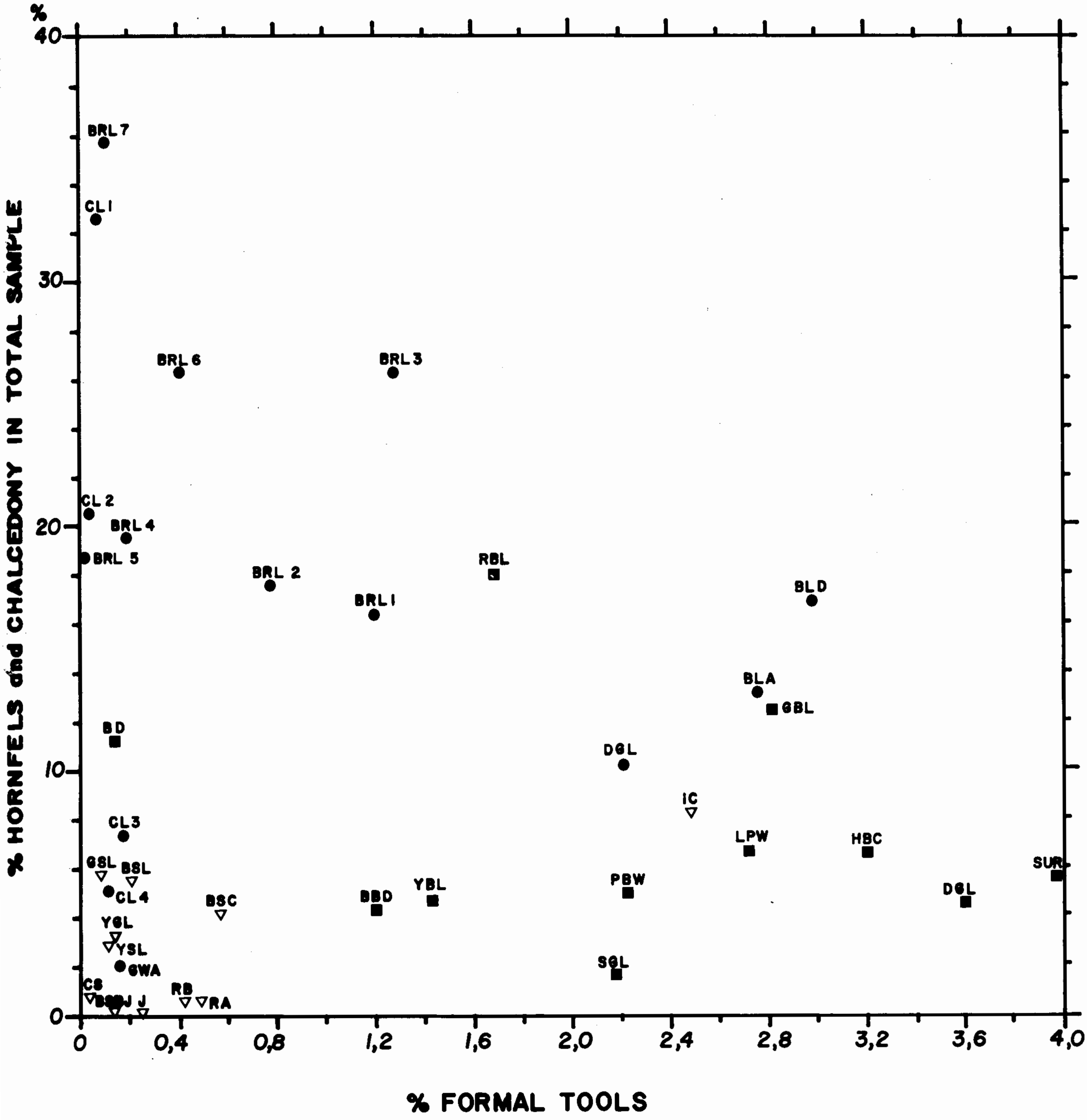


FIG. 93

NBC, KRA AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE PERCENTAGE OF HORNFELS AND CHALCEDONY AND THE PERCENTAGE OF FORMAL TOOLS IN A SAMPLE



in which scrapers have the highest percentage frequency in the formal tool category are not necessarily those in which scrapers are most common. All three sites show a similar change in the incidence of scraper sub-classes through time. Large Smithfield A-type scrapers are found in the late Pleistocene and in the terminal Pleistocene, elongated end scrapers and those with steep-sided retouch or natural facets are found in the early Holocene assemblages, and small convex forms are dominant in the mid-late Holocene but are present throughout the sequence. The large sample of late Pleistocene artefacts at BPA has demonstrated that all the major formal tool classes of the Holocene are represented in the late Pleistocene, but in smaller numbers; exceptions are bored stones and sinkers which may be exclusive to fishing activities at NBC.

Metric attributes. Comparison of the relationship between untrimmed flake lengths and the incidence of formal tools at NBC and BPA shows no clear pattern. At NBC high formal tool frequencies are found in samples with medium-sized untrimmed flakes, while at BPA they are in the smaller size range. At both sites, however, samples in which high formal tool frequencies occur have relatively thick flakes, again suggesting that formal retouch modifies flakes at a later stage in the reduction process so that careful core preparation to produce 'instant' tools is less important when formal tools are rarely made than when they are common. It is also notable that the mean thickness of scrapers is consistently higher than the mean thickness of untrimmed flakes suggesting that thicker flakes were selected for at least one of the most common formal tools. There is, further, a good correlation between the mean lengths for scrapers and untrimmed flakes ($p=.05$) although this is not the case for width, height and w/l ratio (Figs 94 and 95), and it is more obvious in the BPA sample than in that from NBC (Fig. 94). The difference in the correlation coefficients for the two sites is not easy to interpret, but may have to do with the flaking properties of the raw materials. Presumably the use of quartzite cobbles at NBC generates a larger number of unsuitable flakes than do the raw materials used at BPA.

Metric analysis of the scraper class has shown that although the actual measurements may differ amongst contemporary assemblages at the three sites, changes in scraper morphology through time are broadly

FIG. 94

NBC AND BPA: SCATTER DIAGRAM SHOWING SIGNIFICANT LINEAR CORRELATION AT BPA, BUT NOT AT NBC, BETWEEN MEAN LENGTH OF UNTRIMMED FLAKES AND THE MEAN LENGTH OF SCRAPERS

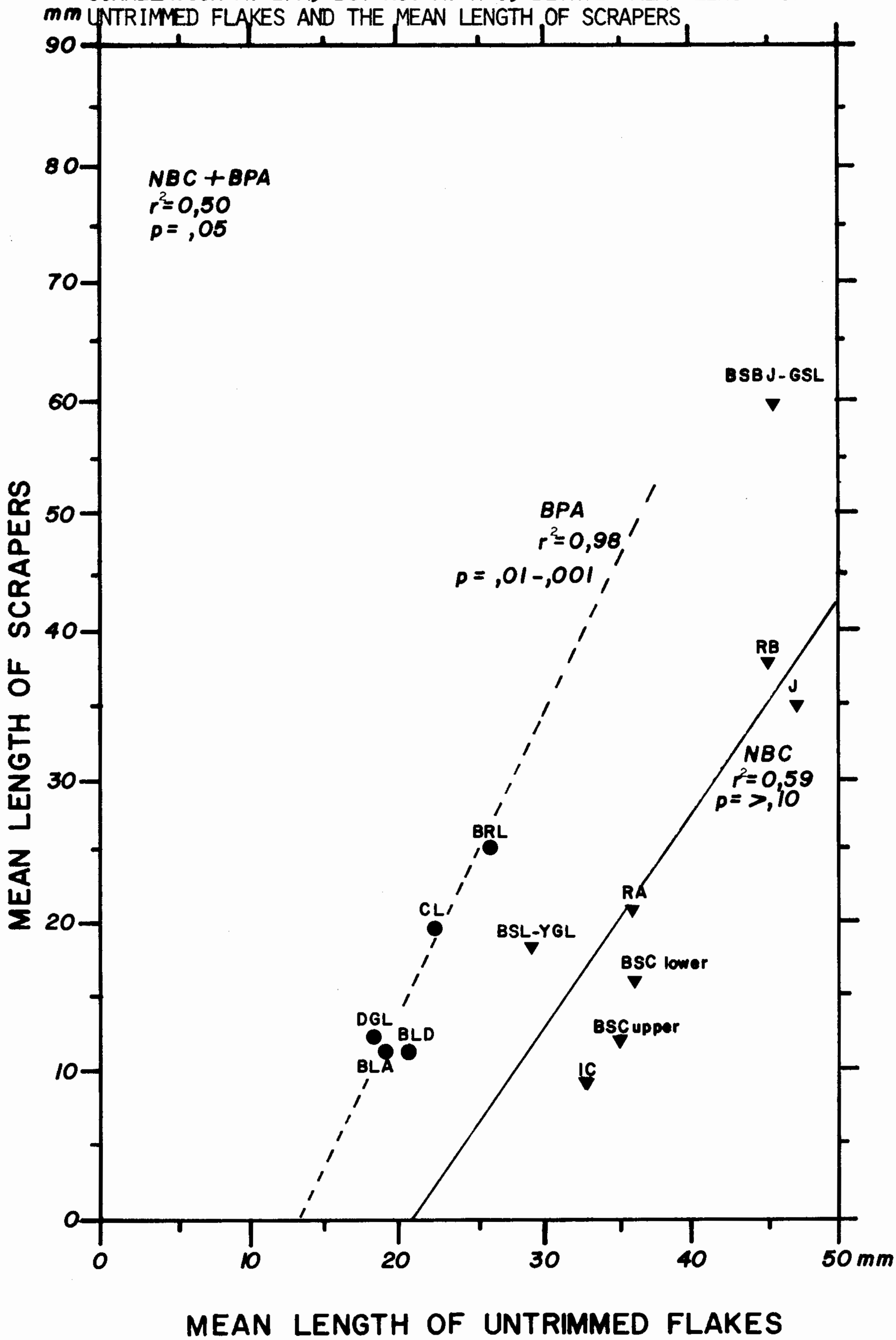
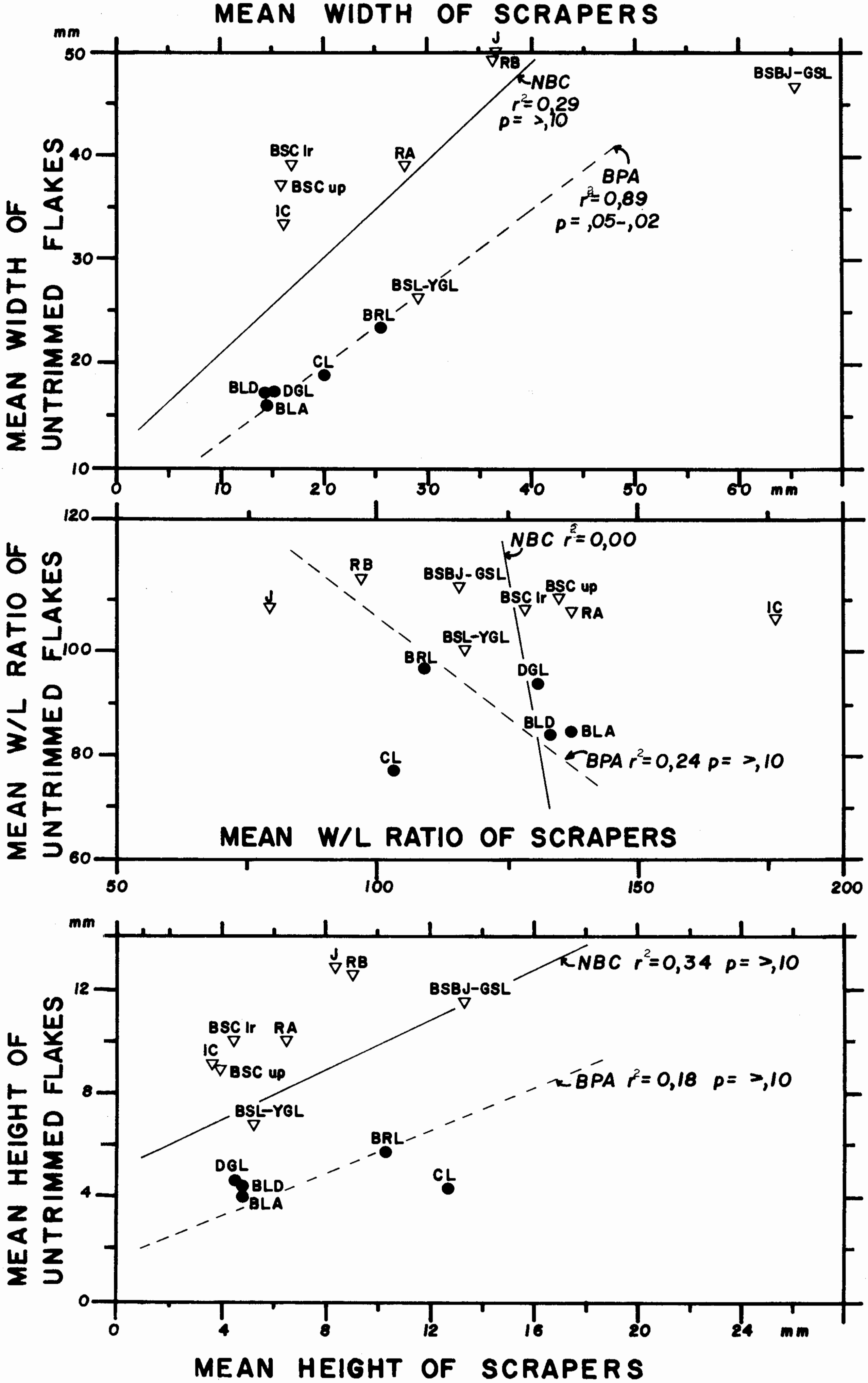


FIG. 95

NBC AND BPA: SCATTER DIAGRAM SHOWING VARIABLE LINEAR CORRELATIONS BETWEEN THE WIDTH, W/L RATIO AND HEIGHT OF SCRAPERS AND UNTRIMMED FLAKES



coincident. These changes are to some extent cyclic in that late Pleistocene samples often have more in common with mid-late Holocene samples than with those of the terminal/Pleistocene early Holocene. Results of the Mann-Whitney and Kolmogorov-Smirnov non-parametric tests are presented in the matrix in Table 61. The sample which shows more instances of similarity than any other is the late Pleistocene one from NBC which includes nine scrapers from YGL, YSL and BSL dating between ca 18 500 and 12 000 B.P. The reason for the high index of similarity is its lack of standardization and relatively wide range of sizes and shapes which make it statistically generalized. Where a larger sample is available from the same time range, as at BPA, the similarity index is reduced.

The group of samples dating between ca 12 000 and ca 7500 B.P. shows greater internal coherence than does the late Pleistocene group in that there is greater similarity between contemporary assemblages than between those of other time periods. Those that fall into this group are BBD/BD, YBL, RBL, LPW and PBW from Kangkara, GSL, CS, BSBJ, J and RB from NBC and BRL 1-6 from BPA. Mean lengths of scrapers range from 21 mm to 59 mm, most of the samples exceeding 25 mm. There is a particularly striking lack of similarity between these samples and those which immediately overlie them as can be seen in Table 61.

The youngest group dating between ca 7000 and 1700 B.P. includes RA, BSC and IC from NBC, GBL, DGL/SGL, HBC and SUR from Kangkara and BLA, BLD and DGL from BPA. The group shows the greatest internal coherence of the three with only one sample (IC from NBC) that is consistently different from the others of similar age. The scrapers in the group are characterized by very low frequencies of specimens longer than 25 mm and the sub-classes are small convex and short wide forms with mean lengths of less than 20 mm. The reason for the lack of similarity between IC and other contemporary assemblages is the very small range and size of scrapers in this assemblage, characteristics which are also present amongst the contemporary samples but to a lesser degree. The high index of similarity amongst the other samples in the group is impressive in view of the timespan involved (ca 5500 years), the distance between the sites and the relatively low index of similarity amongst the older samples over similar time ranges and at the same sites.

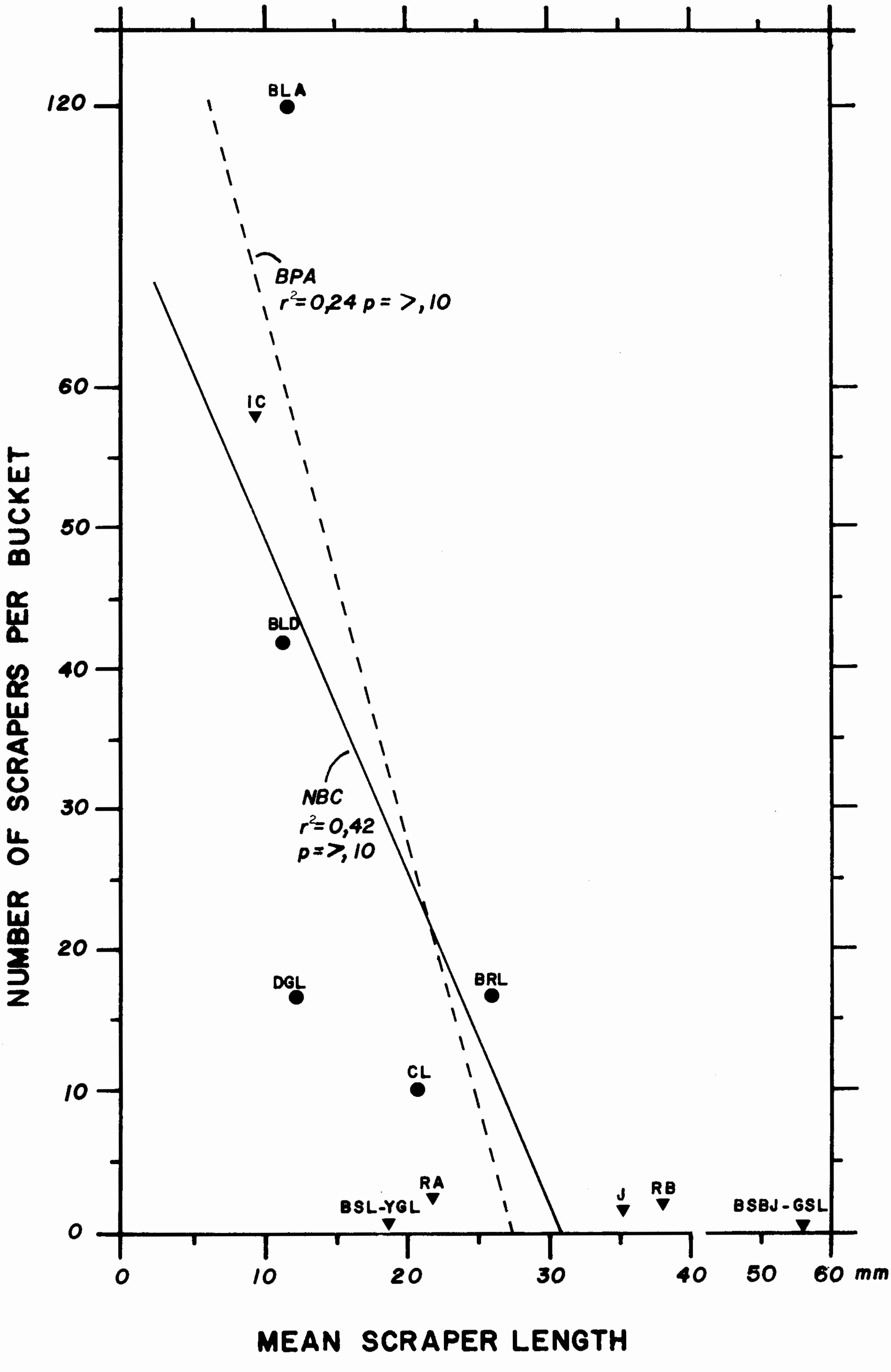
The extent to which the mean length of a scraper sample may be influenced by the choice of raw materials can be seen in Table 36 which shows that samples with short scrapers tend to have a higher incidence of quartz than do samples with long scrapers, but the main differentiating factor here is the incidence of quartzite. If quartzite scrapers are excluded from the sample, there is no clear relationship between scraper length and the incidence of any particular raw material.

Metric data for adzes are available only from BPA. The uniqueness of this sample makes it unwise to generalize about changes in adze length through time in the same way we have been able to do for scrapers. The main point of similarity between the adzes and scrapers is the greater variance in both these formal tool classes in the late Pleistocene samples reflecting a wider size range and a lack of standardization that contrasts with the Holocene samples. The backed microlith samples are too small to assess whether the same generalizations apply, but the size range of segments suggest they do not for they are very similar in both the late Pleistocene and Holocene samples and there is no evidence for greater variance at present.

The increasing standardization and smaller size range of scrapers through time appear to be correlated with an increase in the frequency of these formal tools, but when the number of scrapers per bucket of deposit is plotted against mean scraper length (Fig. 97), the correlation is not a linear one for either NBC or BPA, although samples with a mean length of greater than 15 mm tend to have fewer than 15 scrapers/ bucket, while those smaller than 15 mm have between 15 and 120 per bucket. A purely functional interpretation would suggest that large scrapers lasted longer than smaller ones which were replaced in their hafts more often. Coupled with the increasing standardization and observations by Hayden (1977:180) that retouching or resharpening of stone tools in Australian assemblages is closely related to the incidence of hafting, we could suggest that the smaller size, greater number and wider range of formal tool classes in the mid-late Holocene could be related to a change in hafting policy, a change in tool design and method of use rather than a change in manufacturing technique or lifestyle. Regular hafting of expendable, disposable bits rather than larger and longer-lasting scrapers would be accompanied by less

FIG. 97

NBC AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE NUMBER OF SCRAPERS PER BUCKET AND THE MEAN SCRAPER LENGTH. THIS DEMONSTRATES THAT SMALLER SCRAPERS ARE NOT NECESSARILY MORE NUMEROUS



variability in size and shape as the tools were designed to fit into hafts that introduced size constraints not present in earlier designs. The lack of changes in size in backed microliths from the late Pleistocene to Holocene may imply that these tools were always hafted in mastic, but does not help to explain their relatively low incidence in the late Pleistocene.

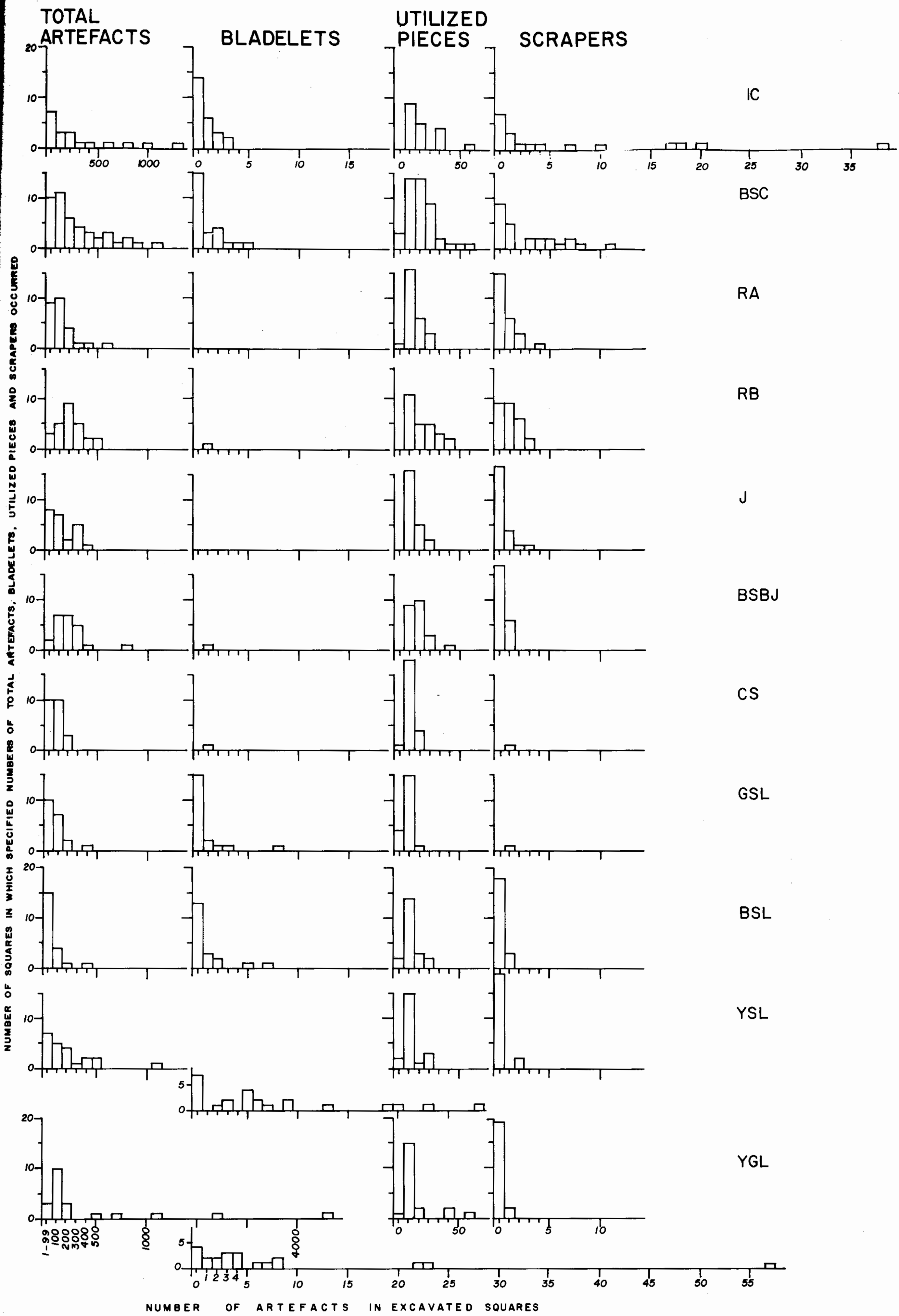
CHOICE OF PLACE OF DISCARD

The distribution of stone artefacts on a site is, theoretically, the result of the pattern of artefact discard at the time the site was occupied. Thus changes in the frequency of artefact classes could reflect changes in activity and the pattern of discard. However, this pattern can be altered by post-depositional factors that obscure the original context; Schiffer (1976:28ff) has called these natural (n) and cultural (c) transforms. In some instances, as in animal burrows or man-made pits, it is relatively easy to isolate and exclude material in disturbed context in a rock shelter deposit, but in other cases it is not a simple matter to distinguish cultural from natural transforms, nor to interpret easily non-random patterning when this occurs.

Limited data are available on the pattern of discard at modern San camps in the Kalahari (Yellen 1977), but these observations were made over a short period of time, they relate only to open sites, and the occupants used a very limited range and number of ground stone tools and no flaked stone. The interpretation of distribution patterns in Stone Age rock shelter deposits is therefore limited to analogues derived from common sense rather than from ethnographic observations, but a few points gleaned from modern San patterns may be relevant. Yellen (1977:118) points out, for example, that the chance of a special activity such as skin preparation occurring at a site is greatly increased as the length of time a site is occupied is increased. Thus the longer a site is occupied, the more chance there is that special activities will take place there. However, the predictive equations for calculating group size and the length of occupation offered by Yellen (1977:125) would not be applicable in a rock shelter site (op.cit: 130) even if it were possible to isolate those artefacts and occupation debris that related to a limited occupation. The value of testing occupation debris distributions against 'normal' and 'random' distri-

FIG. 98

NBC: CHANGES THROUGH TIME IN THE DENSITY OF VARIOUS ARTEFACTS PER EXCAVATED SQUARE. A RANDOM DISTRIBUTION WOULD TEND TO BE J-SHAPED.



butions is questioned by Yellen (op. cit: 134) who could find no evidence for the spatial segregation of activities within a single camp site. Thus, despite efforts to locate spatially segregated clusters of debris and artefacts at Stone Age sites (Whallon 1973), the interpretation of this patterning is still dependent on ethnographic analogy and/or common sense.

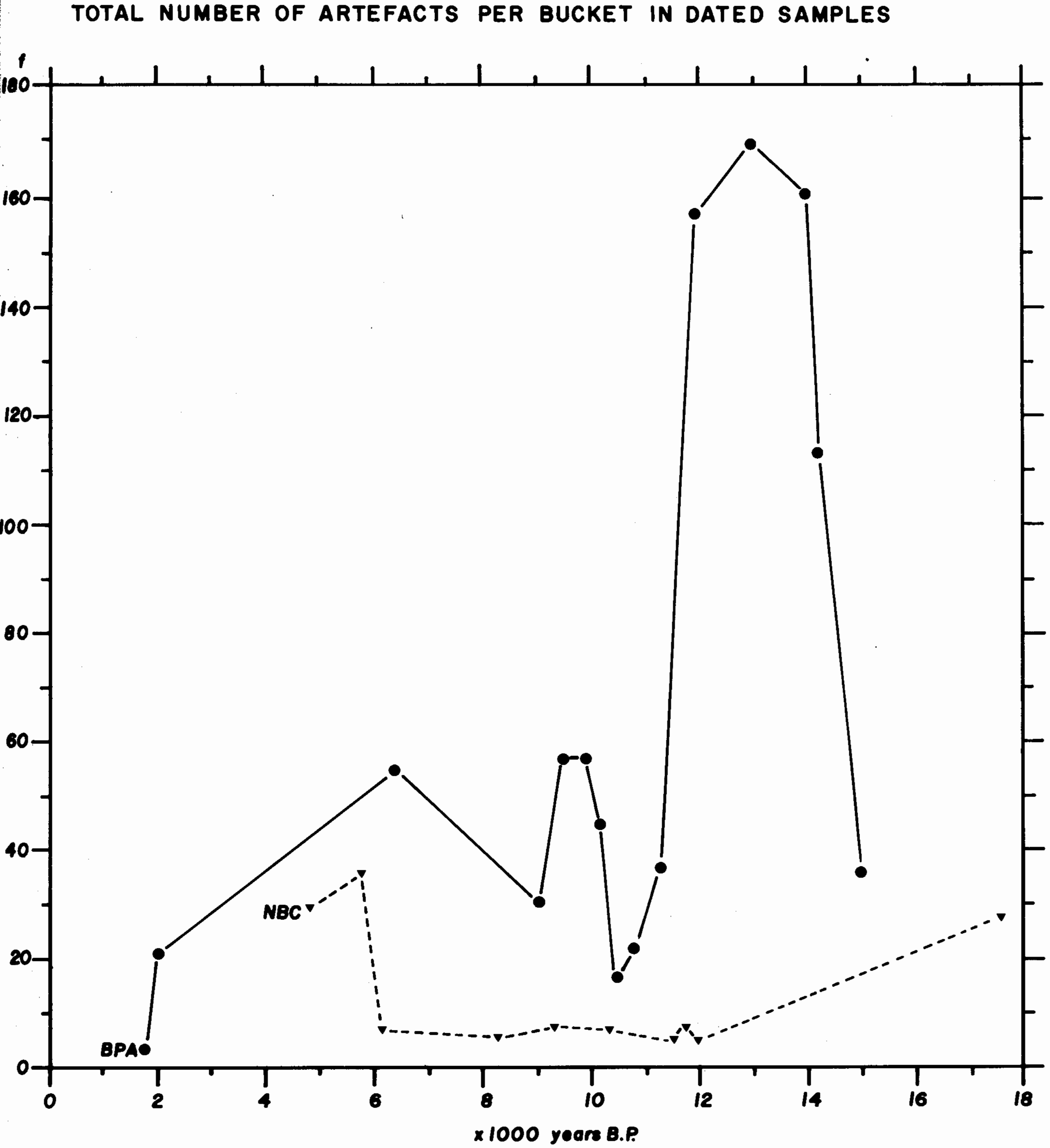
With the focus of this study falling on diachronic change, it was considered worthwhile, in spite of the above limitations, to compare artefact distributions within and between sites to test whether they show any significant changes through time. In this instance, KRA was not considered because only one m^2 was excavated. Two variables were chosen: the quantity of stone artefacts per bucket of deposit excavated and the number of artefacts of various type per horizontal m^2 in each excavated unit. It was expected that the distribution of unretouched bladelets in the late Pleistocene might be different from that in the Holocene units on the assumption that different methods of bladelet production had been used, and that concentrations of formal tools in a few squares may signify the location of special activity areas. The distribution of total artefacts in each unit was used as a control, with the expectation that the distribution of artefacts discarded at an initial stage in artefact production (i.e. flaking of the nodule) would differ from the distribution of artefacts discarded at a later stage after utilization and/or retouching. If, on the other hand, the distribution patterns for all artefacts, utilized and formal tools were similar, we could suggest either that the locus for tool manufacture was the same as for tool use, or that some form of natural transform was responsible for the distribution. Should a natural transform be involved, we would expect this to be site-specific and we would not expect to find a similar pattern at a contemporary site.

Nelson Bay Cave

The numbers of total artefacts, bladelets, utilized pieces and scrapers per square are summarized in Fig. 98 which shows a close correlation in the distribution of each of these classes and categories within a unit, but there is a gross change through time. Thus there is no significant difference in the distribution pattern of total artefacts, bladelets, utilized pieces and scrapers in BSC and RA, but in YSL and

FIG. 99

NBC AND BPA: CHANGES THROUGH TIME IN THE TOTAL NUMBER OF ARTEFACTS PER BUCKET IN DATED SAMPLES



YGL the distribution of bladelets is different from that of other classes and categories, which is in turn different from that in the overlying units. In YGL the square with the highest density of total artefacts (2800) is the same one that yielded the highest number of utilized pieces (60), bladelets (57) and one of the two scrapers. Bone was also concentrated in square B1 both in YGL and YSL where the same square yielded the highest number of artefacts (1100). R G Klein, the excavator, has suggested (pers. comm.) that water may have been responsible for the redistribution of material into this square. There also appears to be a clumped distribution in IC where one square (C5) yielded the most artefacts (1300), utilized pieces (60) and scrapers (38), but here the adjacent two squares also have high tool frequencies and the three squares together account for 50% of the artefacts from the unit; nearly one third of all the quartz in the unit also came from C5. Here a cultural transform may be the reason for this concentration because the unit was thickest in this area of the excavation and had been re-worked either in historic or prehistoric times in the adjacent row of squares (2, 3 and 4) and was very thinly distributed in squares 7-10 (see section in Fig. 16).

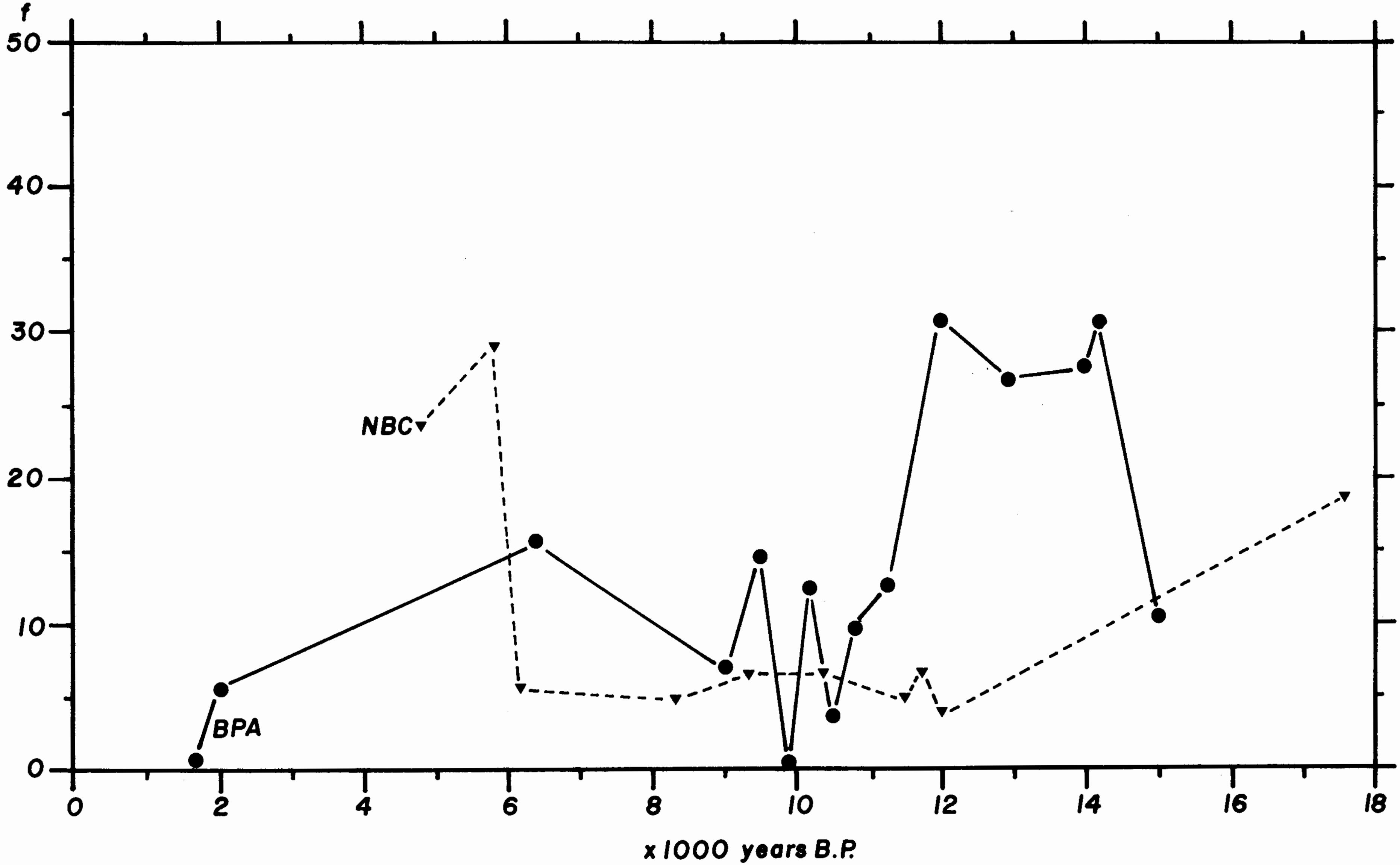
Post-depositional disturbances have therefore made interpretation of the horizontal patterning of artefacts at NBC difficult, but it is nevertheless interesting to note that in units which have not apparently been disturbed (BSL-BSC), the patterning corresponds fairly closely to a J-shaped Poisson random distribution. The contrast between the uppermost and lowest units is illustrated further in Figs 99 and 100 which shows up the difference between them and the randomly distributed middle units.

Boomplaas

The data in Fig. 101 show a striking difference in the distribution pattern of artefacts in CL 1 and CL 3 when compared with the overlying units and this is obvious in Figs. 99 and 100 as well. In these late Pleistocene assemblages the density of artefacts is considerably higher than in the overlying units and they are clumped into a few squares rather than being evenly distributed. Square N13, for example, yielded more than 5400 artefacts, including 129 bladelets, 8 scrapers and 18 utilized flakes in CL 3, while CL 1 N16 had just over 3000 artefacts or twice the number in the next highest square. The correspondence

Fig. 100

NUMBER OF UNTRIMMED FLAKES PER BUCKET IN DATED SAMPLES AT NBC AND BPA



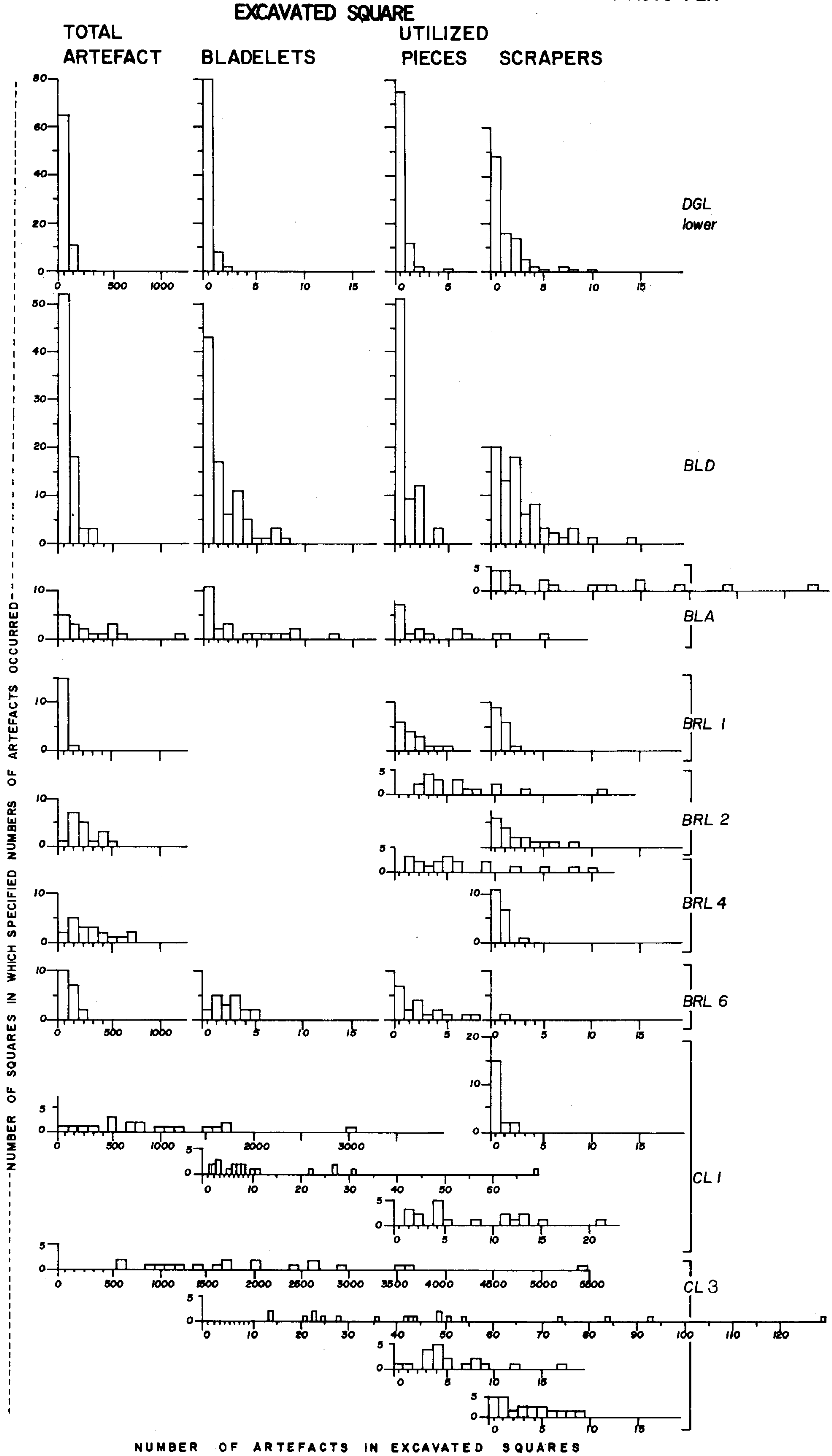
in density between the late Pleistocene units from BPA and NBC was highly suggestive of a cultural rather than a natural transform, but it has been difficult to assess the various factors involved. While at NBC post-depositional water action may have concentrated bone and artefacts in square B1, at BPA the presence of the stalagmite towards the back of the area excavated in the CL Member may have encouraged occupation of the area to the front, but the presence of hearths and ash bands in the CL units argues against the action of a post-depositional n transform being responsible for the concentration of artefacts. However, the fact that all the artefacts are distributed in a similar way would argue for the squares in which high numbers were recorded being simply favoured for artefact manufacture and use in general rather than loci of specialized activity. This in itself is interesting in that it suggests immediate use of artefacts after manufacture rather than re-distribution of the formal and utilized pieces.

Four units from the BRL Member have been plotted in Fig. 101 to show the patterning on low-density living floors dating to the early Holocene. The distributions are not significantly different from the Poisson random distribution at p.05 with grouped data, but there is an interesting difference between the patterning of utilized pieces and scrapers, the former showing higher concentrations than the latter. This is partly the result of very different sample sizes, but may nevertheless be culturally significant and may indicate localized areas of casual flake utilization.

The mid-Holocene BLA Member shows patterning that is significantly different from the Poisson distribution at p.001 and while the total artefacts, bladelets and utilized pieces are similarly distributed, the scrapers are more clumped than would be expected. This may be the result of cultural patterning because the squares at the front of the excavated area were occupied by a long shallow pit filled with charcoal and other smaller charcoal-filled pits were also located in this member. The artefacts, therefore, were concentrated away from the charcoal pits and therefore exhibit a distribution significantly different from Poisson. The fact that the scrapers, however, were concentrated in a few squares to the rear suggests that this may have been a specialized activity area.

FIG. 101

BPA: CHANGES THROUGH TIME IN THE DENSITY OF VARIOUS ARTEFACTS PER EXCAVATED SQUARE



The distribution of artefacts in the BLD 3 unit is not significantly different from the Poisson distribution at p.05, despite the considerably larger sample size from a larger excavation. The scraper distribution, however,has a longer 'tail' and it is possible that these formal tools are concentrated in a few squares as a result of specialized activity.

Figs 99 and 100 illustrate the anomalously high density of material in the CL Member and the variability in the early Holocene between those units isolated as living floors (BRL 2, 4 and 6) and those representing intermediate non-occupation units (BRL 1, 3 and 5). The mean density for the site would be about 10 untrimmed flakes and about 40 total artefacts per bucket, with variability introduced by natural transforms in the sense that the stalagmite limited the occupation area in CL, and by cultural transforms such as the location of charcoal pits in BLA and the localization of areas of specialized activity.

Inter-site comparisons

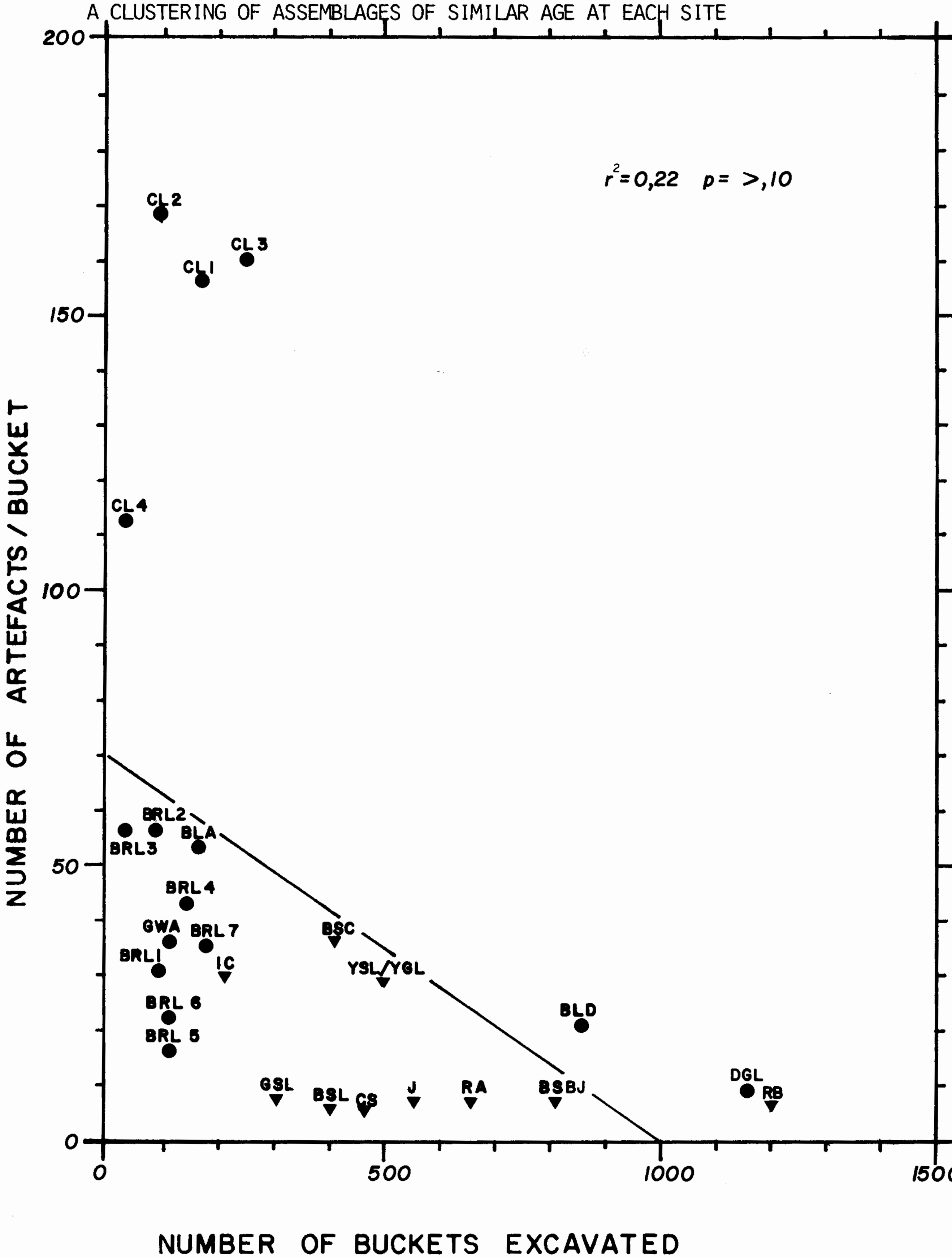
In the introduction to this section it was suggested that natural transforms would be site-specific and would therefore not be expected to occur at the same time at different sites. The data from NBC and BPA indicate that this can be a faulty premise because post-depositional water action appears to have been responsible for the re-distribution of material in the NBC late Pleistocene units while the placement of the stalagmite at BPA appears to have limited the occupation area at BPA.

The lower density of material in some of the terminal Pleistocene/ early Holocene deposits at both sites may be partly fortuitous. At NBC it is related to the fact that the deposits are greatly expanded by the addition of large quantities of shell midden material (a cultural factor), and at BPA to the fact that some of the BRL units are identifiable as living floors with vertical concentration of cultural material, while intermediate units are more dispersed. The division reflects in part the excavator's interpretation of the vertical distribution as a cultural phenomenon and the gross similarity between the values for two somewhat different types of deposit may therefore not be significant.

The increase in artefact density in the mid-Holocene deposits at NBC and BPA is due in both cases to the sampling of units in which

FIG. 102

NBC AND BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE NUMBER OF ARTEFACTS PER BUCKET AND THE NUMBER OF BUCKETS EXCAVATED, BUT A CLUSTERING OF ASSEMBLAGES OF SIMILAR AGE AT EACH SITE



occupation was spatially restricted. In the case of BPA, the presence of the charcoal pits restricted occupation to the rear of the excavated area, while the IC unit at NBC is restricted to two rows of squares presumably because of post-depositional disturbance of the site. At both sites, however, the distribution of scrapers is skewed by the concentration of relatively large numbers in one or two squares and this may represent localized concentrations of activity in which scrapers were used. To eliminate the possibility that all older samples had higher artefact densities because of the compression of the deposits by those overlying them, the number of artefacts/bucket was plotted against the number of buckets excavated in Fig. 102. This shows that although the older CL units at BPA are separated from the younger ones in having a much higher incidence of artefacts/bucket, there is no clear separation of younger and older units either here or at NBC where the values for BSC and YGL/YSL are essentially similar despite some 10 000 years between them.

NON-LITHIC ARTEFACTS

In addition to stone tools, bone artefacts have been found at both NBC and BPA, but not at KRA. Ostrich eggshell has been worked to make beads, pendants and decorated water containers or flasks, tortoiseshell has been used for a pendant and for bowls, marine shells have been made into beads and pendants at BPA. Marine shell ornaments have not been studied at NBC, but ostrich eggshell is found in small quantities in the form of beads at NBC and a few beads were recovered from the 1 m² at KRA. The frequencies are summarized in Tables 62 and 63 and in Figs 103 and 104. Also of interest are finds of mastic and one scraper mounted in mastic at BPA (Deacon & Deacon 1980).

Bone artefacts

The most common class of bone artefact at BPA is that of broken or partially polished portions of bone shafts and the incidence of finished, whole bone tools is low. Bone beads, on the other hand, are relatively common, particularly in CL where five of similar shape and size were found in three adjacent squares in CL 3. They are illustrated in Fig. 106:20-24. Artefacts classified as bone 'points' probably include portions of arrowpoints as well as linkshafts (for example,

FIG. 103

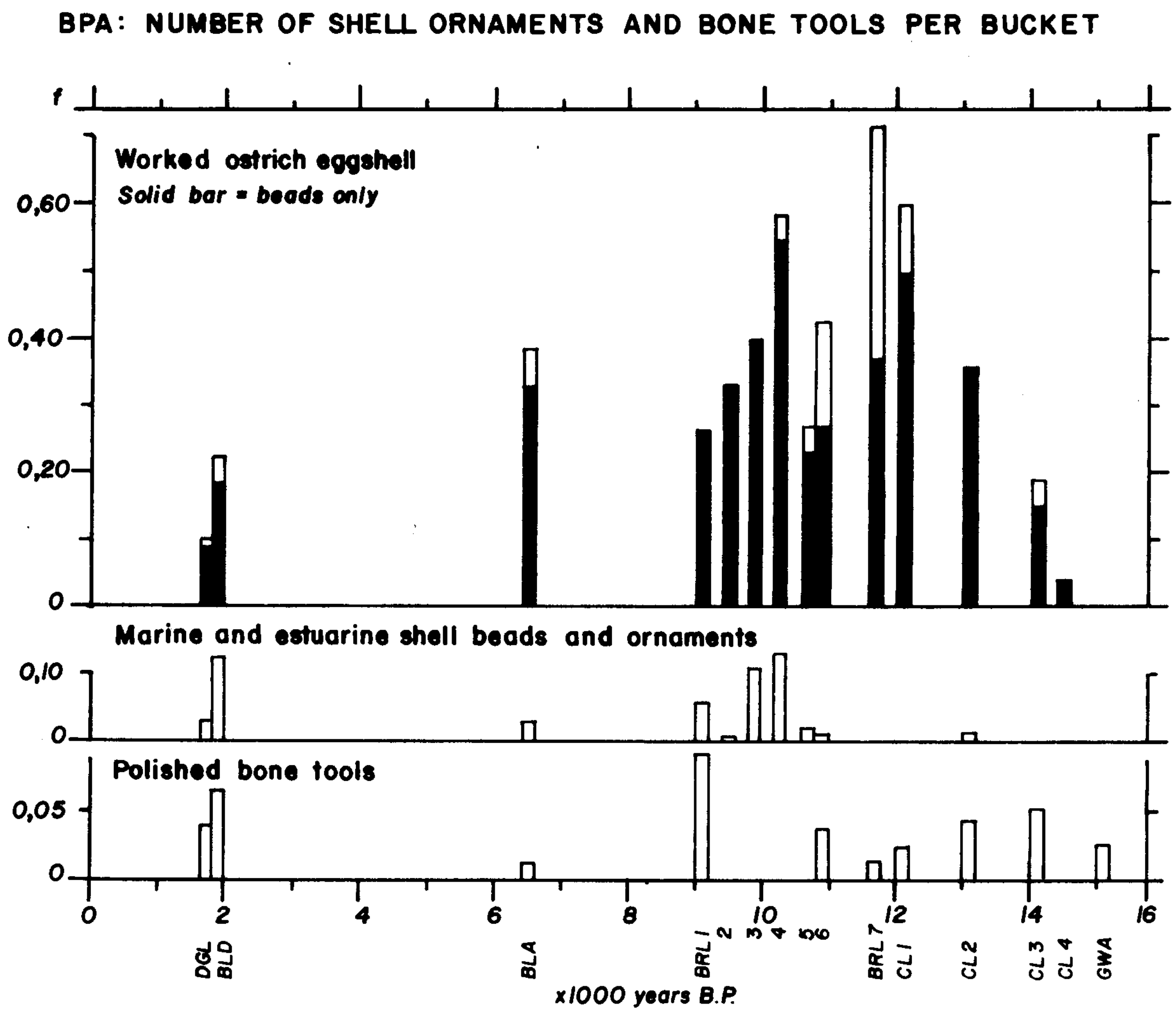


FIG. 104

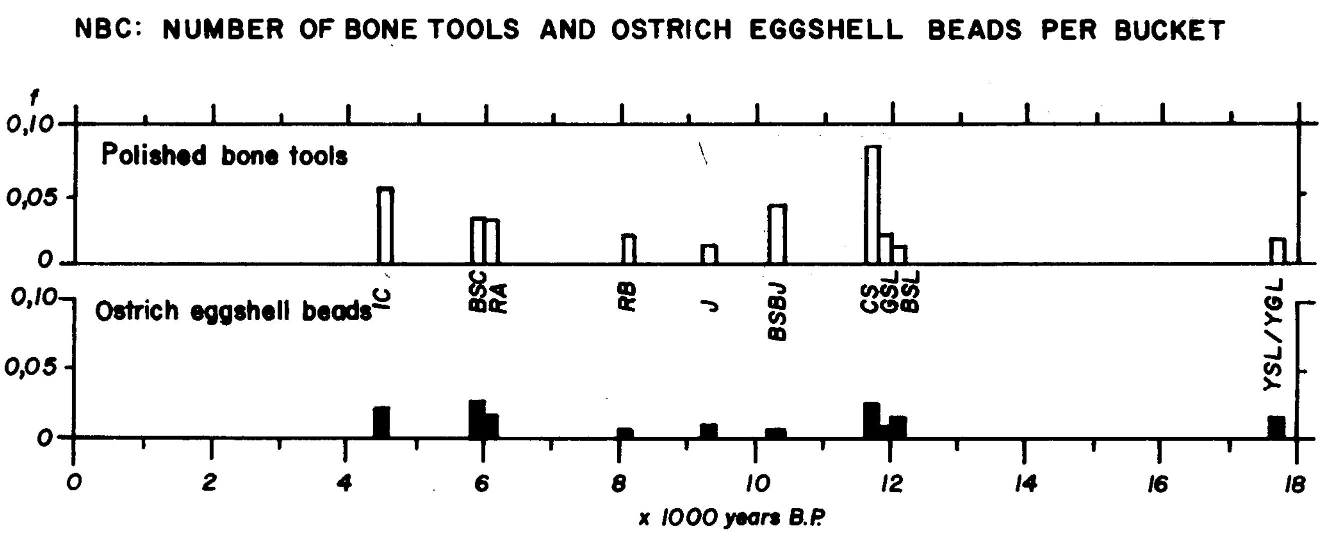


Fig. 105:7, Fig. 106:11 and 29). Portions of two tortoiseshell bowls were found, one from BLD and the other from the late Pleistocene CL Member (Fig. 107:1) giving proof of the antiquity of this ethnographically recorded item. When the distribution of bone tools is viewed through time at BPA, it can be seen that the incidence of these artefacts is the result of sampling a random distribution of a relatively rare artefact class and the fluctuations in Fig. 103 probably have no cultural significance. All the 'classic' formal bone tools are known from the late Pleistocene and both the small sample size and the generally low frequency of complete bone tools make it unrealistic to interpret the frequencies in terms of anything other than the result of low frequency sampling.

At NBC the most common bone artefact is the so-called fish gorge or small double-pointed sliver of ground and polished bone (Fig. 108: 17-32). These are interesting in their temporal restriction to the units between BSL and RA and their high incidence in CS and BSBJ where they account for more than half of the total bone tools in those units. It is assumed that they were used for catching fish both at NBC and at Elands Bay on the west coast where they are also found in large numbers in units dating to the same time period (Parkington 1977a), but fish continue to occur after gorges are no longer found in the deposits indicating that other fishing methods apparently replaced the fish gorge after ca 8000 B.P. As at BPA, the variability in bone tool frequencies is considered to relate more to random sampling than to patterned frequency changes through time, with the exception of course of the fish gorges which clearly represent something different.

Figs 106 and 108 illustrate that most other formal bone tools are present at both NBC and BPA. Spatulates, for example, are found in both terminal Pleistocene/early Holocene and mid-late Holocene units while multi-ringed bone tubes, or those with spiral grooves seem to be limited to the late and terminal Pleistocene.

Shell

Shell frequencies are summarized in Tables 62 and 63 and the incidence of worked shell per bucket of deposit is summarized in Figs 103 and 104. The gross quantity of ostrich eggshell fragments is probably a good indication of the relative availability of ostriches and their eggs

FIG. 105

BPA: Worked bone and copper bead from DGL Member. 1: copper bead; 2,3: bone beads; 4-8: bone points; 9: ?linkshaft; 10,11: polished bone tubes; 12,13: bone flakes with utilized edges; 14: bone with cut ends; 15,16: bone with cut marks possibly made by metal tool; 17-21: bone with incised or grooved lines. (After Deacon et al 1978)

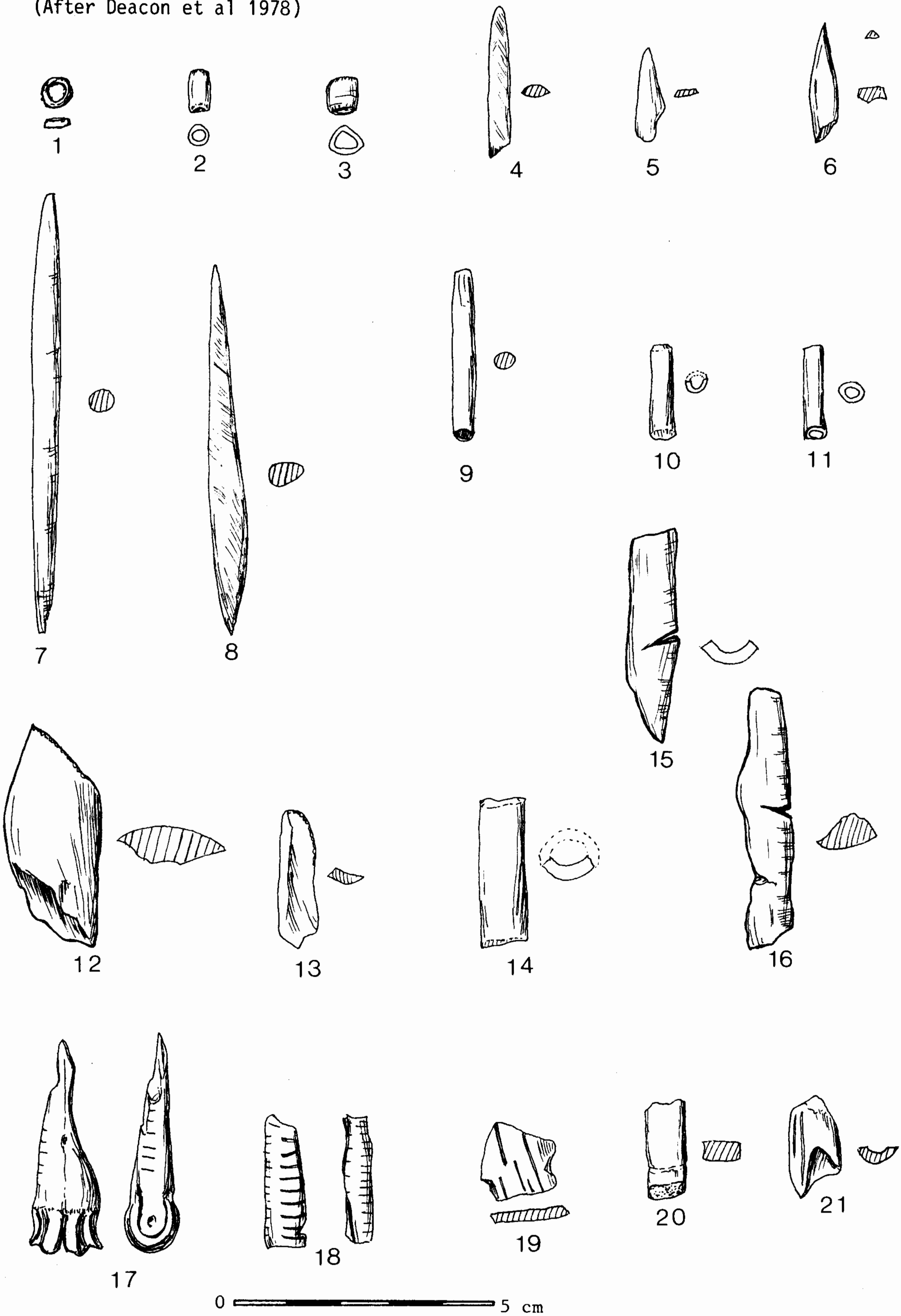
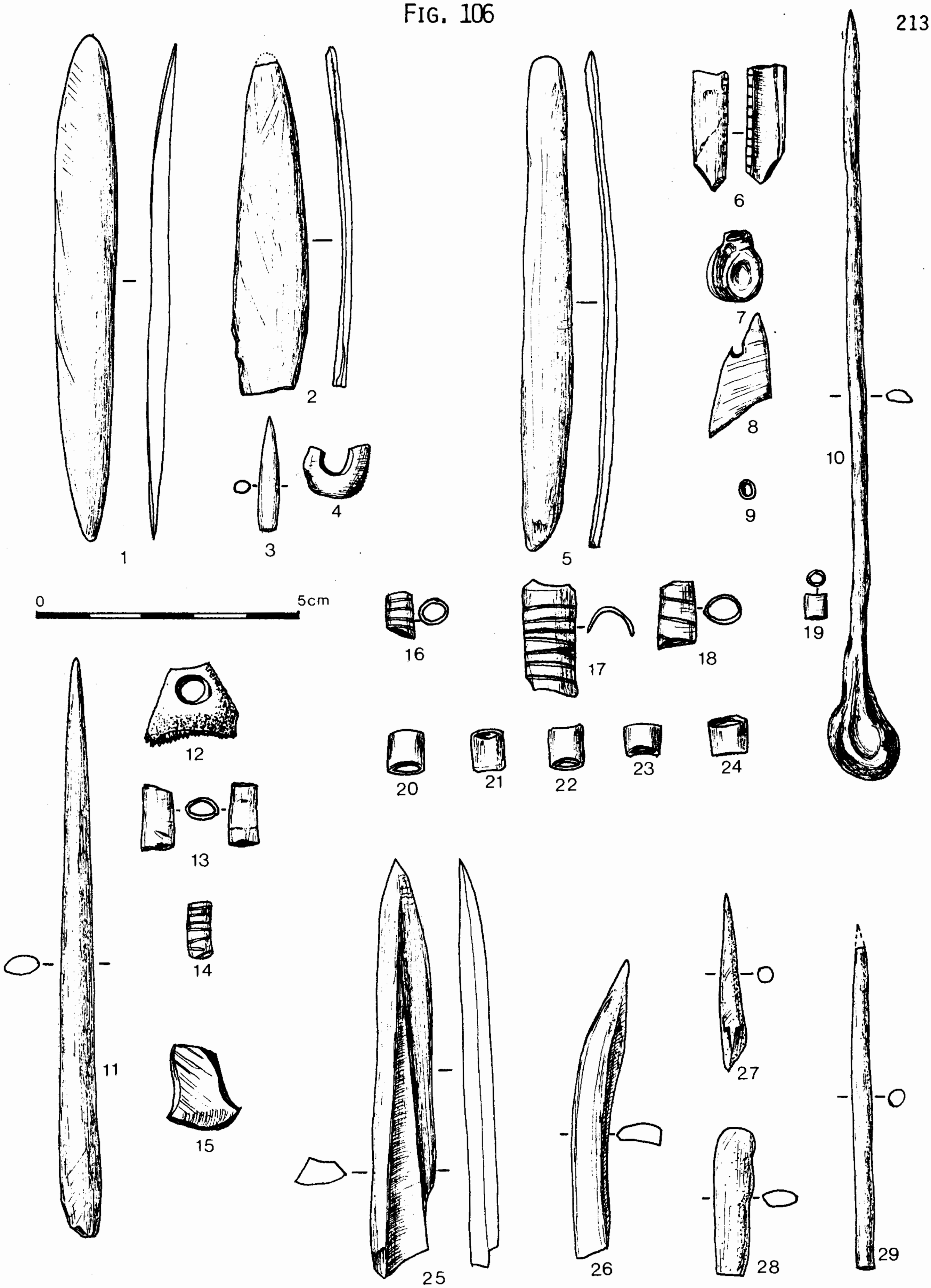


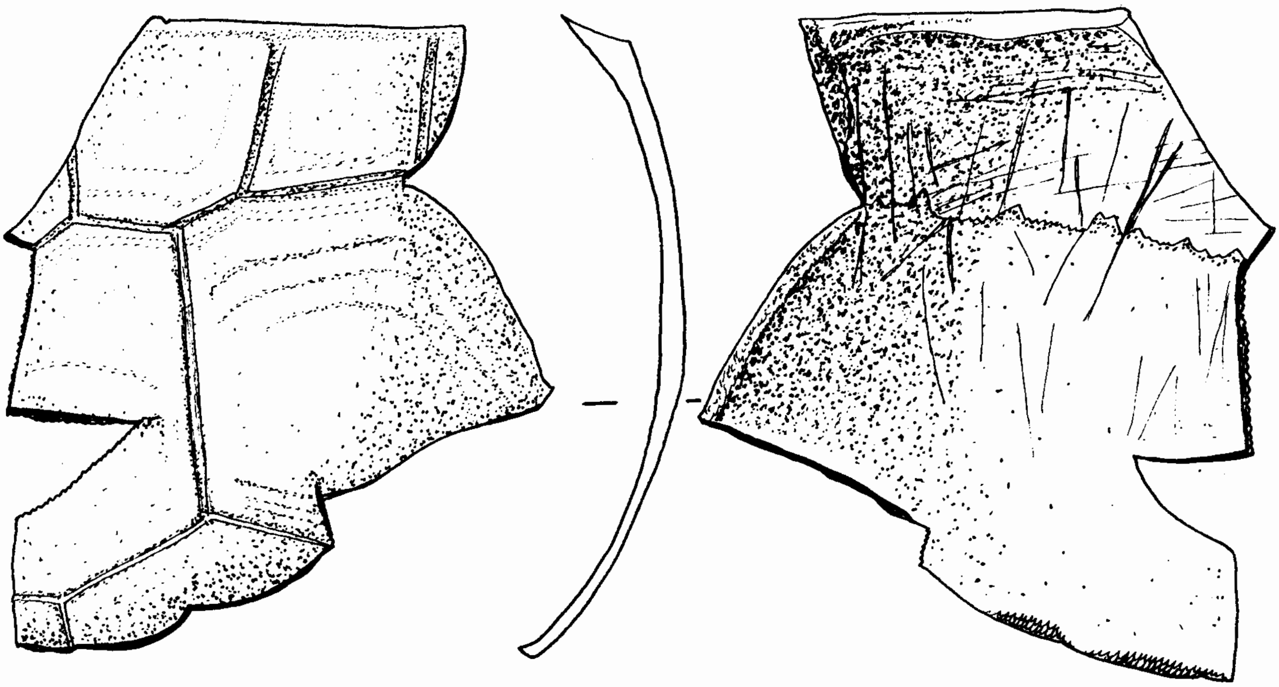
FIG. 106



Bone tools from Boomplaas. 1-4 from Pits in BLD Member; 5, 6, 9, 10: from BLD Member; 7: BFBL; 8: BLA; 11-14: BRL 6; 15: BRL; 16: BRL 7; 17,18,28:CL 2; 25,27:CL 1; 20-24,29: CL 3; 19,26: GWA.
1,2,5,25,28: Spatulates; 3,10,11,26,27,29: Points; 4,12: Tortoise carapace pendants; 6: Polished bone with regular notches; 7: articular end grooved and snapped; 8: scratched and perforated piece of bone; 9,19-24: Bone beads; 14,16-18: spirally grooved 'beads'; 13: polished bone tube; 15: scratched bone.

FIG. 107

BOOMPLAAS CAVE: PART OF A TORTOISESHELL BOWL AND MASTIC

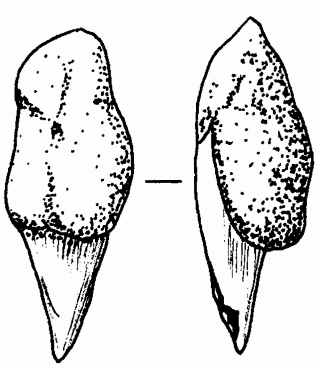


1

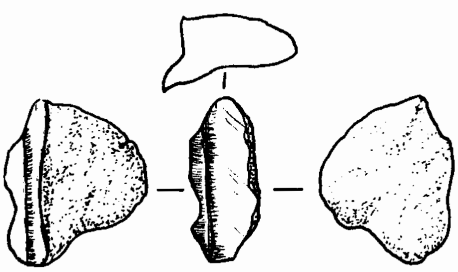
Part of a tortoiseshell bowl
from square P15 CL 3

CM

Lump of mastic on a piece
of wood. Pit 7 DGL Member

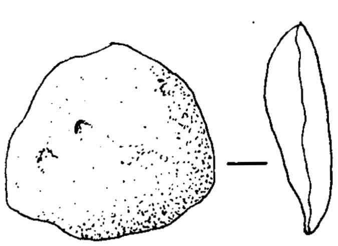


2



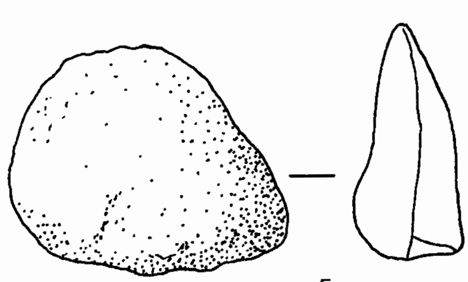
4

Piece of mastic with groove/impression
from Pit 15 BLD Member



3

Lump of mastic from Pit 9
DGL Member



5

Lump of mastic from Pit 23, BLD Member

in the vicinity of a site. At NBC, where ostriches were not recorded in historic times, the frequencies are high only in the late Pleistocene and in CS dated to ca 11 800 B.P. at a time when the rest of the faunal remains suggest more open grassland around the site than exists today. At BPA, on the other hand, where ostriches are to be found even today, ostrich eggshell fragments are found throughout the deposit.

Although isolated ostrich eggshell beads have been reported from LSA deposits older than 20 000 B.P. (see Chapter 7), it is only after this time that they occur in any quantity in archaeological contexts. At both NBC and BPA they are found in the late Pleistocene units and at BPA in particular they increase markedly in frequency after 12 000 B.P. There is no change in the size, finish or method of manufacture of beads through the time period covered by the NBC and BPA sequences.

The use of ostrich eggs as water containers or flasks and the habit of decorating the outside of these shells with patterns of incised lines has a similar antiquity to the manufacture of beads. The sporadic high frequencies of decorated fragments probably relate to the breakage of one or two of these water containers and are unlikely to have any cultural significance. As can be seen in Fig.109 there is no progression of designs through time with ladder-like patterns present from CL through to DGL, but there is a greater variety of patterns present in the older units, particularly in BRL. Ostrich eggshell and shell pendants and buttons appear to be restricted to the Holocene.

The regular occurrence of fragments of marine shell is notable at BPA which even today is some 80 km from the coast. It is only in units that post-date 11 000 B.P., however, that perforated shell beads are found. Most of these are made from the small estuarine shell Nassa kraussiana which occurs regularly but not abundantly in the BRL Member and becomes very common in the two late Holocene units, BLD and DGL. It is only in the mid-late Holocene that marine shell pendants are found and they are most common in the BLD Member (12). Fragments of the white mussel Donax serra have been found in the late Pleistocene units through the Holocene to DGL, but the freshwater mussel, Cafferia caffer, is identifiable only in the late Holocene. All these shells were found in small fragments and were clearly not brought to the site for food but for the manufacture of ornaments or some other purpose. The late occurrence of freshwater mussel shells is similar to that at Wilton

Fig. 108

NBC: Bone tools from RB, J, BSBJ, CS, GSL, BSL,YSL

1: Cut and polished bone with snapped end

2-10: Bone points

11-16: Spatulates

17-32: 'Fish gorges'

33-34: Multi-ringed bone tubes

35: bone bead

36,37: Bone pendants

2-5,12,17,36: From Rice B

1: From J

6,13-15,18-21: From BSBJ

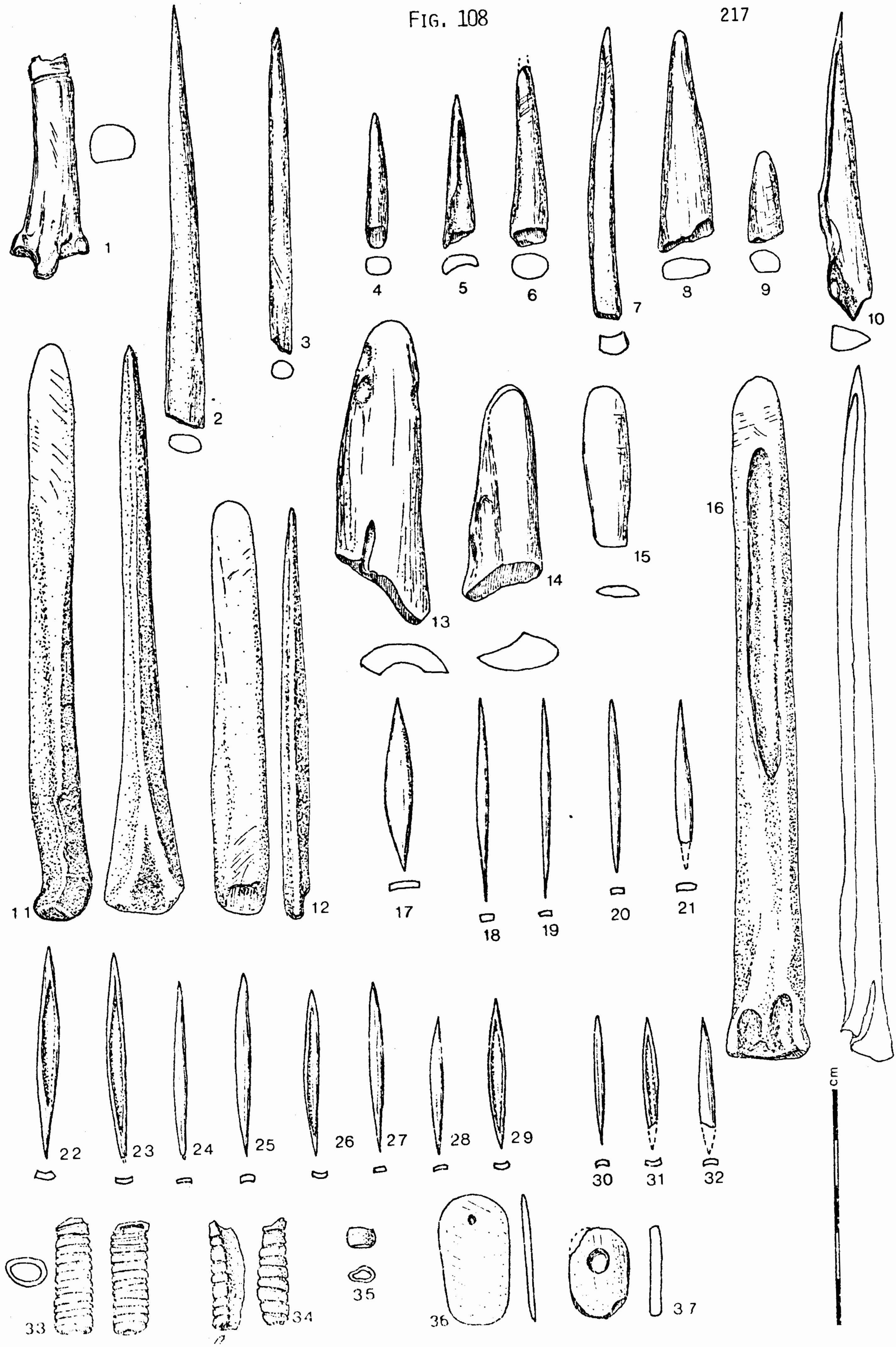
11,16,22-29,34: From CS

8,9,30-32,33,37: From GSL

35: From BSL

10: From YSL

FIG. 108


1
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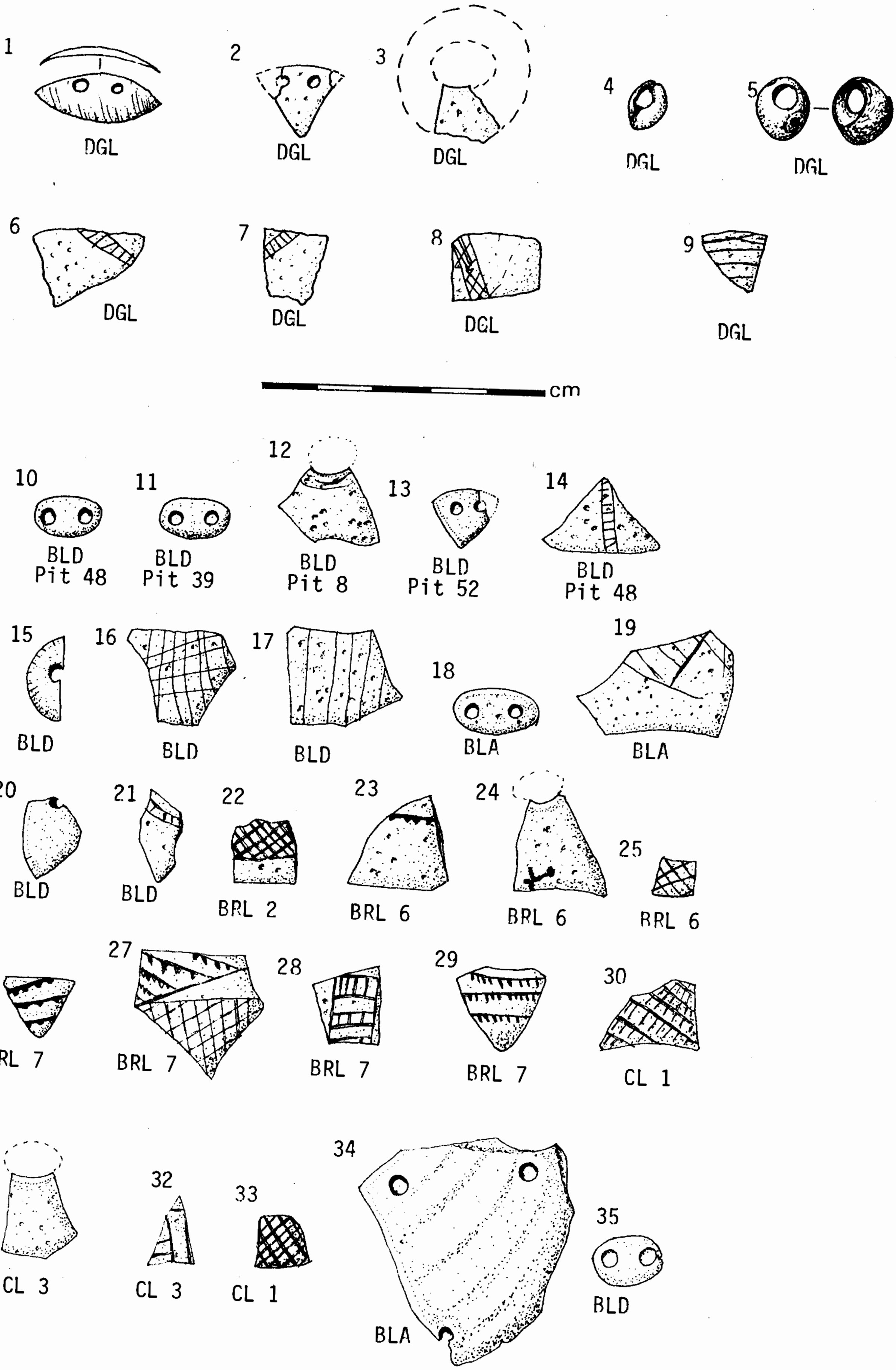
37
cm

FIG. 109



BOOMPLAAS : Worked ostrich eggshell and marine shell. 1,34,35: marine shell buttons and pendant. 2,10,11,13,15,18,20; ostrich eggshell buttons and pendants. 3,24,31: openings to ostrich eggshell water containers. 4,5: *Nassa* and *Natica* estuarine shell beads. 6-9,14,16,17,19,21-23, 25-30,32,33: decorated ostrich eggshell fragments.

(Deacon, J. 1972) and Melkhoutboom (Deacon, H.J. 1976), but at Buffelskloof it has been identified at the base of the Holocene units as well (Opperman 1978).

Pottery

Pottery frequencies at BPA and Kangkara are summarized in Table 64. The Kangkara fragments appear to have been trampled into the SUR unit but are interesting in that they demonstrate the use of quartz temper and are of the same thickness and general appearance as those from BPA.

The sample of pottery from DGL at Boomplaas comprises 1107 sherds of which 68 could be joined, giving a working total of 1039 sherds. The majority (72%) came from the upper units of DGL and all are considered to relate to this member although 44 sherds were found in disturbed context in the underlying BLD Member (Deacon et al 1978:64). It is estimated that about 25 different pots contributed to the sample of sherds, of which 17 are represented by rim sherds. The only reconstructable rim suggests a vessel with a rim diameter of about 80 mm and a contracted concave neck 21 mm high (Fig. 110:1). At least one bowl may be represented, but the majority of the rim sherds appear to come from wide-mouthed pots. No lugs or bosses were found, but there are three pointed or ovoid bases, two of which are nippled, from the upper DGL units (Fig. 110:12).

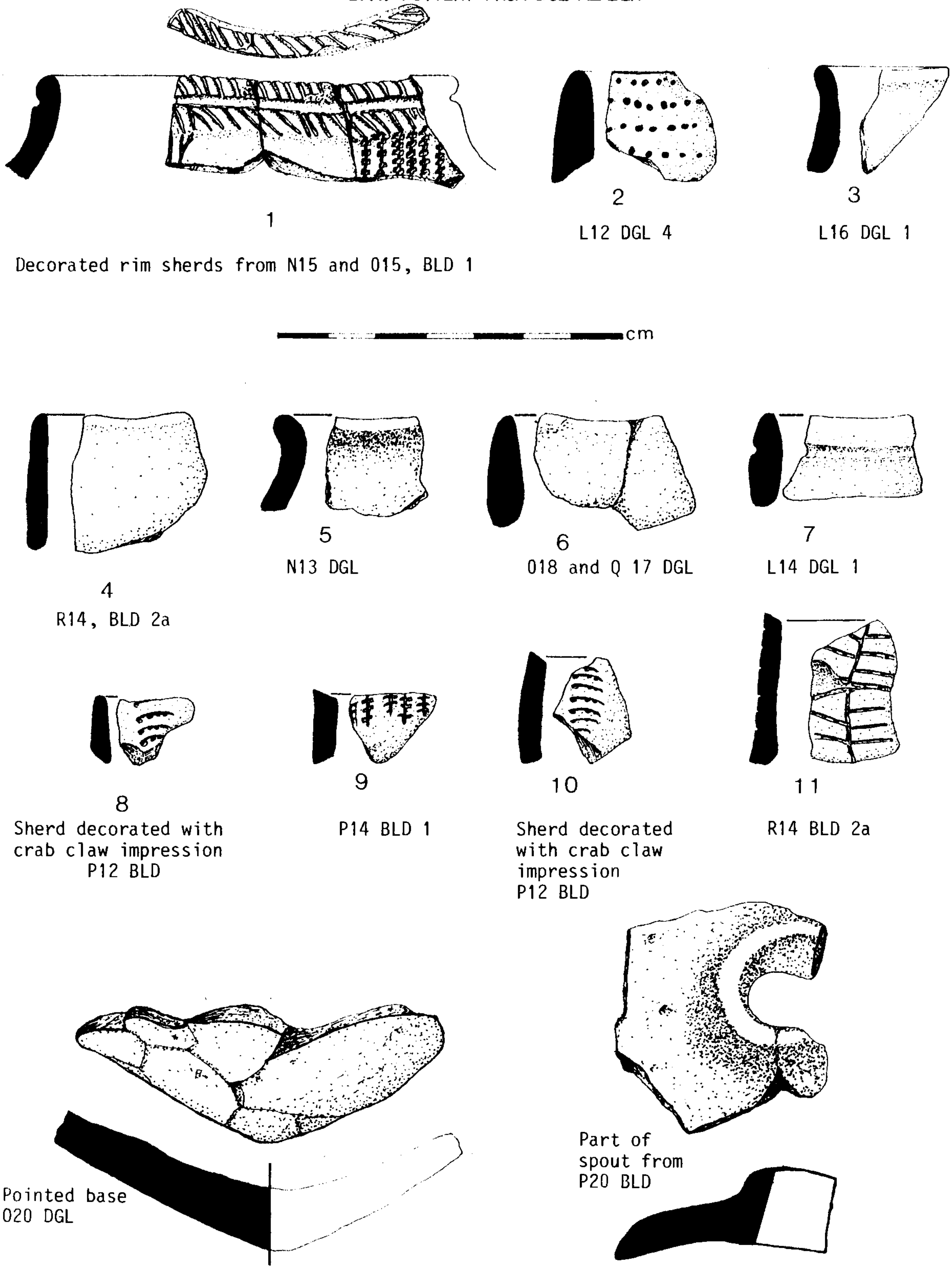
About 80% of the rims are simple rounded forms and the rest have one or both sides flattened (Fig. 110:1-7). The preferred combination of rim attributes is a rounded rim placed directly onto the neck of the pot with the top tapered instead of ridged or thickened.

There are 49 decorated sherds, of which ten are rim pieces and one is a spout fragment. The majority of the decoration patterns have a rectilinear design with dragged or incised lines more common than impressed or punctate lines. The non-linear decoration consists either of punctate dots or impressed patterns for which a die has been used (Fig. 110:2, 8-11). Of the latter type, three types of impressed pattern can be seen: one in which a small crab claw seems to have been used, one in which a series of wedges has been joined by a fine line drawn across them in wet clay, and a third with a series of toothed bars.

The thickness of the sherds is similar to that at other late

FIG. 110

BPA: POTTERY FROM DGL MEMBER



After Deacon et al 1978

Holocene sites with a mean of ca 6 mm, inclusions are quartz with no grass temper and only a small number were rubbed smooth enough to simulate a burnish. The sample falls well within the range of 'Hottentot' pottery described by Rudner (1968) and has been studied in detail by M L Wilson (Deacon et al 1978).

Mastic

Four lumps of mastic and a small convex scraper and part of the impression of a handle set in mastic were found in pits in the BLD Member at BPA. The first (Fig. 197:2) was found in pit 7 and has a small piece of wood attached to it. It seems to have been mastic stored for future use as it has no impression from a hafted tool. The second (Fig. 107:4) has snapped along the line of a handle and has thus retained the impression of it; it came from pit 15. The other two lumps, from pits 9 and 23, have neither impressions nor attachments and seem to have been kept for future use as mastic (Fig. 107:3,5).

The hafted convex scraper (Fig. 111) has been hafted at right angles to the handle similar to a specimen of comparable size with a decorated bone handle in the collections of the Albany Museum (Deacon & Deacon 1980) and is clear confirmation of the fact that small convex scrapers were hafted.

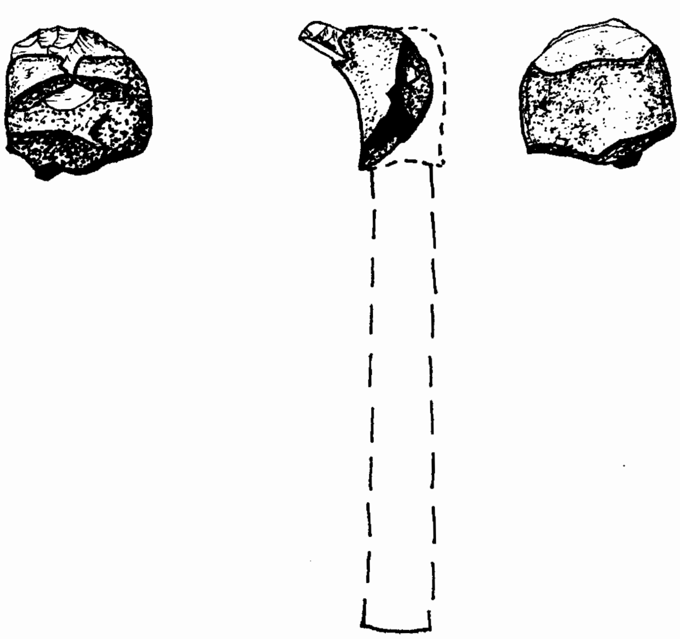


Fig. 111. Small convex scraper mounted in mastic with suggested reconstruction (centre). From pit 27, BLD Member, Boomplaas.

Painted stones and ochre

Four painted stones were found at BPA, three in the BLD Member and one in BLA confirming the antiquity of rock paintings in the southern Cape at ca 6400 B.P. They have been described in detail elsewhere (Deacon et al 1976). Although none were found at NBC, a number were recovered from other caves on the Robberg Peninsula earlier this century (Rudner & Rudner 1973). One BPA painted stones is illustrated in Fig. 28.

Ochre is found throughout the BPA and NBC sequences in small but constant quantities. The frequencies are summarized in Table 65 but it should be stressed that much of the ochre is very friable so that the number of fragments sometimes gives a false impression of the quantity. Should a more realistic measure of the relative quantity be required in future it would be better to weigh the fragments rather than count them.

GENERAL SUMMARY OF RESULTS OF ARTEFACT ANALYSES

Diachronic change has been demonstrated in the methods of stone flaking, in the choice of raw materials, in the design and range of formal tools, in the appearance of items characteristic of the LSA and in the horizontal distribution of artefacts. Some of the changes are common to all the sites suggesting that they are of more than local significance.

The late Pleistocene assemblages at NBC and BPA are characterized by standardized bladelet cores, both single platform and small flat forms, which produced relatively high numbers of small bladelets, a small proportion of which was backed. Preferred raw materials were silcrete and quartz, although quartzite still dominated at NBC. Most of the formal tool designs known in the Holocene were in use in the late Pleistocene, but in much smaller numbers and with a wider variance in the metric attributes of scrapers and adzes. The lowest KRA unit includes a few bladelets and bladelet cores, but none of the formal tools found at BPA and NBC.

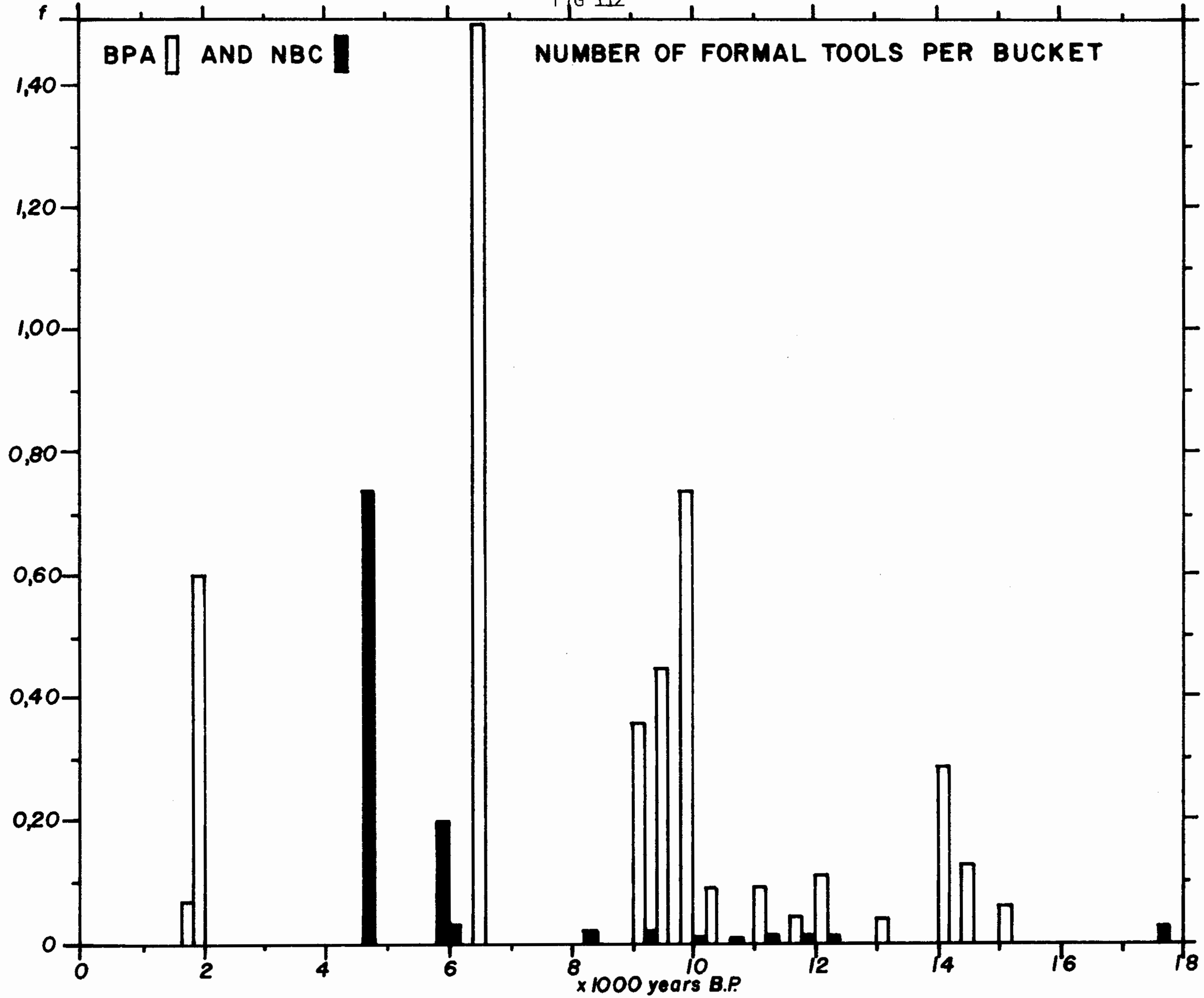
After about 12 000 B.P. and prior to about 7500 B.P., bladelet cores were rarely made, bladelets occur in very low frequencies and the mean length of untrimmed flakes increased with the selection of raw materials such as quartzite and hornfels. Backed microliths and adzes were relatively rare, but scrapers increased both in frequency and in size with end scraper forms, some with side retouch for shaping the blank, preferred in the early Holocene.

After about 7500 B.P. finer grained raw materials were added to the range again and quartz, chalcedony and, to a lesser extent, silcrete and hornfels became more common. The incidence of formal tools increased several fold and the range included small scrapers, backed microliths, borers, adzes and ground stone tools such as bored stones and sinkers at NBC. Bladelet cores and unretouched bladelets were less common than in the late Pleistocene and the flat bladelet cores were absent. It appears that the backed bladelets and segments of the Holocene were shaped by secondary retouch rather than by careful preparation of the core to produce 'instant' artefacts. Although domesticated sheep and pottery were introduced at BPA after 2000 B.P., there is no accompanying change in the artefacts at this time, except for the addition of metal in the form of a copper bead, and the introduction of pottery.

Through the late Pleistocene and Holocene sequence at BPA there is a good correlation between changes in the mean lengths of scrapers and untrimmed flakes indicating that flaking method was geared to some extent to the production of blanks for formal tools, but at NBC the correlation is not as clear (Fig. 94). However, there is no correlation between the incidence of formal tools and any particular flaking method, nor between formal tools and any particular raw material. While flake dimensions, core sub-types, raw material preferences and the range of formal tool designs may be similar in late Pleistocene and Holocene assemblages, the gross frequency of formal tools and the greater standardization in their metric attributes consistently separate the assemblages of these two time periods. While at NBC the incidence of formal tools increased markedly only after 6000 B.P., at BPA the incidence is high after 10 000 B.P. but increased more dramatically after 6500 B.P. (Fig. 112).

Changes in raw material frequencies have shown that these are linked to some extent to the production of certain artefact classes, but the correlation is seldom linear and it would not be possible to predict the range or frequency of formal tools from raw material frequencies alone. Analysis of raw materials from the three sites has

FIG 112



BPA AND NBC
NUMBER OF FORMAL TOOLS PER BUCKET
f
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0
0
2
4
6
8
10
12
14
16
18
x 1000 years B.P.

confirmed the observations on ESA materials by Clark (1980) and of Gould based on Australian data (1977) that if a site is located close to a source of raw material, this material will be far more common than any other. Thus quartzite dominates at NBC and Kangkara and quartz is most common at BPA. This makes changes in raw material frequencies all the more interesting because we can assume that these were motivated by changing preferences. It is the timing of changes in raw material preferences that are coincident at the three sites, rather than the choice of particular materials, although in the terminal Pleistocene/ early Holocene materials that could produce larger flakes were selected over those that occurred in smaller nodules. In a different context, Humphreys (1972b) has also demonstrated the combination of site location and changing preferences through time as the factors affecting the incidence of agates and similar materials at sites in the Middle Orange River area.

Changes in the density and distribution of artefacts through time in excavated units have been noted and it is clear that inter-assemblage differences can be caused by both natural and cultural transforms but the identification of these is not straightforward.

Changes in scraper dimensions through time appear to be cyclic and independent of changes in adze dimensions, although there is some correlation between scraper and untrimmed flake lengths at BPA. Inter-site comparisons show that changes in scraper parameters are broadly contemporary at the three sites, but only one long sequence of adze parameters is available so it is not possible to test their wider significance. Although the actual dimensions of scrapers depend on the range of raw materials at a site, the timing and direction of the shifts in size and shape are regionally contemporary and are therefore largely independent of raw materials. There is no evidence for the assumption that particular raw materials needed more retouch than others, but certain materials were deliberately selected for particular formal tool classes and utilized tools, presumably because of their superior qualities. We can therefore conclude that the choice of raw material had as much to do with the uses for which the final tools were to be made, as with the range of materials available in the vicinity of the site and the qualities of the materials for the job in hand. The most common raw material in an assemblage can have a strong influence on the relative frequency of chips, chunks and untrimmed flakes because of the way in which the material breaks during the flaking process, but would have little influence on the range and frequency of formal tools produced.

T A B L E S

FOR

C H A P T E R 5

TABLES 11-65

Table 11

Nelson Bay Cave: Frequencies and percentage frequencies in classes of the Waste category and in raw material classes

CLASS	RAW MATERIAL		IC	BSC	RA	RB	J	BSBJ	CS	GSL	BSL	YSL	YGL
Chips	Quartz	f	163	621	79	21	1	28	13	29	232	638	1834
		%	*41,2*	*63,6*	*73,8*	*63,6*	*7,7*	*40,6*	*43,3*	*24,4*	*74,4*	*88,7*	*93,9*
	Quartzite	f	170	287	27	9	12	40	14	29	28	11	88
		%	*42,9*	*29,4*	*25,2*	*27,3*	[illegible]	*58,*	*46,7*	*24,4*	*9,0*	*1,5*	*4,5*
	Chalcedony	f	41	68	1	2	-	1	3	56	34	17	27
		%	[illegible]	*7,0*	*0,9*	*6,1*	-	[illegible]	*10,0*	*47,1*	*10,9*	*2,4*	*1,4*
	Silcrete	f			-	1	-	-	-	5	17	53	3
		%		-	-	*3,1*	-	-	-	*4,2*	*5,5*	*7,4*	*0,2*
	Other	f		-	-	-	-	-	-	-	1	-	-
		%	-	-	-	-	-	-	-	-	*0,3*	-	-
	Total	f	396	976	107	33	13	69	30	119	312	719	1952
Chips as % of total waste			*6,7*	*6,9*	*2,5*	*0,5*	*0,3*	*1,2*	*1,2*	*5,2*	*17,4*	*15,1*	*21,5*
Chunks	Quartz	f	123	367	108	44	12	24	26	15	-	488	658
		%	*36,2*	*42,9*	*29,6*	*8,5*	*5,3*	*8,1*	*23,6*	*10,2*	-	*74,3*	*86,4*
	Quartzite	f	140	405	256	468	210	274	84	122	62	57	88
		%	*41,2*	*47,3*	*70,1*	*89,8*	*93,3*	*92,0*	*76,4*	*83,0*	*83,8*	*8,7*	*11,6*
	Chalcedony	f	66	82	1	8	1	-	-	6	9	5	12
		%	*19,4*	*9,6*	*0,3*	*1,5*	*0,4*	-	-	*4,1*	*12,2*	*0,8*	*1,6*
	Silcrete	f	11	1	-	1	-	-	-	4	2	107	3
		%	*3,2*	*0,1*	-	*0,2*	-	-	-	*2,7*	*2,7*	*16,3*	*0.4*
	Other	f	-	1	-	-	2	-	-	-	1	-	1
		%	-	*0,1*	-	-	*0,9*	-	-	-	*1,4*	-	*0,1*
	Total	f	340	856	365	521	225	298	110	147	74	657	762
Chunks as % of total waste			*5,7*	*6,0*	*8,5*	*7,8*	*5,6*	*5,2*	*4,5*	*6,4*	*4,1*	*13,8*	*8,4*
Cores	Quartz	f	6	7	7	1	7	1	2	7	6	34	112
		%	*13,0*	*3,7*	*10,9*	*0,5*	*3,9*	*0,7*	*3,4*	*21,2*	*28,6*	*34,0*	*66,7*
	Quartzite	f	36	171	55	201	170	146	56	22	4	13	36
		%	*78,3*	*91,4*	*85,9*	*99,0*	*95,0*	*99,3*	*94,9*	*66,7*	*19,1*	*13,0*	*21,4*
	Chalcedony	f	3	8	2	1	2	-	1	2	2	2	10
		%	*6,5*	*4,3*	*3,1*	*0,5*	*1,1*	-	*1,7*	*6,1*	*9,5*	*2,0*	*6,0*
	Silcrete	f	-	-	-	-	-	-	-	2	9	51	10
		%	-	-	-	-	-	-	-	*6,1*	*42,9*	*51,0*	*6,0*
	Other	f	1	1	-	-	-	-	-	-	-	-	-
		%	*2,2*	*0,5*	-	-	-	-	-	-	-	-	-
	Total	f	46	187	64	203	179	147	59	33	21	100	168
Cores as % of total waste			*0,8*	*1,3*	*1,5*	*3,0*	*4,4*	*2,6*	*2,4*	*1,4*	*1,2*	*2,1*	*1,9*
Core reduced pieces	Quartz	f	20	26	5	1	3	-	-	-	13	15	53
		%	*54,1*	*56,5*	*83,3*	*12,5*	*100,0*	-	-	-	*86,7*	*88,2*	*81,5*
	Quartzite	f	4	7	-	6	-	-	-	-	2	-	10
		%	*10,8*	*15,2*	-	*75,0*	-	-	-	-	*13,3*	-	*15,4*
	Chalcedony	f	12	12	1	-	-	-	1	5	-	1	2
		%	*32,4*	*26,1*	*16,7*	-	-	-	*100,0*	*100,0*	-	*5,9*	*3,1*
	Silcrete	f	1	1	-	-	-	-	-	-	-	1	-
		%	*2,7*	*2,2*	-	-	-	-	-	-	-	*5,9*	-
	Other	f	-	-	-	1	-	-	-	-	-	-	-
		%	-	-	-	*12,5*	-	-	-	-	-	-	-
	Total	f	37	46	6	8	3	-	1	5	15	17	65
CRPs as % of total waste			*0,6*	*0,3*	*0,1*	*0,1*	*0,1*	-	*0,04*	*0,2*	*0,8*	*0,4*	*0,7*
Untrimmed flakes	Quartz	f	418	774	293	124	39	54	86	54	167	1229	2882
		%	*8,1*	*6,4*	*7,8*	*2,1*	*1,1*	*1,0*	*3,8*	*2,7*	*12,2*	*37,7*	*46,9*
	Quartzite	f	4325	10960	3444	5776	3590	5180	2163	1792	1068	983	2943
		%	*84,2*	*90,1*	*91,8*	*97,5*	*98,7*	*98,9*	*95,5*	*90,2*	*78,0*	*30,1*	*47,9*
	Chalcedony	f	328	394	13	22	6	4	15	69	55	119	230
		%	*6,4*	*3,3*	*0,4*	*0,4*	*0,2*	*0,1*	*0,7*	*3,5*	*4,0*	*3,7*	*3,7*
	Silcrete	f	63	8	2	2	-	1	1	71	80	929	87
		%	*1,2*	*0,1*	*0,1*	*0,03*	-	*0,02*	*0,04*	*3,6*	*5,8*	*28,5*	*1,4*
	Other	f	5	1	-	1	1	-	1	-	-	-	-
		%	*0,1*	*0,01*	-	*0,02*	*0,03*	-	*0,04*	-	-	-	-
	Total	f	5139	12137	3752	5925	3636	5239	2266	1986	1370	3260	6142
Untrimmed flakes as % of total waste			*86,3*	*85,5*	*87,4*	*88,6*	*89,6*	*91,1*	*91,9*	*86,7*	*76,5*	*68,6*	*67,6*
TOTAL WASTE	Quartz	f	730	1795	492	191	62	107	127	105	418	2404	5539
		%	*12,3*	*12,6*	*11,5*	*2,9*	*1,5*	*1,9*	*5,2*	*4,6*	*23,3*	*50,6*	*60,9*
	Quartzite	f	4675	11830	3782	6460	3982	5640	2317	1965	1164	1064	3165
		%	*78,5*	*83,3*	*88,1*	*96,6*	*98,2*	*98,0*	*94,0*	*85,8*	*65,0*	*22,4*	*34,8*
	Chalcedony	f	450	564	18	33	9	5	20	138	100	144	281
		%	*7,6*	*4,0*	*0,4*	*0,5*	*0,2*	*0,1*	*0,8*	*6,0*	*5,6*	*3,0*	*3,1*
	Silcrete	f	97	10	2	4	-	1	1	82	108	1141	103
		%	*1,6*	*0,1*	*0,1*	*0,1*	-	*0,02*	*0,04*	*3,6*	*6,0*	*24,0*	*1,1*
	Other	f	6	3	-	2	3	-	1	-	2	-	1
		%	*0,1*	*0,02*	-	*0,03*	*0,1*	-	*0,04*	-	*0,1*	-	*0,01*
	Total	f	5958	14202	4294	6690	4056	5753	2466	2290	1792	4753	9089
Waste as % of Grand Total			*93,5*	*95,0*	*94,9*	*93,7*	*96,0*	*94,8*	*95,9*	*96,8*	*94,2*	*97,4*	*98,0*
NUMBER OF BUCKETS OF DEPOSIT EXCAVATED			215	415	650	1204	454	818	464	301	392	---- 507 -----	
Total artefacts/bucket			29,7	36,0	7,0	5,9	7,8	7,4	5,5	7,9	4,9	27,9	
Untrimmed flakes/bucket			23,9	29,3	5,8	4,9	6,7	6,4	4,9	6,6	3,5	18,5	
Utilized pieces/bucket			1,2	1,6	0,3	0,4	0,3	0,4	0,2	0,3	0,3	0,4	
Formal tools/bucket			0,7	0,2	0,03	0,02	0,02	0,01	0,00	0,01	0,01	0,03	
Minimum number of larger mammals excluding carnivores, viverrids and marine mammals/bucket			0,33	0,17	0,10	0,05	0,08	0,10	0,14	0,17	0,13	0,27	

Table 12

Nelson Bay Cave : Frequencies and percentage frequencies in classes of the Utilized cate and in raw material classes

CLASS	RAW MATERIAL		IC	BSC	RA	RB	J	BSBJ	CS	GSL	BSL	YSL	YGL
Utilized flakes	Quartz	f	29	43	34	2	2	-	-	-	1	16	35
		%	*15,0*	*10,4*	*26,2*	*0,8*	*1,5*	-	-	-	*1,0*	*13,6*	*21,1*
	Quartzite	f	143	342	94	246	131	220	72	69	91	62	118
		%	*73,7*	*82,4*	*72,3*	*98,0*	*96,3*	*99,6*	*94,7*	*98,6*	*88,4*	*52,5*	*71,1*
	Chalcedony	f	17	30	2	3	2	1	1	-	-	2	8
		%	*8,8*	*7,2*	*1,5*	*1,2*	*1,5*	*0,5*	*1,3*	-	-	*1,7*	*4,8*
	Silcrete	f	5	-	-	-	-	-	-	1	8	38	5
		%	*2,6*	-	-	-	-	-	-	*1,4*	*7,8*	*32,2*	*3,0*
	Other	f	-	-	-	-	1	-	3	-	3	-	-
		%	-	-	-	-	*0,7*	-	*4,0*	-	*2,9*	-	-
	Total	f	194	415	130	251	136	221	76	70	103	118	166
Utilized flakes as % total utilized			*75,2*	*62,0*	*61,6*	*59,8*	*84,5*	*70,8*	*0,7*	*93,3*	*96,3*	*98,3*	*97,1*
Edge damaged flakes		f	88	143	61	104	55	74	38	42	43	62	86
as % total utilized flakes			*45,3*	*34,5*	*46,9*	*41,4*	*40,4*	*33,5*	*50,0*	*60,0*	*41,8*	*52,5*	*51,8*
Steep damage		f	51	147	35	83	49	63	18	10	17	16	37
as % total utilized flakes			*26,3*	*35,4*	*26,9*	*33,1*	*36,0*	*28,5*	*23,7*	*14,3*	*16,5*	*13,6*	*22,3*
Notched edges		f	55	125	34	64	32	84	20	18	43	40	43
as % total utilized flakes			*28,4*	*30,1*	*26,2*	*25,5*	*23,5*	*38,0*	*26,3*	*25,7*	*41,8*	*33,9*	*25,9*
Heavy edge-flaked pieces	Quartzite	f	34	202	65	140	17	76	19	2	3	-	3
	Silcrete	f	-	-	1	-	-	-	-	-	-	-	-
	HEFPs as % of total utilized		*13,2*	*30,2*	*31,3*	*33,3*	*10,6*	*24,4*	*18,1*	*2,7*	*2,8*	-	*1,8*
Smoothed slate		f	1	5	3	7	-	-	-	-	-	-	-
Grindstones:	Quartzite	f	-	1	2	1	-	-	-	-	-	-	-
Rubbers	Quartzite	f	14	5	2	9	2	2	2	-	-	-	1
Hammerstones:	Quartzite	f	6	38	8	8	4	11	6	2	1	2	-
Combination hammer/rubber			9	3	-	4	2	2	2	1	-	-	1
	Total	f	30	52	15	29	8	15	10	3	1	2	2
% Total utilized		%	*11,6*	*7,8*	*7,1*	*6,9*	*5,0*	*4,8*	*9,5*	*4,0*	*0,9*	*1,7*	*1,2*
TOTAL UTILIZED	Quartz	f	29	43	34	2	2	-	-	-	1	16	35
		%	*11,2*	*6,4*	*16,1*	*0,5*	*1,2*	-	-	-	*0,9*	*13,3*	*20,5*
	Quartzite	f	206	591	171	408	156	311	101	74	95	64	123
		%	*79,8*	*88,3*	*81,0*	*97,1*	*96,9*	*99,7*	*96,2*	*98,7*	*88,8*	*53,3*	*71,9*
	Chalcedony	f	17	30	2	3	2	1	1	-	-	2	8
		%	*6,6*	*4,5*	*0,9*	*0,7*	*1,2*	*0,3*	*1,0*	-	-	*1,7*	*4,7*
	Silcrete	f	5	-	1	-	-	-	-	1	8	38	5
		%	*1,9*	-	*0,5*	-	-	-	-	*1,3*	*7,5*	*31,7*	*2,9*
	Other	f	1	5	3	7	1	-	3	-	3	-	-
		%	*0,4*	*0,8*	*1,4*	*1,7*	*0,6*	-	*2,9*	-	*2,8*	-	-
	TOTAL	f	258	669	211	420	161	312	105	75	107	120	171
Utilized as % Grand Total			*4,1*	*4,5*	*4,7*	*5,9*	*3,8*	*5,1*	*4,1*	*3,2*	*5,6*	*2,5*	*1,8*

Table 13

Nelson Bay Cave : Frequencies and percentage frequencies in classes and sub-classes of the Formal Tools category

CLASS	RAW MATERIAL		IC	BSC	RA	RB	J	BSBJ	CS	GSL	BSL	YSL	YGL
Scrapers	Quartz	f	40	29	10	4	-	-	-	-	1	4	2
		%	*32,3*	*42,7*	*62,5*	*14,3*	-	-	-	-	*33,3*	*100,0*	*100,0*
	Quartzite	f	3	1	5	19	7	6	1	1	2	-	-
		%	*2,4*	*1,5*	*31,3*	*67,9*	*77,8*	*100,0*	*100,0*	*100,0*	*66,7*	-	-
	Chalcedony	f	51	38	-	5	2	-	-	-	-	-	-
		%	*41,1*	*55,9*	-	*17,9*	*22,2*	-	-	-	-	-	-
	Silcrete	f	30	-	1	-	-	-	-	-	-	-	-
		%	*24,2*	-	*6,3*	-	-	-	-	-	-	-	-
	Total	f	124	68	16	28	9	6	1	1	3	4	2
Scrapers as % total formal			*78,0*	*81,0*	*76,2*	*96,6*	*90,0*	*85,7*	*100,0*	*50,0*	*75,0*	*80,0*	*18,2*
Backed micro-liths	Quartz	f	17	6	-	-	-	-	-	-	-	-	2
		%	*54,8*	*54,6*	-	-	-	-	-	-	-	-	*50,0*
	Quartzite	f	1	-	-	-	-	-	-	-	-	-	1
		%	*3,2*	-	-	-	-	-	-	-	-	-	*25,0*
	Chalcedony	f	9	5	1	-	-	-	-	-	-	-	1
		%	*29,0*	*45,5*	*100,0*	-	-	-	-	-	-	-	*25,0*
	Silcrete	f	4	-	-	-	-	-	-	-	-	1	-
		%	*12,9*	-	-	-	-	-	-	-	-	*100,0*	-
	Total	f	31	11	1	-	-	-	-	-	-	1	4
Backed microliths as % total formal			*19,5*	*13,1*	*4,8*	-	-	-	-	-	-	*20,0*	*36,4*
Segments		f	25	7	1	-	-	-	-	-	-	-	2
	% total backed		*80,7*	*63,6*	*100,0*	-	-	-	-	-	-	-	*50,0*
Backed flakes/bladelets		f	1	2	-	-	-	-	-	-	-	1	-
	% total backed		*3,2*	*18,2*	-	-	-	-	-	-	-	*100,0*	*25,0*
Broken backed pieces		f	5	2	-	-	-	-	-	-	-	-	-
	% total backed		*16,1*	*18,2*	-	-	-	-	-	-	-	-	-
Borers	Quartz	f	-	1	1	-	-	-	-	-	-	-	-
		%	-	*100,0*	*100,0*	-	-	-	-	-	-	-	-
Borers as % total formal			-	*1,2*	*4,8*	-	-	-	-	-	-	-	-
Misc retouch	Quartz	f	2	-	-	-	-	-	-	-	-	-	1
		%	*66,7*	-	-	-	-	-	-	-	-	-	*20,0*
	Quartzite	f	-	1	2	1	1	1	-	-	-	-	3
		%	-	*50,0*	*100,0*	*100,0*	*100,0*	*100,0*	-	-	-	-	*60,0*
	Chalcedony	f	-	1	-	-	-	-	-	1	-	-	1
		%	-	*50,0*	-	-	-	-	-	*100,0*	-	-	*20,0*
	Silcrete	f	1	-	-	-	-	-	-	-	1	-	-
		%	*33,3*	-	-	-	-	-	-	-	*100,0*	-	-
	Total	f	3	2	2	1	1	1	-	1	1	-	5
Misc Retouch as % formal			*1,9*	*2,4*	*9,5*	*3,5*	*10,0*	*14,3*	-	*50,0*	*25,0*	-	*45,5*
Bored stones (small)	Quartzite	f	1	2	-	-	-	-	-	-	-	-	-
	% total formal		*0,6*	*2,4*	-	-	-	-	-	-	-	-	-
Sinker	Quartzite	f	-	-	1	-	-	-	-	-	-	-	-
	% total formal		-	-	*4,8*	-	-	-	-	-	-	-	-
TOTAL FORMAL	Quartz	f	59	36	11	4	-	-	-	-	1	4	5
		%	*37,1*	*42,9*	*52,4*	*13,8*	-	-	-	-	*25,0*	*80,0*	*45,5*
	Quartzite	f	5	4	8	20	8	7	1	1	2	-	4
		%	*3,1*	*4,8*	*38,1*	*69,0*	*80,0*	*100,0*	*100,0*	*50,0*	*75,0*	-	*36,4*
	Chalcedony	f	60	44	1	5	2	-	-	1	-	-	2
		%	*37,7*	*52,4*	*4,8*	*17,2*	*20,0*	-	-	*50,0*	-	-	*18,2*
	Silcrete	f	35	-	1	-	-	-	-	-	1	1	-
		%	*22,0*	-	*4,8*	-	-	-	-	-	*25,0*	*20,0*	-
	TOTAL	f	159	84	21	29	10	7	1	2	4	5	11
Formal tools as % Grand Total			*2,5*	*0,6*	*0,5*	*0,4*	*0,2*	*0,1*	*0,04*	*0,1*	*0,2*	*0,1*	*0,1*

Table 14

Kangkara Cave : Frequencies and percentage frequencies in classes of the Waste category and in raw material classes

CLASS	RAW MATERIAL		SUR	HBC	SGL	DGL	GBL	PBW	LPW	RBL	YBL	BD	BBD
Chips	Quartz	f	72	123	80	148	354	175	87	77	29	75	24
		%	*72,0*	*75,9*	*88,9*	*87,1*	*66,5*	*78,8*	*39,6*	*22,9*	*74,4*	*65,2*	*61,5*
	Quartzite	f	17	13	8	12	52	17	70	100	1	7	1
		%	*17,0*	*8,0*	*8,9*	*7,1*	*9,8*	*7,7*	*31,8*	*29,7*	*2,6*	*6,1*	*2,6*
	Hornfels	f	1	-	-	-	1	1	5	9	2	11	-
		%	*1,0*	-	-	-	*0,2*	*0,5*	*2,3*	*2,7*	*5,1*	*9,6*	-
	Chalcedony	f	3	18	2	8	89	13	24	106	2	11	4
		%	*3,0*	*11,1*	*2,2*	*4,7*	*16,7*	*5,9*	*10,9*	*31,5*	*5,1*	*9,6*	*10,3*
	Silcrete	f	7	8	-	2	36	16	34	45	5	11	10
		%	*7,0*	*4,9*	-	*1,2*	*6,8*	*7,2*	*15,5*	*13,4*	*12,8*	*9,6*	*25,6*
	Total	f	100	162	90	170	532	222	220	337	39	115	39
Chips as % of total waste			*23,6*	*21,4*	*16,1*	*27,0*	*31,4*	*20,1*	*12,8*	*22,5*	*7,2*	*16,2*	*5,2*
Chunks	Quartz	f	38	66	52	46	129	81	70	61	34	50	53
		%	*60,3*	*59,5*	*70,3*	*53,5*	*61,7*	*45,8*	*29,4*	*29,1*	*41,5*	*30,7*	*26,8*
	Quartzite	f	14	27	18	26	39	61	99	105	37	53	73
		%	*22,2*	*24,3*	*24,3*	*30,2*	*18,7*	*34,5*	*41,6*	*50,0*	*45,1*	*32,5*	*36,9*
	Hornfels	f	-	1	-	-	3	-	5	-	-	11	1
		%	-	*0,9*	-	-	*1,4*	-	*2,1*	-	-	*6,8*	*0,5*
	Chalcedony	f	4	9	2	8	20	11	16	32	4	7	7
		%	*6,3*	*8,1*	*2,7*	*9,3*	*9,6*	*6,2*	*6,7*	*15,2*	*4,9*	*4,3*	*3,5*
	Silcrete	f	7	8	2	6	18	24	48	12	7	42	64
		%	*11,1*	*7,2*	*2,7*	*7,0*	*8,6*	*13,6*	*20,2*	*5,7*	*8,5*	*25,8*	*32,3*
	Total	f	63	111	74	86	209	177	238	210	82	163	198
Chunks as % of total waste			*14,9*	*14,7*	*13,3*	*13,7*	*12,3*	*16,0*	*13,9*	*14,0*	*15,2*	*23,0*	*26,2*
Cores	Quartz	f	7	4	10	5	10	8	3	1	-	4	-
		%	*77,8*	*66,7*	*76,9*	*71,4*	*58,8*	*44,4*	*17,7*	*16,7*	-	*22,2*	-
	Quartzite	f	-	1	-	-	-	-	1	-	2	-	2
		%	-	*16,7*	-	-	-	-	*5,9*	-	*50,0*	-	*5,3*
	Hornfels	f	-	-	-	-	-	-	1	-	-	1	-
		%	-	-	-	-	-	-	*5,9*	-	-	*5,6*	-
	Chalcedony	f	1	1	3	1	3	5	6	3	1	-	-
		%	*11,1*	*16,7*	*23,1*	*14,3*	*17,7*	*27,8*	*35,3*	*50,0*	*25,0*	-	-
	Silcrete	f	1	-	-	1	4	5	6	2	1	13	36
		%	*11,1*	-	-	*14,3*	*23,5*	*27,8*	*35,3*	*33,3*	*25,0*	*72,2*	*94,7*
	Total	f	9	6	13	7	17	18	17	6	4	18	38
Cores as % of total waste			*2,1*	*0,8*	*2,3*	*1,1*	*1,0*	*1,6*	*1,0*	*0,4*	*0,7*	*2,5*	*5,0*
Core reduced pieces	Quartz	f	2	-	-	2	3	8	4	3	-	4	-
		%	*100,0*	-	-	*100,0*	*60,o*	*100,0*	*100,0*	*100,0*	-	*80,0*	-
	Quartzite	f	-	-	-	-	-	-	-	-	-	1	1
		%	-	-	-	-	-	-	-	-	-	*20,0*	*50,0*
	Silcrete	f	-	-	-	-	2	-	-	-	-	-	1
		%	-	-	-	-	*40,0*	-	-	-	-	-	*50,0*
	Total	f	2	-	-	2	5	8	4	3	-	5	2
CRPs as % of total waste			*o,5*	-	-	*0,3*	*0,3*	*0,7*	*0,2*	*0,2*	-	*0,7*	*0,3*
Untrim--med flakes	Quartz	f	39	171	113	124	274	182	124	65	31	30	28
		%	*15,6*	*35,8*	*29,7*	*34,0*	*29,4*	*26,8*	*10,0*	*6,9*	*7,5*	*7,4*	*5,8*
	Quartzite	f	186	287	264	223	498	408	956	725	353	252	225
		%	*74,4*	*60,0*	*69,3*	*61,1*	*53,5*	*60,1*	*77,1*	*76,9*	*84,9*	*61,9*	*46,9*
	Hornfels	f	-	-	-	2	7	6	14	16	7	39	8
		%	-	-	-	*0,6*	*0,8*	*0,9*	*1,1*	*1,7*	*1,7*	*9,6*	*1,7*
	Chalcedony	f	10	15	2	9	76	21	44	75	8	2	10
		%	*4,0*	*3,1*	*0,5*	*2,5*	*8,2*	*3,1*	*3,6*	*8,0*	*1,9*	*0,5*	*2,1*
	Silcrete	f	15	5	2	7	76	62	102	62	17	84	209
		%	*6,0*	*1,1*	*0,5*	*1,9*	*8,2*	*9,1*	*8,2*	*6,6*	*4,1*	*20,6*	*43,5*
	Total	f	250	478	381	365	931	679	1240	943	416	407	480
Untrimmed flakes as % of total waste			*59,0*	*63,1*	*68,3*	*57,9*	*55,0*	*61,5*	*72,1*	*62,9*	*76,9*	*57,5*	*63,4*
TOTAL WASTE	Quartz	f	158	364	255	325	770	454	288	207	94	163	105
		%	*37,3*	*48,1*	*45,7*	*51,6*	*45,5*	*41,1*	*16,8*	*13,8*	*17,4*	*23,0*	*13,9*
	Quartzite	f	217	328	290	261	589	486	1126	930	393	313	302
		%	*51,2*	*43,3*	*52,0*	*41,4*	*34,8*	*44,0*	*65,5*	*62,0*	*72,6*	*44,2*	*39,9*
	Hornfels	f	1	1	-	2	11	7	25	25	9	62	9
		%	*0,2*	*0,1*	-	*0,3*	*0,7*	*0,6*	*1,5*	*1,7*	*1,7*	*8,8*	*1,2*
	Chalcedony	f	18	43	9	26	188	50	90	216	15	20	21
		%	*4,3*	*5,7*	*1,6*	*4,1*	*11,1*	*4,5*	*5,2*	*14,4*	*2,8*	*2,8*	*2,8*
	Silcrete	f	30	21	4	16	136	107	190	121	30	150	320
		%	*7,1*	*2,8*	*0,7*	*2,5*	*0,0*	*9,7*	*11,1*	*8,1*	*5,6*	*21,2*	*42,3*
	TOTAL	f	424	757	558	630	1694	1104	1719	1499	541	708	757
Waste as % of Grand Total			*93,0*	*93,5*	*93,6*	*94,9*	*93,6*	*94,4*	*94,2*	*96,7*	*97,1*	*95,0*	*90,7*

Core sub-classes		SUR	HBC	SGL	DGL	GBL	PBW	LPW	RBL	YBL	BD	BBD
Irregular	f	9	6	13	7	17	18	17	6	4	10	9
Bladelet	f	-	-	-	-	-	-	-	-	-	8	29
Bladelet as % total cores		-	-	-	-	-	-	-	-	-	*44,4*	*76,3*

Table 15. Kangkara Cave: frequencies and percentage frequencies in classes of the Utilized category and in raw material classes

CLASS	RAW MATERIAL		SUR	HBC	SGL	DGL	GBL	PBW	LPW	RBL	YBL	BD	BBD
Utilized flakes	Quartz	f	8	14	20	9	29	15	7	6	1	6	-
		%	*57,1*	*66,7*	*80,0*	*90,0*	*44,6*	*37,5*	*12,5*	*23,1*	*16,7*	*16,7*	-
	Quartzite	f	4	4	3	-	18	15	29	11	3	12	24
		%	*28,6*	*19,1*	*12,0*	-	*27,7*	*37,5*	*51,8*	*42,3*	*50,0*	*33,3*	*35,3*
	Hornfels	f	-	-	-	-	1	-	1	1	-	-	-
		%	-	-	-	-	*1,5*	-	*1,8*	*3,9*	-	-	-
	Chalcedony	f	1	3	2	-	9	1	3	4	-	2	5
		%	*7,1*	*14,3*	*8,0*	-	*13,9*	*2,5*	*5,4*	*15,4*	,	*5,6*	*7,4*
	Silcrete	f	1	-	-	1	8	9	16	4	2	16	39
		%	*7,1*	-	-	*10,0*	*12,3*	*22,5*	*28,6*	*15,4*	*33,3*	*44,4*	*57,4*
	Total	f	14	21	25	10	65	40	56	26	6	36	68
Util. flakes as % total utilized			*100,0*	*77,8*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*75,0*	*100,0*	*100,0*
Hammer	Quartzite	f	-	1	-	-	-	-	-	-	-	-	-
As % total utilized			-	*3,7*	-	-	-	-	-	-	-	-	-
Heavy edge-flaked pieces	Quartzite	f	-	5	-	-	-	-	-	-	2	-	-
	As % total utilized		-	*18,5*	-	-	-	-	-	-	*25,0*	-	-
TOTAL UTILIZED		f	14	27	25	10	65	40	56	26	8	36	68
	Utilized as % Grand Total		*3,1*	*3,3*	*4,2*	*1,5*	*3,6*	*3,4*	*3,1*	*1,7*	*1,4*	*4,8*	*8,1*

Table 16

Kangkara Cave : Frequencies and percentage frequencies in classes and sub-classes of the Formal Tools category

CLASS	RAW MATERIAL		SUR	HBC	SGL	DGL	GBL	PBW	LPW	RBL	YBL	BD	BBD
Scrapers	Quartz	f	11	17	9	15	12	3	6	2	1	-	-
		%	68,8	77,3	81,8	79,0	29,3	11,5	12,5	8,0	16,7	-	-
	Quartzite	f	-	-	1	-	3	10	14	4	-	-	3
		%	-	-	9,1	-	7,3	38,5	29,2	16,0	-	-	42,9
	Hornfels	f	-	1	-	-	-	-	1	1	-	-	-
		%	-	4,6	-	-	-	-	2,1	4,0	-	-	-
	Chalcedony	f	3	4	-	1	16	1	5	9	3	-	1
		%	18,8	18,2	-	5,3	39,0	3,9	10,4	36,0	50,0	-	14,3
	Silcrete	f	2	-	1	3	10	12	22	9	2	1	3
		%	12,5	-	9,1	15,8	24,4	46,2	45,8	36,0	33,3	100,0	42,9
	Total	f	16	22	11	19	41	26	48	25	6	1	7
Scrapers as % total formal			*88,9*	*84,6*	*84,6*	*79,2*	*80,4*	*100,0*	*90,6*	*96,2*	*100,0*	*33,3*	*70,0*
Backed micro-liths	Quartz	f	-	3	2	3	2	-	-	-	-	-	-
		%	-	75,0	100,0	75,0	28,6	-	-	-	-	-	-
	Chalcedony	f	2	1	-	1	3	-	-	-	-	-	-
		%	100,0	25,0	-	25,0	42,9	-	-	-	-	-	-
	Silcrete	f	-	-	-	-	2	-	-	-	-	-	-
		%	-	-	-	-	28,6	-	-	-	-	-	-
	Total	f	2	4	2	4	7	-	-	-	-	-	-
Backed as % total formal			*11,1*	*15,4*	*15,4*	*16,7*	*13,7*	-	-	-	-	-	-
Segments		f	1	3	2	2	4	-	-	-	-	-	-
As % total backed			*50,0*	*75,0*	*100,0*	*50,0*	*57,1*	-	-	-	-	-	-
Backed flakes/bladelets		f	1	-	-	-	3	-	-	-	-	-	-
As % total backed			*50,0*	-	-	-	*42,8*	-	-	-	-	-	-
Broken backed pieces		f	-	1	-	2	-	-	-	-	-	-	-
As % total backed			-	*25,0*	-	*50,0*	-	-	-	-	-	-	-
Borers	Quartz	f	-	-	-	-	2	-	-	-	-	-	-
Borers as % total formal			-	-	-	-	*3,9*	-	-	-	-	-	-
Adzes	Chalcedony	f	-	-	-	-	-	-	1	-	-	-	-
		%	-	-	-	-	-	-	100,0	-	-	-	-
	Silcrete	f	-	-	-	1	1	-	-	-	-	-	-
		%	-	-	-	100,0	100,0	-	-	-	-	-	-
	Total	f	-	-	-	1	1	-	1	-	-	-	-
Adzes as % total formal			-	-	-	*4,2*	*2,0*	-	*1,9*	-	-	-	-
Misc retouch	Quartz	f	-	-	-	-	-	-	-	1	-	-	-
		%	-	-	-	-	-	-	-	100,0	-	-	-
	Quartzite	f	-	-	-	-	-	-	-	-	-	1	-
		%	-	-	-	-	-	-	-	-	-	50,0	-
	Silcrete	f	-	-	-	-	-	-	4	-	-	1	3
		%	-	-	-	-	-	-	100,0	-	-	50,0	100,0
	Total	f	-	-	-	-	-	-	4	1	-	2	3
Misc Ret. as % total formal			-	-	-	-	-	-	*7,6*	*3,9*	-	*66,7*	*30,0*
TOTAL FORMAL	Quartz	f	11	20	11	18	16	3	6	3	1	-	-
		%	61,1	76,9	84,6	75,0	31,4	11,5	7,5	11,5	16,7	-	-
	Quartzite	f	-	-	1	-	3	10	14	4	-	1	3
		%	-	-	7,7	-	5,9	38,5	26,4	15,4	-	33,3	30,0
	Hornfels	f	-	1	-	-	-	-	1	1	-	-	-
		%	-	3,9	-	-	-	-	1,9	3,9	-	-	-
	Chalcedony	f	5	5	-	2	19	1	6	9	3	-	1
		%	27,8	19,2	-	8,3	37,3	3,9	7,5	34,6	50,0	-	10,0
	Silcrete	f	2	-	1	4	13	12	26	9	2	2	6
		%	11,1	-	7,7	16,7	25,5	46,2	49,1	34,6	33,3	66,7	60,0
	TOTAL	f	18	26	13	24	51	26	53	26	6	3	10
Formal as % Grand Total			*4,0*	*3,2*	*2,2*	*3,6*	*2,8*	*2,2*	*2,7*	*1,7*	*1,4*	*0,2*	*1,2*

Table 17

Boomplaas Cave : Frequencies and percentage frequencies in classes of the Waste category and raw material classes

CLASS	RAW MATERIAL		DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Chips	Quartz	f	5714	8746	4855	1179	1938	500	2163	739	325	6844	1178	10307	7606	22730	1125	1445	44391
		%	*95,6*	*89,3*	*93,8*	*88,2*	*86,8*	*81,7*	*79,1*	*86,9*	*65,5*	*82,8*	*65,6*	*66,8*	*77,5*	*90,1*	*75,3*	*73,0*	*79,6*
	Quartzite	f	9	27	9	19	64	18	194	18	72	385	87	931	509	405	23	23	1978
		%	*0,2*	*0,3*	*0,2*	*1,4*	*2,9*	*2,9*	*7,1*	*2,1*	*14,5*	*4,7*	*4,8*	*6,0*	*5,2*	*1,6*	*1,5*	*1,2*	*3,6*
	Hornfels	f	84	208	49	48	63	50	224	59	50	494	87	883	226	113	2	2	1313
		%	*1,4*	*2,1*	*0,9*	*3,6*	*2,8*	*8,2*	*8,2*	*6,9*	*10,1*	*6,0*	*4,8*	*5,7*	*2,3*	*0,5*	*0,1*	*0,1*	*2,4*
	Chalced	f	120	772	207	84	160	28	124	32	47	475	439	3290	1445	1420	37	8	6639
		%	*2,0*	*7,9*	*4,0*	*6,3*	*7,2*	*4,6*	*4,5*	*3,8*	*9,5*	*5,8*	*24,4*	*21,8*	*14,7*	*5,6*	*2,5*	*0,4*	*11,9*
	Silcrete	f	53	37	54	7	8	16	30	2	2	65	5	26	29	563	308	501	1432
		%	*0,9*	*0,4*	*1,0*	*0,5*	*0,4*	*2,6*	*1,1*	*0,2*	*0,4*	*0,8*	*0,3*	*0,2*	*0,3*	*2,2*	*20,6*	*25,3*	*2,6*
	Total	f	5980	9790	5174	1337	2233	612	2735	850	496	8263	1796	15437	9815	25231	1495	1979	55753
Chips as % Waste		%	*56,5*	*56,9*	*58,0*	*55,0*	*48,5*	*40,7*	*45,1*	*49,3*	*22,7*	*44,6*	*29,1*	*62,3*	*65,1*	*63,7*	*54,9*	*52,7*	*60,5*
Chunks	Quartz	f	1614	2125	918	383	716	229	1103	381	381	3193	1078	1863	1635	5663	348	389	10976
		%	*85,7*	*76,7*	*79,3*	*77,4*	*64,3*	*58,3*	*68,8*	*76,1*	*54,4*	*66,4*	*50,2*	*44,5*	*59,7*	*77,6*	*74,0*	*59,9*	*62,7*
	Quartzite	f	16	47	14	43	213	59	292	59	193	859	442	969	569	962	56	69	3067
		%	*0,9*	*1,7*	*1,2*	*8,7*	*19,1*	*15,0*	*18,22*	*11,8*	*27,6*	*17,9*	*20,6*	*23,1*	*20,8*	*13,2*	*11,9*	*10,6*	*17,5*
	Hornfels	f	126	203	73	41	103	77	144	43	80	488	153	441	161	73	2	1	831
		%	*6,7*	*7,3*	*6,3*	*8,3*	*9,3*	*19,6*	*9,0*	*8,6*	*11,4*	*10,2*	*7,1*	*10,5*	*5,9*	*1,0*	*0,4*	*0,2*	*4,8*
	Chalced	f	79	321	109	18	50	14	23	14	41	160	444	885	354	448	21	30	2182
		%	*4,2*	*11,6*	*9,4*	*3,6*	*4,5*	*3,6*	*1,4*	*2,8*	*5,9*	*3,3*	*20,7*	*21,1*	*12,9*	*6,1*	*4,5*	*4,6*	*12,5*
	Silcrete	f	49	74	44	10	32	14	41	4	5	106	30	33	20	156	43	160	442
		%	*2,6*	*2,7*	*3,8*	*2,0*	*2,9*	*3,6*	*2,6*	*0,8*	*0,7*	*2,2*	*1,4*	*0,8*	*0,7*	*2,1*	*0,2*	*24,7*	*2,5*
	Total	f	1884	2770	1158	495	1114	393	1603	501	700	4806	2147	4191	2739	7302	470	649	17498
Chunks as % Waste		%	*17,8*	*16,1*	*13,0*	*20,4*	*24,2*	*26,1*	*26,4*	*29,0*	*32,0*	*25,9*	*34,7*	*16,9*	*18,2*	*18,4*	*17,3*	*17,3*	*19,0*
Cores	Quartz	f	7	25	14	15	13	3	12	-	1	44	3	71	41	107	5	8	235
		%	*53,9*	*48,1*	*41,2*	*71,4*	*52,0*	*60,0*	*63,2*	-	*7,1*	*51,2*	*15,0*	*50,7*	*68,3*	*70,9*	*45,5*	*32,0*	*57,7*
	Quartzite	f	-	1	9	-	2	1	2	-	5	10	1	2	1	5	1	-	10
		%	-	*1,9*	*26,5*	-	*8,0*	*20,0*	*10,5*	-	*35,7*	*11,6*	*5,0*	*1,4*	*1,7*	*3,3*	*9,1*	-	*2,5*
	Hornfels	f	4	4	-	-	3	-	-	-	5	8	3	12	1	2	-	-	18
		%	*30,8*	*7,7*	-	-	*12,0*	-	-	-	*35,7*	*9,3*	*15,0*	*8,6*	*1,7*	*1,3*	-	-	*4,4*
	Chalced	f	-	19	9	6	3	1	4	1	3	18	10	52	13	14	1	4	94
		%	-	*36,5*	*26,5*	*28,6*	*12,0*	*20,0*	*21,1*	*50,0*	*21,4*	*20,9*	*50,0*	*37,1*	*21,7*	*9,3*	*9,1*	*16,0*	*23,1*
	Silcrete	f	2	3	2	-	4	-	1	1	-	6	3	3	4	23	4	13	50
		%	*15,4*	*5,8*	*5,9*	-	*16,0*	-	*5,3*	*50,0*	-	*7,0*	*15,0*	*2,1*	*6,7*	*15,2*	*36,4*	*52,0*	*12,3*
	Total	f	13	52	34	21	25	5	19	2	14	86	20	140	60	151	11	25	407
Cores as % Waste		%	*0,1*	*0,3*	*0,4*	*0,9*	*0,5*	*0,3*	*0,3*	*0,1*	*0,6*	*0,5*	*0,3*	*0,6*	*0,4*	*0,4*	*0,4*	*0,7*	*0,4*
Core reduced pieces	Quartz	f	9	23	2	-	2	1	3	-	1	7	25	58	34	46	3	4	170
		%	*69,2*	*62,2*	*66,7*	-	*50,0*	*50,0*	*33,3*	-	*33,3*	*38,9*	*39,1*	*33,5*	*43,0*	*74,2*	*75,0*	*100,0*	*44,0*
	Quartzite	f	-	-	-	-	1	-	-	-	-	1	1	7	7	2	-	-	17
		%	-	-	-	-	*25,0*	-	-	-	-	*5,6*	*1,6*	*4,1*	*8,9*	*3,2*	-	-	*4,4*
	Hornfels	f	2	1	-	-	-	-	1	-	-	1	5	15	7	2	-	-	29
		%	*15,4*	*2,7*	-	-	-	-	*11,1*	-	-	*5,6*	*7,8*	*8,7*	*8,9*	*3,2*	-	-	*2,5*
	Chalced	f	2	13	1	-	-	1	5	-	2	8	33	92	31	11	1	-	168
		%	*15,4*	*35,1*	*33,3*	-	-	*50,0*	*55,6*	-	*66,7*	*44,4*	*51,6*	*53,2*	*39,2*	*17,7*	*25,0*	-	*43,5*
	Silcrete	f	-	-	-	-	1	-	-	-	-	1	-	1	-	1	-	-	2
		%	-	-	-	-	*25,00*	-	-	-	-	*5,6*	-	*0,6*	-	*1,6*	-	-	*0,5*
	Total	f	13	37	3	-	4	2	9	-	3	18	64	173	79	62	4	4	386
CRPs as % Waste		%	*0,1*	*0,2*	*0,03*	-	*0,1*	*0,1*	*0,2*	-	*0,1*	*0,1*	*1,0*	*0,7*	*0,5*	*0,2*	*0,2*	*0,1*	*0,4*
Flakes	Quartz	f	1887	3055	1743	281	506	136	377	74	153	1527	269	835	656	3362	236	379	5737
		%	*69,9*	*67,2*	*68,5*	*48,5*	*41,1*	*27,6*	*22,2*	*19,8*	*15,7*	*28,5*	*12,5*	*17,2*	*27,6*	*49,1*	*31,9*	*34,5*	*31,8*
	Quartzite	f	44	85	55	98	270	120	590	119	495	1692	821	1585	812	1844	66	86	5214
		%	*1,6*	*1,9*	*2,2*	*16,9*	*21,9*	*24,4*	*34,7*	*31,9*	*50,7*	*31,6*	*38,2*	*32,7*	*34,2*	*26,9*	*8,9*	*7,8*	*28,9*
	Hornfels	f	338	383	218	97	249	174	484	121	213	1338	354	939	379	241	8	10	1931
		%	*12,5*	*8,4*	*8,6*	*16,7*	*20,2*	*35,4*	*28,5*	*32,4*	*21,8*	*25,0*	*16,5*	*19,4*	*16,0*	*3,5*	*1,1*	*0,9*	*10,7*
	Chalced	f	229	821	314	81	143	47	126	40	106	543	656	1400	441	550	60	21	3128
		%	*8,5*	*18,1*	*12,3*	*14,0*	*11,6*	*9,6*	*7,4*	*10,7*	*10,9*	*10,2*	*30,6*	*28,9*	*18,6*	*8,0*	*8,0*	*1,9*	*17,3*
	Silcrete	f	200	204	216	23	62	15	122	19	10	251	47	91	87	852	371	604	2052
		%	*7,4*	*4,5*	*8,5*	*4,0*	*5,0*	*3,1*	*7,2*	*5,1*	*1,0*	*4,7*	*2,2*	*1,9*	*3,7*	*12,4*	*50,1*	*54,9*	*11,4*
	Total	f	2698	4548	2546	580	1230	492	1699	373	977	5351	2147	4850	2375	6849	741	1100	18062
Flakes as % Waste		%	*25,5*	*26,5*	*28,6*	*23,8*	*26,7*	*32,7*	*28,0*	*21,6*	*44,6*	*28,9*	*34,8*	*19,6*	*15,8*	*17,3*	*27,2*	*29,3*	*19,6*
TOTAL WASTE	Quartz	f	9232	13974	7532	1858	3175	869	3658	1194	861	11615	2553	13134	9972	31908	1717	2225	61509
		%	*87,2*	*81,3*	*84,5*	*76,4*	*69,0*	*57,8*	*60,3*	*69,2*	*39,3*	*62,7*	*41,4*	*53,0*	*66,2*	*80,6*	*63,1*	*59,2*	*66,8*
	Quartzite	f	69	160	87	160	551	198	1078	196	765	2947	1352	3495	1898	3218	146	178	10286
		%	*0,7*	*0,9*	*1,0*	*6,6*	*11,9*	*13,2*	*17,8*	*11,4*	*34,9*	*15,9*	*21,9*	*14,1*	*12,6*	*8,1*	*5,4*	*4,7*	*11,2*
	Hornfels	f	554	799	340	186	418	301	853	223	348	2329	602	2290	774	431	12	13	4122
		%	*5,2*	*4,7*	*3,8*	*7,6*	*9,1*	*20,0*	*14,1*	*13,0*	*15,9*	*12,6*	*9,8*	*9,2*	*5,1*	*1,1*	*0,4*	*0,4*	*4,5*
	Chalced	f	430	1946	640	189	356	91	282	87	199	1204	1582	5719	2284	2443	120	63	12211
		%	*4,1*	*11,3*	*7,2*	*7,8*	*7,7*	*6,1*	*4,7*	*5,0*	*9,1*	*6,5*	*25,6*	*23,1*	*15,2*	*6,2*	*4,4*	*1,7*	*13,3*
	Silcrete	f	304	318	316	40	107	45	194	26	17	429	85	154	140	1595	726	1278	3978
		%	*2,9*	*1,9*	*3,5*	*1,6*	*2,3*	*3,0*	*3,2*	*1,5*	*0,8*	*2,3*	*1,4*	*0,6*	*0,9*	*4,0*	*26,7*	*34,0*	*4,3*
	Total	f	10588	17197	8915	2433	4606	1504	6065	1726	2190	18524	6174	24791	15068	39595	2721	3757	92106
Waste as % Grand Total			*97,2*	*96,1*	*96,2*	*97,1*	*96,8*	*97,3*	*97,7*	*98,7*	*97,5*	*97,4*	*98,9*	*99,3*	*99,5*	*99,6*	*99,6*	*99,1*	*99,4*

Table 18

Boomplaas Cave: Frequencies and percentage frequencies of classes in the Utilized category and raw material classes

CLASS	RAW MATERIAL		DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Utilized flakes	Quartz	f	17	66	52	16	48	13	26	4	4	111	3	18	11	35	2	11	80
		%	*34,7*	*41,5*	*57,1*	*39,0*	*42,5*	*59,1*	*19,6*	*17,4*	*8,3*	*29,2*	*4,6*	*11,4*	*19,6*	*41,7*	*28,6*	*42,3*	*20,2*
	Quartzite	f	1	4	1	4	14	2	24	-	5	49	12	11	5	8	-	3	39
		%	*2,0*	*2,5*	*1,1*	*9,8*	*12,4*	*9,1*	*18,1*	-	*10,4*	*12,9*	*18,5*	*7,0*	*8,9*	*9,5*	-	*11,5*	*9,9*
	Hornfels	f	12	17	13	4	14	2	37	11	17	85	13	33	11	12	-	-	69
		%	*24,5*	*10,7*	*14,3*	*9,8*	*12,4*	*9,1*	*27,8*	*47,8*	*35,4*	*82,4*	*20,0*	*20,9*	*19,6*	*14,3*	-	-	*17,4*
	Chalced	f	9	57	22	16	29	4	37	8	22	116	35	92	23	18	3	2	173
		%	*18,4*	*35,9*	*24,2*	*39,0*	*25,7*	*18,2*	*27,8*	*34,8*	*45,8*	*30,5*	*53,9*	*58,2*	*41,1*	*21,4*	*42,9*	*7,7*	*43,7*
	Silcrete	f	10	15	3	1	8	1	9	-	-	19	2	4	6	11	2	10	35
		%	*20,4*	*9,4*	*3,3*	*2,4*	*7,1*	*4,6*	*6,8*	-	-	*5,0*	*3,1*	*2,5*	*10,7*	*13,1*	*28,6*	*38,5*	*8,8*
	<u>Total</u>	f	49	159	91	41	113	22	133	23	48	380	65	158	56	84	7	26	396
As % Total Utilized			*73,1*	*94,6*	*98,9*	*97,6*	*98,3*	*100,0*	*99,3*	*100,0*	*100,0*	*99,0*	*100,0*	*98,1*	*83,6*	*89,4*	*100,0*	*96,3*	*94,1*
Rubbers:	Quartzite	f	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-	1	5
As % Total Utilized			*4,5*	*1,2*	-	-	-	-	-	-	-	-	-	*0,6*	-	*3,2*	-	*3,7*	*1,2*
Hammers:	Quartzite	f	1	5	-	-	-	-	1	-	-	1	-	1	10	5	-	-	16
As % Total Utilized			*1,5*	*3,0*	-	-	-	-	*0,8*	-	-	*0,3*	-	*0,6*	*14,9*	*5,3*	-	-	*3,8*
Rubbers/Hammers	Quartzite	f	13	2	-	-	-	-	-	-	-	-	-	-	1	2	-	-	3
As % Total Utilized			*19,4*	*1,2*	-	-	-	-	-	-	-	-	-	-	*1,5*	*2,1*	-	-	*0,7*
Grindstones	Quartzite	f	-	-	-	1	2	-	-	-	-	3	-	1	-	-	-	-	1
	Hornfels	f	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As % Total Utilized			-	-	*1,1*	*2,4*	*1,7*	-	-	-	-	*0,8*	-	*0,6*	-	-	-	-	*0,2*
Ground shale		f	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As % Total Utilized			*1,5*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL UTILIZED	Quartz	f	17	66	52	16	48	13	26	4	4	111	3	18	11	35	2	11	80
		%	*25,4*	*39,3*	*56,5*	*38,1*	*41,7*	*59,1*	*19,4*	*17,4*	*8,3*	*28,9*	*4,6*	*11,2*	*16,4*	*37,2*	*28,6*	*40,7*	*19,0*
	Quartzite	f	18	4	1	4	14	2	24	-	5	49	12	11	5	8	-	3	39
		%	*26,9*	*2,4*	*1,1*	*9,5*	*12,2*	*9,1*	*17,9*	-	*10,4*	*12,8*	*18,5*	*6,8*	*7,5*	*8,5*	-	*11,1*	*9,3*
	Hornfels	f	13	17	14	4	14	2	37	11	17	85	13	33	12	12	-	-	70
		%	*19,4*	*10,1*	*15,2*	*9,5*	*12,2*	*9,1*	*27,6*	*47,8*	*35,4*	*22,1*	*20,0*	*20,5*	*17,9*	*12,8*	-	-	*16,6*
	Chalced	f	9	57	22	16	29	4	37	8	22	116	35	92	23	18	3	2	173
		%	*13,4*	*33,9*	*23,9*	*38,1*	*25,2*	*18,2*	*27,6*	*34,8*	*45,8*	*30,2*	*53,9*	*57,1*	*34,3*	*19,2*	*42,9*	*7,4*	*41,1*
	Silcrete	f	10	24	3	2	10	1	10	-	-	23	2	7	16	21	2	11	59
		%	*14,9*	*14,3*	*3,3*	*4,8*	*8,7*	*4,6*	*7,5*	-	-	*6,0*	*3,1*	*4,4*	*23,9*	*22,3*	*28,6*	*40,7*	*14,0*
	<u>Total</u>	f	67	168	92	42	115	22	134	23	48	384	65	161	67	94	7	27	421
Utilized as % of Grand Total			*0,6*	*0,9*	*1,1*	*1,7*	*2,4*	*1,4*	*2,2*	*1,3*	*2,1*	*2,0*	*1,0*	*0,7*	*0,4*	*0,2*	*0,3*	*0,7*	*0,5*

Table 19

Boomplaas Cave : Frequencies and percentage frequencies in classes and sub-classes of the Formal Tools category by raw material

CLASS	RAW MATERIAL		DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Scrapers	Quartz	f	150	269	149	17	19	12	4	-	-	52	1	3	-	44	-	3	51
		%	*79,4*	*74,5*	*77,2*	*63,0*	*51,4*	*63,2*	*40,0*	-	-	*55,3*	*100,0*	*27,3*	-	*73,3*	-	*60,0*	*63,0*
	Quartzite	f	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	4
		%	-	-	-	-	-	-	-	-	-	-	-	*9,1*	*33,3*	*3,3*	-	-	*4,9*
	Hornfels	f	7	14	3	4	13	6	4	-	-	27	-	-	-	3	-	-	3
		%	*3,7*	*3,9*	*1,6*	*14,8*	*35,1*	*31,6*	*40,0*	-	-	*28,7*	-	-	-	*5,0*	-	-	*3,7*
	Chalced	f	27	73	41	6	4	1	-	-	1	12	-	5	1	1	-	-	7
		%	*14,3*	*20,2*	*21,2*	*22,2*	*10,8*	*5,3*	-	-	*100,0*	*12,8*	-	*45,5*	*33,3*	*1,7*	-	-	*8,6*
	Silcrete	f	5	5	-	-	1	-	2	-	-	3	-	2	1	10	1	2	16
		%	*2,7*	*1,4*	-	-	*2,7*	-	*20,0*	-	-	*3,2*	-	*18,2*	*33,3*	*16,7*	*100,0*	*40.0*	*19,8*
	Total	f	189	361	193	27	37	19	10	-	1	94	1	11	3	60	1	5	81
Scrapers as % Formal			*78,1*	*67,4*	*80,1*	*90,0*	*100,0*	*95,0*	*83,3*	-	*11,1*	*87,0*	*16,7*	*61,1*	*75,0*	*82,2*	*33,3*	*83,3*	*73,6*
Adzes	Quartz	f	1	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
		%	*2,6*	*1,0*	-	-	-	*100,0*	-	-	-	*20,0*	-	-	-	-	-	-	-
	Quartzite	f	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
		%	*2,6*	-	-	-	-	-	-	-	-	-	-	-	-	*16,7*	-	-	*8,4*
	Hornfels	f	14	33	7	-	-	-	-	-	3	3	1	1	-	3	1	-	6
		%	*36,8*	*32,7*	*50,0*	-	-	-	-	-	*75,0*	*60,0*	*33,3*	*50,0*	-	*50,0*	*100,0*	-	*50,0*
	Chalced	f	14	57	7	-	-	-	-	-	1	1	2	1	-	1	-	-	4
		%	*36,8*	*56,4*	*50,0*	-	-	-	-	-	*25,0*	*20,0*	*66,7*	*50,0*	-	*16,7*	-	-	*33,3*
	Silcrete	f	8	10	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
		%	*21,1*	*9,9*	-	-	-	-	-	-	-	-	-	-	-	*16,7*	-	-	*8,3*
	Total	f	38	101	14	-	-	1	-	-	4	5	3	2	-	6	1	-	12
Adzes as % Formal		%	*15,7*	*18,8*	*5,8*	-	-	*5,0*	-	-	*44,4*	*4,6*	*50,0*	*11,1*	-	*8,2*	*33,3*	-	*10,9*
Backed microliths (total)	Quartz	f	6	30	17	1	-	-	-	-	2	3	-	1	-	5	-	-	6
		%	*100,0*	*66,7*	*56,7*	*100,0*	-	-	-	-	*100,0*	*100,0*	-	*100,0*	-	*83,3*	-	-	*85,7*
	Quartzite	f	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	-	*2,2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hornfels	f	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	-	*2,2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chalced	f	-	12	13	-	-	-	-	-	-	-	-	-	-	1	-	-	1
		%	-	*26,7*	*43,3*	-	-	-	-	-	-	-	-	-	-	*16,7*	-	-	*14,3*
	Silcrete	f	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	-	*2,2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	f	6	45	30	1	-	-	-	-	2	3	-	1	-	6	-	-	7
Backed microliths as % Formal		%	*2,5*	*8,4*	*12,5*	*3,3*	-	-	-	-	*22,2*	*2,8*	-	*5,6*	-	*8,2*	-	-	*6,9*
Segments		f	2	19	19	1	-	-	-	-	1	2	-	-	-	5	-	-	5
As % total backed			*33,33*	*42,2*	*63,3*	*100,0*	-	-	-	-	*50,0*	*66,7*	-	-	-	*83,3*	-	-	*71,4*
Backed bladelets & flakes		f	3	13	6	-	-	-	-	-	-	-	-	1	-	1	-	-	2
% total backed		%	*50,0*	*28,9*	*20,0*	-	-	-	-	-	-	-	-	*100,0*	-	*16,7*	-	-	*28,6*
Broken backed		f	1	13	5	-	-	-	-	-	1	1	-	-	-	-	-	-	-
As % total backed			*16,7*	*28,9*	*18,7*	-	-	-	-	-	*50,0*	*33,3*	-	-	-	-	-	-	-
Borers	Quartz	f	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	*100,0*	*38,5*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chalced	f	-	7	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2
		%	-	*53,9*	-	-	-	-	-	-	-	-	*100,0*	-	-	-	-	-	*100,0*
	Silcrete	f	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	-	*7,7*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	f	1	13	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2
Borers as % Formal			*0,4*	*2,4*	-	-	-	-	-	-	-	-	*33,3*	-	-	-	-	-	*1,8*
Misc Retouch	Quartz	f	4	5	2	-	-	-	-	-	-	-	-	-	-	1	-	-	1
		%	*50,0*	*31,3*	*50,0*	-	-	-	-	-	-	-	-	-	-	*100,0*	-	-	*12,5*
	Quartzite	f	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
		%	-	*6,25*	-	-	-	-	-	-	-	-	-	*25,0*	-	-	-	-	*12,5*
	Hornfels	f	1	3	-	2	-	-	-	-	2	4	-	1	-	-	-	-	1
		%	*12,5*	*18,8*	-	*100,0*	-	-	-	-	*100,0*	*66,7*	-	*25,0*	-	-	-	-	*12,5*
	Chalced	f	2	5	1	-	-	-	1	-	-	1	-	2	-	-	-	-	2
		%	*25,0*	*31,3*	*25,0*	-	-	-	*50,0*	-	-	*16,7*	-	*50,0*	-	-	-	-	*25,0*
	Silcrete	f	1	2	1	-	-	-	1	-	-	1	-	-	1	-	1	1	3
		%	*12,5*	*12,5*	*25,0*	-	-	-	*50,0*	-	-	*16,7*	-	-	*100,0*	-	*100,0*	*100,0*	*37,5*
	Total	f	8	16	4	2	-	-	2	-	2	6	-	4	1	1	1	1	8
Misc Retouch as % Formal		%	*3,3*	*3,0*	*1,7*	*8,7*	-	-	*16,7*	-	*22,2*	*5,6*	-	*22,2*	*25,0*	*1,4*	*33,3*	*16,7*	*7,3*
TOTAL FORMAL	Quartz	f	162	310	168	18	19	13	4	-	2	56	1	4	-	49	-	3	57
		%	*67,2*	*57,8*	*89,7*	*60,0*	*51,4*	*65,0*	*33,3*	-	*22,2*	*51,9*	*16,7*	*22,2*	-	*67,1*	-	*50,0*	*52,3*
	Quartzite	f	1	2	21	-	-	-	-	-	1	1	-	4	1	5	-	-	10
		%	*0,4*	*0,4*	*8,7*	-	-	-	-	-	*11,1*	*0,9*	-	*22,2*	*25,0*	*6,9*	-	-	*11,9*
	Hornfels	f	21	51	10	6	13	6	4	-	5	34	1	2	-	4	1	-	8
		%	*8,7*	*9,5*	*4,2*	*20,0*	*35,1*	*30,0*	*33,3*	-	*55,6*	*31,5*	*16,7*	*11,1*	-	*5,5*	*33,3*	-	*7,3*
	Chalced	f	43	154	42	6	4	1	1	-	1	13	4	5	2	4	1	1	17
		%	*17,8*	*28,7*	*17,4*	*20,0*	*10,8*	*5,0*	*8,3*	-	*11,1*	*12,0*	*66,7*	*27,8*	*50,0*	*5,5*	*33,3*	*16,7*	*15,5*
	Silcrete	f	14	19	-	-	1	-	3	-	-	4	-	3	1	11	1	2	18
		%	*5,8*	*3,5*	-	-	*2,7*	-	*25,0*	-	-	*3,7*	-	*16,7*	*25,0*	*15,1*	*33,3*	*33,3*	*16,5*
	Total	f	241	536	241	30	37	20	12	-	9	108	6	18	4	73	3	6	110
Formal as % Grand Total		%	*2,2*	*3,0*	*2,8*	*1,2*	*0,8*	*1,3*	*0,2*	-	*0,4*	*0,6*	*0,1*	*0,1*	*0,03*	*0,2*	*0,1*	*0,2*	*0,1*

Table 20

Nelson Bay Cave : Frequencies and percentage frequencies in core sub-classes and in bladelets for raw material classes

SUB-CLASS	RAW MATERIAL		IC	BSC	RA	RB	J	BSBJ	CS	GSL	BSL	YSL	YGL
Irregular	Quartz	f	1	4	3	-	7	1	2	6	4	8	60
		%	*4,6*	*3,4*	*7,1*	-	*4,9*	*1,1*	*3,9*	*21,4*	*28,6*	*29,6*	*70,0*
	Quartzite	f	20	107	37	142	135	92	48	19	2	6	20
		%	*90,9*	*91,5*	*88,1*	*99,3*	*94,4*	*98,9*	*94,1*	*67,9*	*14,3*	*22,2*	*23,0*
	Chalcedony	f	-	6	2	1	1	-	1	2	2	1	4
		%	-	*5,1*	*4,8*	*0,7*	*0,7*	-	*2,0*	*7,1*	*14,3*	*3,7*	*4,6*
	Silcrete	f	-	-	-	-	-	-	-	1	6	12	3
		%	-	-	-	-	-	-	-	*3,6*	*42,9*	*44,4*	*3,5*
	Other	f	1	-	-	-	-	-	-	-	-	-	-
		%	*4,6*	-	-	-	-	-	-	-	-	-	-
	Total	f	46	187	64	203	179	147	59	33	21	100	168
	As % total cores		*47,8*	*62,6*	*65,6*	*70,4*	*79,9*	*63,3*	*86,4*	*84,9*	*66,7*	*27,0*	*51,8*
Radial	Quartz	f	-	1	3	-	-	-	-	-	-	11	6
		%	-	*1,5*	*15,0*	-	-	-	-	-	-	*42,3*	*30,0*
	Quartzite	f	16	63	17	56	35	54	8	3	2	5	13
		%	*100,0*	*94,0*	*85,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*19,2*	*65,0*
	Chalcedony	f	-	2	-	-	-	-	-	-	-	1	1
		%	-	*3,0*	-	-	-	-	-	-	-	*3,9*	*5,0*
	Silcrete	f	-	-	-	-	-	-	-	-	-	9	-
		%	-	-	-	-	-	-	-	-	-	*34,6*	-
	Other	f	-	1	-	-	-	-	-	-	-	-	-
		%	-	*1,5*	-	-	-	-	-	-	-	-	-
	Total	f	16	67	20	56	35	54	8	3	2	26	20
	As % total cores		*34,8*	*35,8*	*31,3*	*27,6*	*19,6*	*36,7*	*13,6*	*9,1*	*9,5*	*26,0*	*11,9*
Bladelet	Quartz	f	5	2	1	1	-	-	-	1	2	15	46
		%	*62,5*	*66,7*	*50,0*	*25,0*	-	-	-	*50,0*	*40,0*	*31,9*	*75,4*
	Quartzite	f	-	1	1	3	-	-	-	-	-	2	3
		%	-	*33,3*	*50,0*	*75,0*	-	-	-	-	-	*4,3*	*4,9*
	Chalcedony	f	3	-	-	-	1	-	-	-	-	-	5
		%	*37,5*	-	-	-	*100,0*	-	-	-	-	-	*8,2*
	Silcrete	f	-	-	-	-	-	-	-	1	3	30	7
		%	-	-	-	-	-	-	-	*50,0*	*60,0*	*63,8*	*11,5*
	Total	f	8	3	2	4	1	-	-	2	5	47	61
	As % total cores		*17,4*	*1,6*	*3,1*	*2,0*	*0,6*	-	-	*6,1*	*23,8*	*47,0*	*36,3*
TOTAL CORES		f	46	187	64	203	179	147	59	33	21	100	168
BLADELETS	Quartz	f	5	12	-	1	-	-	1	2	5	52	115
		%	*27,8*	*52,2*	-	*100,0*	-	-	*100,0*	*12,5*	*23,8*	*29,7*	*77,7*
	Quartzite	f	8	6	-	-	-	1	-	11	7	6	14
		%	*44,44*	*26,1*	-	-	-	*100,0*	-	*68,8*	*33,3*	*3,4*	*9,5*
	Hornfels	f	-	-	-	-	-	-	-	-	2	2	1
		%	-	-	-	-	-	-	-	-	*9,5*	*1,1*	*0,7*
	Chalcedony	f	5	5	-	-	-	-	-	2	1	3	14
		%	*27,8*	*21,7*	-	-	-	-	-	*12,5*	*4,8*	*1,7*	*9,5*
	Silcrete	f	-	-	-	-	-	-	-	1	6	112	4
		%	-	-	-	-	-	-	-	*6,3*	*28,6*	*64,0*	*2,7*
TOTAL BLADELETS		f	18	23	-	1	-	1	1	16	21	175	148
BLADELETS AS % TOTAL UNTRIMMED FLAKES		%	*0,4*	*0,2*	-	*0,02*	-	*0,02*	*0,04*	*0,8*	*1,5*	*5,4*	*2,4*

NELSON BAY CAVE : UNTRIMMED FLAKES - TABLES 21 - 25

Key to numerical notation for stratigraphic units:

NUMBER	STRATIGRAPHIC UNIT
1	IC
3	IC
4	BSC
5	BSC
6	BSC
7	BSC
8	BSC
9	RA
10	RB
11	J
12	BSBJ
13	CS
14	GSL
15	BSL
16	YSL
18	YGL

Table 21

NELSON BAY CAVE : UNTRIMMED FLAKES

Length

(a) Quartz only
(b) Quartzite only
(c) Other
(T) Total sample

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
1	(a)	11	17,64	31,26	1,69	5,59	9 - 29
	(b)	175	35,11	342,98	1,40	18,52	10 -132
	(c)	6	21,67	71,47	3,45	8,45	12 - 34
	(T)	*192*	*33,69*	*337,19*	*1,33*	*18,36*	*9 -132*
3	(a)	91	18,79	71,66	0,89	8,47	7 - 58
	(b)	837	34,48	266,63	0,56	16,33	8 -110
	(c)	34	17,12	27,74	0,90	5,27	8 - 33
	(T)	*962*	*32,38*	*269,18*	*0,53*	*16,41*	*7 -110*
4	(a)	9	17,11	13,11	1,21	3,62	14 - 23
	(b)	301	32,84	223,17	0,86	14,94	11 - 96
	(c)	5	17,60	5,80	1,08	2,41	15 - 21
	(T)	*315*	*32,15*	*223,95*	*0,84*	*14,97*	*11 - 96*
5	(a)	17	15,24	13,44	0,89	3,67	10 - 25
	(b)	247	40,75	244,71	1,00	15,64	10 - 97
	(c)	6	27,17	124,57	4,56	11,16	15 - 45
	(T)	*270*	*38,84*	*268,51*	*0,99*	*16,39*	*10 - 97*
6	(a)	-	-	-	-	-	-
	(b)	71	39,09	180,65	1,60	13,44	15 - 76
	(c)	1	22,0				
	(T)	*72*	*38,85*	*182,16*	*1,59*	*13,50*	*15 - 76*
7	(a)	1	16,00				
	(b)	45	40,40	127,20	1,68	11,28	15 - 61
	(T)	*46*	*39,87*	*137,32*	*1,73*	*11,72*	*15 - 61*
8	(a)	35	15,43	11,66	0,58	3,42	11 - 28
	(b)	319	36,73	234,50	0,86	15,31	10 - 87
	(c)	23	15,65	23,69	1,02	4,87	9 - 29
	(T)	*377*	*33,46*	*259,49*	*0,83*	*16,11*	*9 - 87*

Length contd.

UNIT	F	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
9 (a)	31	15,45	19,12	0,79	4,37	10 - 29
(b)	191	40,01	180,58	0,97	13,44	11 -106
(c)	-	-	-	-	-	-
(T)	*222*	*36,58*	*230,61*	*1,02*	*15,19*	*10 -106*
10 (a)	6	20,00	127,60	4,61	11,30	10 - 42
(b)	285	46,14	264,92	0,96	16,28	13 -110
(c)	-	-	-	-	-	-
(T)	*291*	*45,61*	*275,49*	*0,97*	*16,60*	*10 -110*
11 (a)	1	21,00				
(b)	107	47,91	280,20	1,62	16,74	13 -105
(c)	-	-	-	-	-	-
(T)	*108*	*47,66*	*284,28*	*1,62*	*16,86*	*13 -105*
12 (a)	1	19,00				
(b)	288	46,99	274,60	0,98	16,57	17 -100
(c)	-	-	-	-	-	-
(T)	*289*	*46,89*	*276,36*	*0,98*	*16,62*	*17 -100*
13 (a)	-	-	-	-	-	-
(b)	128	44,81	277,97	1,47	16,67	15 -106
(c)	-	-	-	-	-	-
14 (a)	-	-	-	-	-	-
(b)	183	38,00	233,71	1,13	15,29	9 - 88
(c)	-	-	-	-	-	-
15 (a)	2	16,00	-	-	-	12 - 20
(b)	120	25,78	193,72	1,27	13,92	11 - 94
(c)	3	16,67	4,33	1,20	2,08	15 - 19
(T)	*125*	*25,41*	*189,65*	*1,23*	*13,77*	*11 - 94*
16 (a)	52	15,29	16,48	0,56	4,06	8 - 27
(b)	245	26,97	180,03	0,86	13,42	10 - 94
(c)	15	21,27	41,78	1,67	6,46	12 - 38
(T)	*312*	*24,75*	*165,26*	*0,73*	*12,86*	*8 - 94*
18 (a)	65	16,57	10,69	0,41	3,27	11 - 26
(b)	117	40,53	242,80	1,44	15,58	17 - 90
(c)	23	17,44	20,80	0,95	4,56	11 - 26
(T)	*205*	*30,34*	*282,41*	*1,17*	*16,81*	*11 - 90*

Table 22

NELSON BAY CAVE : UNTRIMMED FLAKES

Width

(a) Quartz only
(b) Quartzite only
(c) Other
(T) Total sample

UNIT	f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
1 (a)	11	15,00	29,40	1,64	5,42	10 - 30
(b)	175	36,26	356,09	1,43	18,87	8 - 99
(c)	6	16,67	67,87	3,36	8,24	8 - 30
(T)	*192*	*34,43*	*362,45*	*1,37*	*19,04*	*8 - 99*
3 (a)	91	16,22	71,60	0,89	8,46	4 - 63
(b)	837	33,83	273,26	0,57	16,53	8 -110
(c)	34	14,68	27,38	0,90	5,23	6 - 30
(T)	*962*	*31,49*	*282,23*	*0,54*	*16,80*	*4 -110*
4 (a)	9	13,78	7,94	0,94	2,82	9 - 17
(b)	301	34,44	191,93	0,80	13,85	10 - 74
(c)	5	14,80	9,20	1,36	3,03	11 - 19
(T)	*315*	*33,53*	*201,24*	*0,80*	*14,19*	*9 - 74*
5 (a)	17	11,35	4,99	0,54	2,23	8 - 15
(b)	247	43,56	278,30	1,06	16,68	12 - 94
(c)	6	20,67	99,07	4,06	9,95	10 - 30
(T)	*270*	*41,03*	*327,45*	*1,10*	*18,10*	*8 - 94*
6 (a)	-	-	-	-	-	-
(b)	71	42,52	251,37	1,88	15,86	10 - 94
(c)	1	22,00				
(T)	*72*	*42,24*	*253,68*	*1,88*	*15,93*	*10 - 94*
7 (a)	1	12,00	-	-	-	-
(b)	45	43,42	189,30	2,05	13,76	12 - 73
(c)	-	-	-	-	-	-
(T)	*46*	*42,74*	*206,55*	*2,12*	*14,37*	*12 - 73*
8 (a)	35	11,83	5,62	0,40	2,37	7 - 19
(b)	319	38,30	293,83	0,96	17,14	8 - 97
(c)	23	14,13	6,12	0,52	2,47	10 - 19
(T)	*377*	*34,37*	*334,83*	*0,94*	*18,30*	*7 - 97*
9 (a)	31	12.03	19.90	0,80	4,46	8 - 30
(b)	191	43,75	259,11	1,17	16,10	11 -126
(c)	-	-	-	-	-	-
(T)	*222*	*39,32*	*346,86*	*1,25*	*18,62*	*8 -126*
10 (a)	6	18,83	89,37	3,86	9,45	9 - 32
(b)	285	50,31	303,57	1,03	17,42	15 -108
(c)	-	-	-	-	-	-
(T)	*291*	*49,66*	*318,91*	*1,05*	*17,86*	*9 -108*
11 (a)	1	27,00	-	-	-	-
(b)	107	50,34	327,92	1,75	18,11	10 -105
(c)	-	-	-	-	-	-
(T)	*108*	*50,12*	*329,90*	*1,75*	*18,16*	*10 -105*

NBC : UNTRIMMED FLAKES

Width contd.

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
12	(a)	1	9,00	-	-	-	-
	(b)	288	50,49	303,53	1,03	17,42	17 -135
	(c)	-	-	-	-	-	-
	(T)	*289*	*50,35*	*308,44*	*1,03*	*17,56*	*9 -135*
13	(a)	-	-	-	-	-	-
	(b)	128	49,48	261,92	1,43	16,18	22 - 89
	(c)	-	-	-	-	-	-
	(T)	*128*	*49,48*	*261,92*	*1,43*	*16,18*	*22 - 89*
14	(a)	-	-	-	-	-	-
	(b)	183	41,46	245,80	1,16	15,68	13 -108
	(c)	-	-	-	-	-	-
	(T)	*183*	*41,46*	*245,80*	*1,16*	*15,68*	*13 -108*
15	(a)	2	12,00	-	-	-	11 - 13
	(b)	120	27,88	181,49	1,23	13,47	10 - 81
	(c)	3	15,33	20,33	2,60	4,51	11 - 20
	(T)	*125*	*27,32*	*182,07*	*1,21*	*13,49*	*10 - 81*
16	(a)	52	12,48	11,08	0,46	3,33	5 - 19
	(b)	245	26,86	248,51	1,01	15,76	5 - 97
	(c)	15	16,73	54,50	1,91	7,38	8 - 34
	(T)	*312*	*23,98*	*230,42*	*0,86*	*15,18*	*5 - 97*
18	(a)	65	12,26	15,57	0,49	3,95	6 - 24
	(b)	117	40,79	269,53	1,52	16,42	13 - 91
	(c)	23	14,44	31,98	1,18	5,66	7 - 28
	(T)	*205*	*28,79*	*354,41*	*1,32*	*18,83*	*6 - 91*

Table 23

NELSON BAY CAVE : UNTRIMMED FLAKES

Height of piece

(a) Quartz only
(b) Quartzite only
(b) Other

(T) Total sample

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
1	(a)	11	5,00	3,60	0,57	1,90	3 - 10
	(b)	175	9,40	32,22	0,43	5,68	3 - 47
	(c)	6	4,50	0,70	0,84	0,34	4 - 6
	(T)	*192*	*9,0*	*31,26*	*0,40*	*5,59*	*3 - 47*
3	(a)	91	4,98	7,58	0,29	2,75	2 - 20
	(b)	837	9,85	24,97	0,17	5,00	2 - 31
	(c)	34	4,03	1,79	0,23	1,34	2 - 7
	(T)	*962*	*9,19*	*25,50*	*0,16*	*5,05*	*2 - 31*
4	(a)	9	3,89	0,86	0,31	0,93	3 - 6
	(b)	301	9,05	18,28	0,25	4,28	2 - 27
	(c)	5	3,60	0,30	0,25	0,55	3 - 4
	(T)	*315*	*8,81*	*18,68*	*0,24*	*4,32*	*2 - 27*
5	(a)	17	3,35	1,37	0,28	1,17	2 - 6
	(b)	247	11,25	21,63	0,30	4,65	3 - 27
	(c)	6	6,33	15,47	1,61	3,93	3 - 14
	(T)	*270*	*10,64*	*24,26*	*0,30*	*4,93*	*2 - 27*
6	(a)	-	-	-	-	-	-
	(b)	71	10,61	14,90	0,46	3,86	2 - 19
	(c)	1	6,00				
	(T)	*72*	*10,54*	*14,98*	*0,46*	*3,87*	*2 - 19*
7	(a)	1	5,00				
	(b)	45	11,11	16,15	0,60	4,02	4 - 20
	(c)	-	-	-	-	-	-
	(T)	*46*	*10,98*	*16,60*	*0,60*	*4,07*	*4 - 20*
8	(a)	35	3,37	1,53	0,21	1,24	2 - 6
	(b)	319	9,62	24,60	0,28	4,96	2 - 30
	(c)	23	3,87	2,30	0,32	1,52	2 - 8
	(T)	*377*	*8,69*	*25,87*	*0,26*	*5,09*	*2 - 30*
9	(a)	31	3,56	1,57	0,23	1,25	1 - 8
	(b)	191	11,08	16,27	0,29	4,03	3 - 30
	(c)	-	-	-	-	-	-
	(T)	*222*	*10,00*	*21,40*	*0,31*	*4,63*	*1 - 30*
10	(a)	6	4,67	9,87	1,28	3,14	2 - 10
	(b)	285	12,85	23,26	0,29	4,82	4 - 37
	(c)	-	-	-	-	-	-
	(T)	*291*	*12,68*	*24,31*	*0,29*	*4,93*	*2 - 37*
11	(a)	1	4,00				
	(b)	107	12,99	33,37	0,56	5,78	3 - 41
	(c)	-	-	-	-	-	-
	(T)	*108*	*12,91*	*33,80*	*0,56*	*5,81*	*3 - 41*

NBC : UNTRIMMED FLAKES

Height of piece contd.

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
12	(a)	1	3,00				
	(b)	288	12,84	25,77	0,30	5,08	4 - 34
	(c)	-	-	-	-	-	-
	(T)	*289*	*12,81*	*26,01*	*0,30*	*5,10*	*3 - 34*
13	(a)	-	-	-	-	-	-
	(b)	128	12,27	24,46	0,44	4,95	3 - 32
	(c)	-	-	-	-	-	-
	(T)	*128*	*12,27*	*24,46*	*0,44*	*4,95*	*3 - 32*
14	(a)	-	-	-	-	-	-
	(b)	183	10,27	22,99	0,35	4,80	3 - 27
	(c)	-	-	-	-	-	-
	(T)	*183*	*10,27*	*22,99*	*0,35*	*4,80*	*3 - 27*
15	(a)	2	3,00				
	(b)	120	6,90	15,99	0,37	4,00	2 - 24
	(c)	3	4,33	0,33	0,33	0,58	4 - 5
	(T)	*125*	*6,78*	*15,76*	*0,36*	*3,97*	*2 - 24*
16	(a)	52	3,35	1,76	0,18	1,33	2 - 7
	(b)	245	7,15	24,58	0,32	4,96	2 - 29
	(c)	15	4,20	5,60	0,61	2,37	2 - 10
	(T)	*312*	*6,37*	*22,05*	*0,27*	*4,70*	*2 - 29*
18	(a)	65	3,35	2,01	0,18	1,42	1 - 8
	(b)	117	10,52	25,27	0,47	5,03	3 - 35
	(c)	23	3,26	3,38	0,38	1,84	1 - 8
	(T)	*205*	*7,43*	*28,10*	*0,37*	*5,30*	*1 - 35*

Table 24

NELSON BAY CAVE : UNTRIMMED FLAKES

Width/length ratio $(\frac{W}{L} \times \frac{100}{1})$

(a) Quartz only
(b) Quartzite only
(c) Other
(T) Total sample

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
1	(a)	11	88,18	637,56	7,61	25,25	47 - 133
	(b)	175	111,18	2176,22	3,53	46,65	35 - 279
	(c)	6	86,50	3205,10	23,11	56,61	36 - 191
	(T)	*192*	*109,59*	*2143,63*	*3,34*	*46,30*	*35 - 280*
3	(a)	91	90,68	1109,29	3,49	33,31	25 - 200
	(b)	837	103,67	1487,31	1,33	38,57	21 - 404
	(c)	34	89,79	1081,50	5,64	32,89	42 - 159
	(T)	*962*	*102,48*	*1454,75*	*1,23*	*38,14*	*21 - 405*
4	(a)	9	84,00	647,25	8,48	25,44	45 - 114
	(b)	301	112,39	1566,73	2,28	39,58	39 - 279
	(c)	5	85,60	546,80	10,46	23,38	52 - 118
	(T)	*315*	*111,66*	*1555,29*	*2,22*	*39,44*	*40 - 280*
5	(a)	17	78,77	742,32	6,61	27,25	31 - 139
	(b)	247	110,77	1135,51	2,14	33,70	40 - 314
	(c)	6	79,50	1574,70	16,20	39,68	41 - 150
	(T)	*270*	*108,60*	*1190,70*	*2,10*	*34,51*	*32 - 315*
6	(a)	-	-	-	-	-	-
	(b)	71	110,83	1050,46	3,85	32,41	46 - 178
	(c)	1	100,00				
	(T)	*72*	*111,14*	*1036,86*	*3,80*	*32,20*	*46 - 179*
7	(a)	1	75,00				
	(b)	45	109,96	1080,54	4,90	32,87	65 - 219
	(c)	-	-	-	-	-	-
	(T)	*46*	*109,67*	*1080,35*	*4,85*	*32,87*	*66 - 219*
8	(a)	35	78,54	381,67	3,30	19,54	47 - 135
	(b)	319	106,96	1053,07	1,82	32,45	38 - 197
	(c)	23	95,74	744,84	5,69	27,29	51 - 158
	(T)	*377*	*104,14*	*1041,56*	*1,66*	*32,27*	*38 - 198*
9	(a)	31	80,07	743,53	4,90	27,27	39 - 154
	(b)	191	112,98	1124,42	2,43	33,53	41 - 209
	(c)	-	-	-	-	-	-
	(T)	*222*	*108,89*	*1199,33*	*2,32*	*34,63*	*40 - 210*
10	(a)	6	101,83	2100,57	18,71	45,83	50 - 159
	(b)	285	114,73	1370,56	2,19	37,02	38 - 253
	(c)	-	-	-	-	-	-
	(T)	*291*	*115,00*	*1382,94*	*2,18*	*37,19*	*39 - 254*
11	(a)	1	128,57				
	(b)	107	108,63	999,82	3,06	31,62	52 - 233
	(c)	-	-	-	-	-	-
	(T)	*108*	*109,27*	*993,82*	*3,03*	*31,53*	*53 - 233*

NELSON BAY CAVE : UNTRIMMED FLAKES

Width/length ratio contd.

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
12	(a)	1	211,11				
	(b)	288	111,37	926,07	1,79	30,43	39 - 238
	(c)	-	-	-	-	-	-
	(T)	*289*	*111,66*	*936,77*	*1,80*	*30,61*	*39 - 238*
13	(a)	-	-	-	-	-	-
	(b)	128	115,66	942,61	2,71	30,70	32 - 188
	(c)	-	-	-	-	-	-
	(T)	*128*	*115,66*	*942,61*	*2,71*	*30,70*	*32 - 188*
14	(a)	-	-	-	-	-	-
	(b)	183	115,24	1403,79	2,77	37,47	41 - 307
	(c)	-	-	-	-	-	-
	(T)	*183*	*115,24*	*1403,79*	*2,77*	*37,47*	*41 - 307*
15	(a)	2	81,67				55 - 108
	(b)	120	112,70	1025,98	2,92	32,03	45 - 211
	(c)	3	92,00	823,00	16,56	28,69	73 - 125
	(T)	*125*	*112,19*	*1032,96*	*2,88*	*32,14*	*45 - 211*
16	(a)	52	86,04	975,25	4,33	31,23	35 - 158
	(b)	245	100,72	1478,30	2,46	38,45	29 - 271
	(c)	15	79,67	868,67	7,61	29,47	39 - 135
	(T)	*312*	*97,78*	*1404,20*	*2,12*	*37,47*	*29 - 271*
18	(a)	65	74,57	529,37	2,85	23,01	23 - 150
	(b)	117	103,19	767,96	2,56	27,71	51 - 172
	(c)	23	82,61	617,61	5,18	24,85	43 - 113
	(T)	*205*	*92,32*	*847,17*	*2,03*	*29,11*	*23 - 173*

Table 25

NELSON BAY CAVE : UNTRIMMED FLAKES

Relative thickness

(a) Quartz only
(b) Quartzite only
(c) Other
(T) TOTAL SAMPLE

UNIT		f	MEAN	STD ERROR	STD DEVIATION	RANGE
1	(a)	11	32,18	4,15	13,75	16 - 69
	(b)	175	26,66	0,57	7,50	10 - 50
	(c)	6	26,33	2,65	6,50	18 - 34
	(T)	192	26,97	0,58	7,99	10 - 69
3	(a)	91	28,69	0,76	7,23	13 - 46
	(b)	837	29,10	0,28	8,20	12 - 67
	(c)	34	25,82	0,93	5,42	15 - 38
	(T)	962	28,94	0,26	8,05	12 - 67
4	(a)	9	25,33	1,57	4,72	19 - 34
	(b)	301	26,91	0,42	7,26	12 - 55
	(c)	5	22,40	1,69	3,78	18 - 28
	(T)	315	26,79	0,40	7,17	12 - 55
5	(a)	17	25,41	1,59	6,57	15 - 37
	(b)	247	26,67	0,48	7,57	13 - 75
	(c)	6	26,67	3,21	7,87	18 - 38
	(T)	270	26,59	0,46	7,50	13 - 75
6	(a)	-	-	-	-	-
	(b)	71	26,27	0,76	6,39	11 - 38
	(c)	1	27,00	-	-	-
	(T)	72	26,28	0,75	6,34	11 - 30
7	(a)	-	-	-	-	-
	(b)	45	26,11	0,88	5,88	14 - 38
	(c)	-	-	-	-	-
	(T)	45	26,11	0,88	5,88	14 - 38
8	(a)	35	24,54	1,20	7,12	13 - 36
	(b)	319	24,98	0,36	6,45	11 - 45
	(c)	23	25,74	1,65	7,92	12 - 48
	(T)	377	24,98	0,34	6,60	11 - 48
9	(a)	31	25,10	1,33	7,39	9 - 43
	(b)	191	26,45	0,41	5,71	11 - 42
	(c)	-	-	-	-	-
	(T)	222	26,26	0,40	5,97	9 - 43
10	(a)	6	23,00	2,65	6,48	15 - 32
	(b)	285	26,94	0,41	6,88	13 - 51
	(c)	-	-	-	-	-
	(T)	291	26,86	0,40	6,88	13 - 51
11	(a)	-	-	-	-	-
	(b)	107	25,89	0,62	6,44	15 - 52
	(c)	-	-	-	-	-
	(T)	107	25,89	0,62	6,44	15 - 52

NELSON BAY CAVE : UNTRIMMED FLAKES

Relative thickness continued

UNIT		f	MEAN	STD ERROR	STD DEVIATION	RANGE
12	(a)	1	-	-	-	-
	(b)	288	26,20	0,40	6,77	9 - 49
	(c)	-	-	-	-	-
	(T)	289	26,19	0,40	6,76	9 - 49
13	(a)	-	-	-	-	-
	(b)	128	25,87	0,62	6,99	11 - 45
	(c)	-	-	-	-	-
	(T)	128	25,87	0,62	6,99	11 - 45
14	(a)	-	-	-	-	-
	(b)	183	25,80	0,58	7,90	10 - 56
	(c)	-	-	-	-	-
	(T)	183	25,80	0,58	7,90	10 - 56
15	(a)	2	-	-	-	-
	(b)	120	25,23	0,67	7,30	11 - 47
	(c)	3	27,33	2,33	4,04	23 - 31
	(T)	125	25,22	0,65	7,28	11 - 47
16	(a)	52	24,27	1,13	8,15	12 - 54
	(b)	245	25,40	0,55	8,67	10 - 59
	(c)	15	21,27	1,70	6.60	13 - 35
	(T)	312	25,02	0,48	8,52	10 - 59
18	(a)	65	22,25	0,89	7,19	11 - 46
	(b)	117	25,56	0,66	7,16	10 - 49
	(c)	23	19,61	1,85	8,87	9 - 40
	(T)	205	24,16	0,53	7,59	9 - 49

Table 26. Boomplaas : Frequencies of cores in sub-classes and raw material analysis of core class

SUB-CLASS	RAW MATERIAL	DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Bladelet	Quartz	2	7	5	-	1	-	2	-	-	3	-	8	5	35	-	1	49
	Hornfels	2	-	-	-	-	-	-	-	2	2	1	1	-	-	-	-	2
	Chalced	-	8	3	-	-	-	-	-	1	1	5	6	1	2	-	3	17
	Silcrete	2	-	-	-	-	-	-	-	-	-	1	2	1	12	3	7	26
	Total	6	15	8	-	1	-	2	-	3	6	7	17	7	49	3	11	94
Flat Bladelet	Quartz	-	-	-	-	-	-	-	-	-	-	-	54	29	35	2	1	121
	Quartzite	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2
	Hornfels	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
	Chalcedony	-	-	-	-	-	-	-	-	-	-	-	26	9	9	1	-	45
	Total	-	-	-	-	-	-	-	-	-	-	-	81	39	45	3	1	169
TOTAL BLADELET		6	15	8	-	1	-	2	-	3	6	7	98	46	94	6	12	263
Irregular	Quartz	5	17	9	15	12	3	10	-	1	41	2	9	7	38	3	6	65
	Quartzite	-	1	-	-	2	1	2	-	5	10	1	2	-	1	1	-	5
	Hornfels	2	4	-	-	3	-	-	-	3	6	2	10	1	1	-	-	14
	Chalcedony	-	9	6	6	3	1	4	1	2	17	5	20	3	4	-	1	33
	Silcrete	-	4	2	-	4	-	1	1	-	6	2	1	3	10	1	6	23
	Total	7	35	17	21	24	5	17	2	11	80	12	42	14	54	5	13	140
Large irregular	Quartz	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	Quartzite	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
	Total	-	2	-	-	-	-	-	-	-	-	1	-	-	3	-	-	4
Total all cores		*13*	*52*	*25*	*21*	*25*	*5*	*19*	*2*	*14*	*86*	*20*	*140*	*60*	*151*	*11*	*25*	*407*
% Bladelet cores		*46,2*	*28,9*	*32,0*	-	*4,0*	-	*10,4*	-	*21,4*		*35,0*	*70,0*	*76,7*	*62,3*	*54,6*	*48,0*	

Table 27. Boomplaas : Frequencies of bladelets in chips, untrimmed flakes and raw material classes

SUB-CLASS	RAW MATERIAL	DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Bladelets in Chips class	Quartz	-	16	16	-	-	-	-	-	-	-	6	54	77	164	5	5	311
	Quartzite	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	6
	Hornfels	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	2
	Chalcedony	-	1	-	-	-	-	-	-	-	-	3	35	18	10	-	-	66
	Silcrete	-	-	-	-	-	-	-	-	-	-	-	1	2	26	3	13	45
	Total	-	16	16	-	-	-	-	-	-	-	9	94	100	201	8	18	430
Bladelets in untrimmed flakes class	Quartz	27	64	38	2	2	-	3	1	5	13	12	92	97	411	24	37	673
	Quartzite	-	1	-	-	-	-	-	1	-	1	1	13	3	7	2	-	26
	Hornfels	6	9	-	-	1	2	2	2	-	7	-	12	12	4	-	-	28
	Chalcedony	2	32	13	1	2	1	5	4	6	19	35	142	48	76	4	1	306
	Silcrete	2	1	3	-	2	-	-	1	-	3	8	8	5	195	95	174	485
	Total	27	107	54	3	7	3	10	9	11	43	56	267	165	693	125	212	1518
Total bladelets		27	124	70	3	7	3	10	9	11	43	65	361	265	894	133	230	1948
Bladelets as % total untrimmed flakes		0,9	2,7	2,7	0,5	0,6	0,6	0,6	2,4	1,1	0,8	2,6	7,5	11,2	13,1	18,0	20,9	9,2

Table 28

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Length

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
DGL	(1)	148	17,28	37,02	0,50	6,08	8 - 52
	(2)	54	17,02	31,53	0,76	5,62	6 - 39
	(3)	78	21,33	141,73	1,35	11,91	8 - 80
	(4)	30	21,60	99,01	1,82	9,95	10 - 47
	(5)	6	26,00	218,80	6,04	14,79	10 - 50
	(T)	316	18,81	74,77	0,49	8,65	6 - 80
BLD	(1)	77	17,57	33,01	0,66	5,75	10 - 52
	(2)	42	18,21	22,51	0,73	4,75	11 - 30
	(3)	49	23,02	95,94	1,40	9,80	12 - 54
	(4)	32	23,22	87,21	1,65	9,34	12 - 57
	(5)	10	30,60	145,60	3,82	12,07	16 - 50
	(T)	210	20,45	69,37	0,58	8,33	10 - 57
BLA	(1)	59	17,75	50,33	0,92	7,09	8 - 55
	(2)	18	17,39	56,72	1,78	7,53	8 - 36
	(3)	31	20,07	38,73	1,12	6,22	10 - 37
	(4)	23	22,00	79,82	1,86	8,93	11 - 54
	(5)	-	-	-	-	-	-
	(T)	131	18,99	55,25	0,65	7,43	8 - 55
BRL	(1)	19	18,95	28,83	1,23	5,37	13 - 32
	(2)	22	21,50	59,02	1,64	7,68	11 - 37
	(3)	54	27,26	133,37	1,57	11,55	10 - 62
	(4)	41	26,22	110,23	1,64	10,50	9 - 60
	(5)	13	38,77	146,36	3,36	12,10	12 - 64
	(T)	149	26,07	125,60	0,92	11,21	9 - 64
BRL 7	(1)	-	-	-	-	-	-
	(2)	28	23,32	76,52	1,65	8,75	9 - 45
	(3)	19	27,63	148,25	2,79	12,18	11 - 64
	(4)	11	22,18	105,16	3,09	10,26	12 - 45
	(5)	4	28,00	171,33	6,55	13,09	12 - 41
	(T)	62	24,74	108,69	1,32	10,43	9 - 64

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Length continued

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
CL 1-2	(1)	15	44,27	247,92	4,07	15,75	12 - 78
	(2)	68	22,29	96,06	1,19	9,80	9 - 53
	(3)	18	28,72	112,21	2,50	10,59	12 - 50
	(4)	25	26,04	117,29	2,17	10,83	9 - 53
	(5)	8	11,25	27,36	1,85	5,23	11 - 19
	(T)	134	25,55	174,15	1,14	13,20	9 - 78
CL 3-4	(1)	5	16,20	13,70	1,66	3,70	12 - 21
	(2)	30	20,10	48,65	1,27	6,98	10 - 35
	(3)	10	33,70	87,57	2,96	9,36	19 - 51
	(4)	84	19,96	63,34	0,87	7,96	11 - 62
	(5)	4	15,75	21,58	2,32	4,65	10 - 20
	(T)	133	20,76	72,12	0,74	8,49	10 - 62
GWA	(1)	3	19,33	89,33	5,46	9,45	12 - 30
	(2)	9	20,89	61,36	2,61	7,83	12 - 36
	(3)	-	-	-	-	-	-
	(4)	40	20,55	45,38	1,07	6,74	11 - 38
	(5)	-	-	-	-	-	-
	(T)	52	20,54	47,94	0,96	6,92	11 - 38
LP	(1)	10	19,80	21,07	1,45	4,59	13 - 27
	(2)	4	17,00	40,67	3,19	6,38	11 - 23
	(3)	2	21,50	24,50	3,50	4,95	18 - 25
	(4)	1	20,00	20,00	-	-	-
	(5)	-	-	-	-	-	-
	(T)	17	20,68	42,67	1,50	6,53	13 - 37
LPC	(1)	34	26,62	143,46	2,05	11,98	12 - 65
	(2)	3	18,00	31,00	3,22	5,57	13 - 24
	(3)	6	22,00	105,60	4,20	10,28	14 - 40
	(4)	10	43,60	553,38	7,44	23,52	14 - 80
	(5)	7	32,71	103,57	3,85	10,18	15 - 48
	(T)	60	29,17	243,37	2,05	15,60	11 - 80

Table 29

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Width

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
DGL	(1)	148	15,61	45,10	0,55	6,72	5 - 48
	(2)	54	15,72	47,87	0,94	6,92	6 - 53
	(3)	78	21,01	146,92	1,37	12,12	8 - 98
	(4)	30	16,50	41,29	1,17	6,43	8 - 32
	(5)	6	19,83	78,97	3,63	8,89	10 - 31
	(T)	316	17,13	75,41	0,49	8,68	5 - 98
BLD	(1)	77	13,66	31,83	0,64	5,64	5 - 30
	(2)	42	14,29	31,14	0,86	5,58	6 - 32
	(3)	49	20,88	88,40	1,34	9,40	9 - 52
	(4)	32	20,34	55,01	1,31	7,42	10 - 36
	(5)	10	25,80	151,51	3,89	12,31	10 - 48
	(T)	210	17,07	67,19	0,57	8,20	5 - 52
BLA	(1)	59	13,36	34,34	0,76	5,86	4 - 43
	(2)	18	13,28	24,92	1,18	4,99	5 - 24
	(3)	31	19,48	80,79	1,61	8,99	8 - 50
	(4)	23	18,78	75,00	1,81	8,66	8 - 46
	(5)	-	-	-	-	-	-
	(T)	131	15,75	58,31	0,67	7,64	4 - 50
BRL	(1)	19	15,79	33,95	1,34	5,83	5 - 30
	(2)	22	18,91	95,52	2,08	9,77	7 - 43
	(3)	54	26,67	124,72	1,52	11,17	10 - 58
	(4)	41	25,34	79,63	1,39	8,92	13 - 51
	(5)	13	37,39	128,09	3,14	11,32	13 - 55
	(T)	149	24,71	125,09	0,92	11,18	5 - 58
BRL 7	(1)	-	-	-	-	-	-
	(2)	28	18,18	78,00	1,67	8,83	4 - 35
	(3)	19	26,79	122,29	2,54	11,06	13 - 54
	(4)	11	20,09	102,69	3,06	10,13	5 - 34
	(5)	4	39,25	815,58	14,28	28,56	6 - 69
	(T)	62	22,52	161,30	1,61	12,70	4 - 69

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Width continued

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
CL1-2	(1)	8	6,75	5,07	0,80	2,25	5 - 12
	(2)	68	16,18	103,70	1,24	10,18	4 - 44
	(3)	18	25,89	110,69	2,48	10,52	7 - 41
	(4)	25	23,64	156,99	2,51	12,53	5 - 50
	(5)	15	50,93	444,78	5,45	21,09	14 - 89
	(T)	134	22,20	270,06	1,42	16,43	4 - 89
CL3	(1)	5	11,80	57,20	3,38	7,56	6 - 24
	(2)	30	12,10	64,02	1,46	8,00	5 - 36
	(3)	10	35,20	359,96	6,00	18,97	6 - 80
	(4)	84	13,96	99,72	1,09	9,99	4 - 45
	(5)	4	11,25	112,25	5,30	10,60	5 - 27
	(T)	133	14,98	139,92	1,03	11,83	4 - 80
GWA	(1)	3	13,00	39,00	3,61	6,25	6 - 18
	(2)	9	10,67	28,50	1,78	5,34	5 - 20
	(3)	-	-	-	-	-	-
	(4)	40	14,40	75,58	1,38	8,69	5 - 36
	(5)	-	-	-	-	-	-
	(T)	52	13,67	65,83	1,13	8,11	5 - 36
LP	(1)	10	16,10	26.54	1,63	5,15	7 - 26
	(2)	4	16,50	23,00	2,40	4,80	10 - 21
	(3)	2	24,00	18,00	3,00	4,24	21 - 27
	(4)	1	21,00	-	-	-	-
	(5)	-	-	-	-	-	-
	(T)	17	17,16	53,14	1,67	7,29	7 - 34
LPC	(1)	34	20,79	129,99	1,96	11,40	5 - 62
	(2)	3	15,67	24,33	2,85	4,93	10 - 19
	(3)	10	34,70	296,68	5,45	17,22	12 - 65
	(4)	6	15,33	68,67	3,38	8,29	8 - 30
	(5)	7	29,00	157,00	4,74	12,53	10 - 50
	(T)	60	23,55	174,53	1,74	13,21	5 - 65

Table 30

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Height of Piece

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
DGL	(1)	148	4,45	5,91	0,20	2,43	1 - 15
	(2)	54	3,94	3,04	0,24	1,74	1 - 10
	(3)	78	5,23	17,35	0,47	4,17	1 - 30
	(4)	30	4,27	5,38	0,42	2,32	1 - 10
	(5)	6	4,67	6,67	1,05	2,58	2 - 9
	(T)	316	4,54	8,30	0,16	2,88	1 - 30
BLD	(1)	77	3,83	3,51	0,21	1,87	1 - 11
	(2)	42	3,29	1,62	0,20	1,27	1 - 6
	(3)	49	5,16	7,81	0,40	2,79	1 - 14
	(4)	32	4,88	4,05	0,36	2,01	2 - 9
	(5)	10	8,10	18,32	1,35	4,28	3 - 18
	(T)	210	4,40	5,97	0,17	2,44	1 - 18
BLA	(1)	59	3,80	3,75	0,25	1,94	1 - 10
	(2)	18	2,67	1,53	0,29	1,24	1 - 6
	(3)	31	4,65	2,70	0,30	1,64	1 - 9
	(4)	23	4,70	4,40	0,44	2,10	2 - 12
	(5)	-	-	-	-	-	-
	(T)	131	4,00	3,69	0,17	1,92	1 - 12
BRL	(1)	19	4,21	4,06	0,46	2,02	1 - 9
	(2)	22	3,82	3,01	0,37	1,74	1 - 7
	(3)	54	5,83	8,78	0,40	2,96	2 - 18
	(4)	41	6,29	7,16	0,42	2,68	2 - 13
	(5)	13	9,39	18,59	1,20	4,31	3 - 19
	(T)	149	5,77	9,61	0,25	3,10	1 - 19
BRL 7	(1)	-	-	-	-	-	-
	(2)	28	4,29	3,55	0,36	1,88	1 - 8
	(3)	19	5,90	7,88	0,64	2,81	3 - 14
	(4)	11	5,18	11,16	1,01	3,34	1 - 11
	(5)	4	6,50	17,67	2,10	4,20	2 - 11
	(T)	62	5,08	7,22	0,34	2,69	1 - 14

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Height of Piece continued

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
CL 1-2	(1)	8	2,38	0,27	0,18	0,52	2 - 3
	(2)	68	3,99	5,93	0,30	2,43	1 - 14
	(3)	18	5,94	7,70	0,65	2,78	2 - 13
	(4)	25	5,16	7,39	0,54	2,72	1 - 13
	(5)	15	12,20	30,31	1,42	5,51	4 - 26
	(T)	134	5,29	15,34	0,34	3,92	1 - 26
CL 3	(1)	5	3,40	3,80	0,87	1,95	2 - 6
	(2)	30	2,77	2,67	0,30	1,63	1 - 7
	(3)	10	7,70	12,23	1,11	3,50	2 - 15
	(4)	84	3,27	5,58	0,26	2,36	1 - 11
	(5)	4	2,50	1,67	0,65	1,29	1 - 4
	(T)	133	3,47	6,60	0,22	2,57	1 - 15
GWA	(1)	3	4,67	14,33	2,19	3,79	2 - 9
	(2)	9	3,33	4,00	0,67	2,00	2 - 8
	(3)	-	-	-	-	-	-
	(4)	40	3,68	3,76	0,31	1,94	1 - 9
	(5)	-	-	-	-	-	-
	(T)	52	3,67	4,15	0,28	2,04	1 - 9
LP	(1)	10	4,80	1,73	0,42	1,32	2 - 7
	(2)	4	4,00	2,67	0,82	1,63	2 - 6
	(3)	2	4,50	0,50	0,50	0,71	4 - 5
	(4)	1	3,00	-	-	-	-
	(5)	-	-	-	-	-	-
	(T)	17	4,79	4,62	0,49	2,15	2 - 10
LPC	(1)	34	6,35	12,42	0,60	3,52	2 -21
	(2)	3	4,33	1,33	0,67	1,16	3 - 5
	(3)	10	9,60	45,16	2,13	6,72	2 - 25
	(4)	6	4,33	14,67	1,56	3,83	2 - 12
	(5)	7	8,00	11,67	1,29	3,42	2 - 13
	(T)	60	6,76	18,82	0,57	4,34	2 - 25

Table 31

BOOMPLAAS CAVE : UNTRIMMED FLAKES
Width/Length Ratio $(\frac{W}{L} \times \frac{100}{1})$

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
DGL	(1)	148	91,84	1009,61	2,61	31,77	37 - 219
	(2)	54	95,94	1515,00	5,30	38,92	50 - 283
	(3)	78	103,22	966,46	3,52	31,09	33 - 175
	(4)	30	83,07	1235,17	6,42	35,15	44 - 219
	(5)	6	88,00	1585,20	16,25	39,82	48 - 150
	(T)	316	94,44	1136,93	1,90	33,72	33 - 283
BLD	(1)	77	77,35	594,94	2,78	24,39	31 - 131
	(2)	42	80,05	870,49	4,55	29,50	39 - 154
	(3)	49	94,04	754,79	3,93	27,47	29 - 157
	(4)	32	91,75	898,90	5,30	29,98	44 - 188
	(5)	10	85,40	857,16	9,26	29,28	52 - 143
	(T)	210	84,36	782,92	1,93	27,98	29 - 188
BLA	(1)	59	78,00	898,10	3,90	29,97	33 - 200
	(2)	18	83,67	1539,77	9,25	39,24	41 - 187
	(3)	31	100,10	1970,09	7,97	44,39	50 - 238
	(4)	23	88,00	955,73	6,45	30,92	36 - 150
	(5)	-	-	-	-	-	-
	(T)	131	85,76	1296,26	3,15	36,00	33 - 238
BRL	(1)	19	83,90	750,54	6,29	27,40	38 - 150
	(2)	22	89,77	1505,42	8,27	38,80	40 - 171
	(3)	54	102,46	1102,25	4,52	33,20	43 - 200
	(4)	41	102,90	1174,49	5,35	34,27	50 - 188
	(5)	13	97,92	398,41	5,54	19,96	79 - 140
	(T)	149	97,95	1098,88	2,72	33,15	38 - 200
BRL 7	(1)	-	-	-	-	-	-
	(2)	28	80,21	1778,25	7,97	42,17	32 - 206
	(3)	19	102,63	1231,36	8,05	35,09	55 - 174
	(4)	11	90,73	1168,22	10,31	34,18	38 - 141
	(5)	4	121,50	2823,00	26,57	53,13	50 - 168
	(T)	62	91,61	1636,96	5,14	40,46	32 - 206

BOOMPLAAS CAVE : UNTRIMMED FLAKES
W/L continued

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
CL 1-2	(1)	8	47,50	764,00	9,77	27,64	36 - 100
	(2)	68	71,63	1104,45	4,03	33,23	22 - 168
	(3)	18	92,33	1291,41	8,47	35,94	46 - 159
	(4)	25	92,04	1500,79	7,75	38,74	26 - 179
	(5)	15	117,20	1455,89	9,85	38,16	63 - 193
	(T)	134	81,59	1521,90	3,37	39,01	22 - 193
CL 3	(1)	5	69,40	1320,80	16,25	36,34	46 - 133
	(2)	30	58,93	1086,27	6,02	32,96	25 - 156
	(3)	10	99,90	1413,43	11,89	37,60	31 - 156
	(4)	84	66,46	1166,88	3,73	34,16	26 - 147
	(5)	4	65,25	2138,25	23,12	46,24	35 - 134
	(T)	133	67,35	1254,52	3,07	35,42	25 - 156
GWA	(1)	3	67,33	514,33	13,09	22,68	50 - 93
	(2)	9	49,00	77,50	2,93	8,80	41 - 68
	(3)	-	-	-	-	-	-
	(4)	40	71,90	1531,63	6,19	39,14	18 - 156
	(5)	-	-	-	-	-	-
	(T)	52	67,67	1279,13	4,96	35,77	18 - 156
LP	(1)	10	80,50	304,94	5,52	17,46	46 - 100
	(2)	4	100,00	512,67	11,32	22,64	82 - 133
	(3)	2	111,50	40,50	4,50	6,36	107 - 116
	(4)	1	104,00	-	-	-	-
	(5)	-	-	-	-	-	-
	(T)	17	82,74	585,98	5,55	24,71	46 - 146
LPC	(1)	34	78,53	589,05	4,16	24,27	38 - 125
	(2)	3	93,00	2179,00	26,95	46,68	58 - 146
	(3)	10	84,40	369,60	6,08	19,23	52 - 112
	(4)	6	70,00	393,20	8,10	19,83	46 - 100
	(5)	7	86,43	429,95	7,84	20,74	52 - 110
	(T)	60	82,38	540,35	3,05	23,25	38 - 133

Table 32

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Relative thickness

(1) Quartz only
(2) Chalcedony only
(3) Hornfels only
(4) Silcrete only
(5) Quartzite only
(T) TOTAL SAMPLE

UNIT		f	MEAN	STD ERROR	STD DEVIATION	RANGE
DGL	(1)	148	26,45	0,73	8,90	8 - 58
	(2)	54	24,37	1,18	8,66	6 - 44
	(3)	78	23,44	0,80	7,03	8 - 38
	(4)	30	22,67	1,75	9,58	11 - 39
	(5)	6	20,83	2,39	5,85	15 - 31
	(T)	316	24,89	0,48	8,55	6 - 58
BLD	(1)	77	24,36	0,86	7,55	9 - 44
	(2)	42	20,31	0,84	5,70	11 - 35
	(3)	49	23,44	0,80	7,03	8 - 38
	(4)	32	22,34	1,51	6,51	11 - 39
	(5)	10	28,30	2,39	5,85	15 - 31
	(T)	210	23,15	0,50	7,18	7 - 44
BLA	(1)	59	24,56	0,96	7,39	13 - 40
	(2)	18	17,39	0,85	3,62	9 - 23
	(3)	31	24,03	1,14	6,34	9 - 36
	(4)	23	23,91	1,74	8,34	14 - 50
	(5)	Quartzite absent from sample				
	(T)	131	23,34	0,64	7,27	9 - 50
BRL	(1)	19	23,53	1,79	7,82	13 - 36
	(2)	22	19,27	1,33	6,25	10 - 36
	(3)	54	21,54	0,89	6,57	12 - 46
	(4)	41	24,27	1,10	7,02	11 - 45
	(5)	13	23,62	1,53	5,52	14 - 32
	(T)	149	22,39	0,56	6,87	10 - 46
BRL 7	(1)	Quartz absent from sample				
	(2)	28	21,11	0,91	4,81	13 - 32
	(3)	19	21,68	1,49	6,50	14 - 35
	(4)	11	22,82	2,66	8,83	11 - 36
	(5)	4	20,25	2,18	4,35	16 - 24
	(T)	62	21,53	0,77	6,08	11 - 36
CL 1-2	(1)	8	27,75	2,76	7,82	19 - 42
	(2)	68	21,52	0,91	7,49	11 - 51
	(3)	18	21,67	1,35	5,73	13 - 31
	(4)	25	20,76	1,19	5,96	11 - 31
	(5)	15	25,47	1,35	5,22	18 - 35
	(T)	134	22,21	0,60	6,98	11 - 51
CL 3	(1)	5	24,40	3,04	6,80	16 - 35
	(2)	30	18,53	1,16	6,38	9 - 34
	(3)	10	22,00	1,10	3,46	16 - 26
	(4)	84	19,42	0,66	6,09	8 - 32
	(5)	4	21,75	6,12	12,23	14 - 40
	(T)	133	19,67	0,55	6,29	8 - 40

BOOMPLAAS CAVE : UNTRIMMED FLAKES

Relative thickness continued

UNIT		f	MEAN	STD ERROR	STD DEVIATION	RANGE
GWA	(1)	3	27,00	6,25	10,82	18 - 39
	(2)	9	22,89	2,07	6,19	12 - 33
	(3)	Hornfels absent from sample				
	(4)	40	22,85	1,23	7,80	10 - 51
	(5)	Quartzite absent from sample				
	(T)	52	23,10	1,06	7,62	10 - 51
LP	(1)	10	27,20	2,29	7,24	18 - 38
	(2)	2	27,50	4,50	6,36	23 - 32
	(3)	Hornfels absent from sample				
	(4)	5	19,00	2,00	4,47	14 - 25
	(5)	2	28,50	0,50	0,71	28 - 29
	(T)	19	25,21	1,58	6,90	14 - 38
LPC	(1)	34	27,56	1,24	7,22	15 - 44
	(2)	5	23,20	2,15	4,82	18 - 29
	(3)	12	22,42	1,84	6,37	14 - 36
	(4)	2	24,00	10,00	14,14	14 - 34
	(5)	5	23,40	2,36	5,27	16 - 30
	(T)	34	27,56	1,24	7,22	15 - 44

Table 33

NELSON BAY CAVE : RATIO OF UTILIZED:UNTRIMMED FLAKES

Stratigraphic Unit	Utilized : Untrimmed flakes
IC	1: 26,5
BSC	1: 29,3
RA	1: 28,9
RB	1: 23,6
J	1: 26,7
BSBJ	1: 23,7
CS	1: 29,8
GSL	1: 28,4
BSL	<u>1: 13,3</u>
YSL	1: 27,6
YGL	<u>1: 37,0</u>

Site $\bar{x}$	1: 26,80
Standard deviation	1: 5,74
Standard error	1: 1,73

Range within one standard deviation: 32,54 - 21,06

Values outside this range are underlined.

Table 34

KANGKARA: RATIO OF UTILIZED:UNTRIMMED FLAKES

Stratigraphic Unit	Utilized : Untrimmed flakes
SUR	1: 19,2
HBC	1: 22,8
SGL	1: 15,2
DGL	1: 45,6
GBL	1: 15,5
PBW	1: 21,2
LPW	1: 23,9
RBL	1: 41,0
YBL	1: 69,3
BD	1: 13,1
BBD	1: 7,2

Site $\bar{x}$	1: 26,73
Standard deviation	1: 18,19
Standard error	1: 5,48

Range within one standard deviation: 44,92 - 8,54

Values outisde this range are underlined.

Table 35

BOOMPLAAS CAVE: RATIO OF UTILIZED:UNTRIMMED FLAKES

Stratigraphic Unit	Utilized : Untrimmed flakes
DGL	1: 60,6
BLD	1: 28,6
BLA	1: 28,0
BRL 1	1: 14,2
BRL 2	1: 10,9
BRL 3	1: 22,4
BRL 4	1: 12,8
BRL 5	1: 16,2
BRL 6	1: 20,4
TOTAL BRL	1: 14,1
BRL 7	1: 33,0
CL 1	1: 30,7
CL 2	1: 42,4
CL 3	1: 81,5
CL 4	1:105,9
GWA	1: 42,3
TOTAL CL	1: 42,8

Site $\bar{x}$ 1: 35,25

Standard deviation 1: 26,75

Range within one standard deviation: 1: 8,5 - 1: 62,0

Values outside this range are underlined

Table 36

NELSON BAY CAVE : SCRAPERS

Length

(a) Total sample
(b) Quartzite omitted

STRATIGRAPHIC UNIT		f	MEAN mm	VARIANCE	STD ERROR	STD DEVIATION	RANGE
IC	(a)	120	9,57	8,92	0,27	2,99	5 - 29
	(b)	117	9,29	4,48	0,20	2,12	5 - 18
BSC upper	(a)	33	12,12	19,24	0,76	4,39	7 - 25
	(b)	33	12,12	19,24	0,76	4,39	7 - 25
BSC lower	(a)	33	16,27	158,58	2,19	12,59	4 - 75
	(b)	32	14,44	48,96	1,24	6,99	4 - 35
RA	(a)	16	21,75	485,13	5,51	22,03	6 - 68
	(b)	11	10,18	5,36	0,70	2,32	6 - 14
RB	(a)	28	41,64	578,31	4,54	24,05	8 -107
	(b)	9	15,56	95,53	3,26	9,77	7 - 36
J	(a)	9	46,78	668,44	8,62	25,85	28 -101
	(b)	2	31,5	12,5	2,5	3,54	19 - 34
BSBJ-GSL	(a)	8	59,25	445,64	7,46	21,11	35 -103
	(b)			all	quartzite		
BSL-YGL	(a)	9	18,44	257,03	5,34	16,03	8 - 59
	(b)	7	11,71	8,57	1,11	2,93	8 - 15

Grouped units

IC-RA	(a)	202	12,05	83,89	0,64	9,16	4 - 75
	(b)	193	10,68	18,00	0,31	4,24	4 - 35
RB-GSL	(a)	45	47,22	438,66	3,12	20,94	8 -107
	(b)	11	18,46	119,27	3,29	10,92	7 - 36
BSL-YGL	(a)	9	18,44	257,03	5,34	16,03	8 - 59
	(b)	7	11,71	8,57	1,11	2,93	8 - 15

Table 37

NELSON BAY CAVE : SCRAPERS

Width

(a) Total sample
(b) Quartzite omitted

STRATIGRAPHIC UNIT		f	MEAN mm	VARIANCE	STD ERROR	STD DEVIATION	RANGE
IC	(a)	120	16,18	9,29	0,28	3,05	8 - 30
	(b)	117	16,01	7,63	0,26	2,76	8 - 26
BSC upper	(a)	33	15,64	17,43	0,73	4,17	10 - 28
	No quartzite						
BSC lower	(a)	33	17,12	149,61	2,13	12,23	10 - 81
	(b)	32	15,13	18,69	0,76	4,32	10 - 33
RA	(a)	16	20,06	1056,86	8,13	32,51	11 -136
	(b)	11	14,18	3,76	0,59	1,94	11 - 17
RB	(a)	28	36,71	359,92	3,59	18,97	12 - 85
	(b)	9	22,11	194,36	4,65	13,94	12 - 57
J	(a)	9	36,22	314,94	5,92	17,75	21 - 66
	(b)	2	21,50	0,50	0,50	0,71	21 - 22
BSBJ - GSL	(a)	8	65,38	416,84	7,22	20,42	36 -101
	All quartzite						
BSL-YGL	(a)	9	29,33	1058,25	10,84	32,53	13 -111
	(b)	7	15,00	1,67	0,49	1,29	13 - 17

Grouped units

IC-RA	(a)	202	17,19	121,38	0,78	11,02	8 -136
RB-GSL	(a)	45	41,71	468,30	3,23	21,64	12 -101
BSL-YGL	(a)	9	29,33	1058,25	10,84	32,53	13 -111

Table 38

NELSON BAY CAVE : SCRAPERS — Total sample

Width/length ratio $\frac{W}{L} \times 100$

STRATIGRAPHIC UNIT	f	MEAN mm	VARIANCE	STD ERROR	STD DEVIATION	RANGE
IC	120	177,64	1919,04	4,00	43,81	72-319
BSC upper	33	135,61	1178,31	5,98	34,33	88-214
BSC lower	33	119,94	2554,12	8,80	50,54	60-300
RA	16	137,13	1483,45	9,63	38,52	78-222
RB	28	97,89	1296,69	6,81	36,01	52-225
J	9	79,78	494,69	7,41	22,24	51-128
BSBJ - GSL	8	116,50	1893,43	15,38	43,51	71-210
BSL - YGL	9	146,78	1506,19	12,94	38,81	100-191

NELSON BAY CAVE : SCRAPERS

Raw material (%)

STRATIGRAPHIC UNIT	f	QUARTZ	QUARTZITE	CHALCEDONY	SILCRETE	OTHER
IC	120	31,7	2,5	40,8	25,0	-
BSC upper	33	45,5	-	54,5	-	-
BSC lower	33	39,4	3,0	57,6	-	-
RA	16	62,5	31,3	-	6,3	-
RB	28	14,3	67,9	17,9	-	-
J	9	-	77,8	22,2	-	-
BSBJ - GSL	8	-	100,0	-	-	-
BSL - YGL	9	77,8	22,2	-	-	-

Table 39

NELSON BAY CAVE : SCRAPERS

Height of piece

(a) Total sample

(b) Quartzite omitted

STRATIGRAPHIC UNIT		f	MEAN mm	VARIANCE	STD ERROR	STD DEVIATION	RANGE
IC	(a)	120	4,05	1,78	1,22	1,33	2 - 10
	(b)	117	3,96	1,2	0,10	1,09	2 - 7
BSC upper	(a)	33	4,76	3,63	0,33	1,90	2 - 12
	(b)	No quartzite					
BSC lower	(a)	33	6,39	33,43	1,01	5,78	1 - 34
	(b)	32	5,53	9,16	0,54	3,03	1 - 18
RA	(a)	16	8,38	56,78	1,89	7,54	3 - 27
	(b)	11	4,27	0,62	0,24	0,79	3 - 5
RB	(a)	28	13,82	105,04	1,94	10,25	3 - 53
	(b)	9	11,11	250,86	5,28	15,84	3 - 53
J	(a)	9	13,22	10,94	1,10	3,31	11 - 21
	(b)	2	12,00	-	-	-	12 - 12
BSBJ-GSL	(a)	8	26,50	136,00	4,12	11,66	9 - 42
	(b)	All quartzite					
BSL-YGL	(a)	9	8,89	44,86	2,23	6,70	3 - 25
	(b)	7	6,14	6,14	0,94	2,48	3 - 10

Grouped units

IC-RA	(a)	202	4,89	12,95	2,53	3,60	1 - 34
RB-GSL	(a)	45	15,96	112,73	1,58	10,62	3 - 53
BSL-YGL	(a)	9	8,89	44,86	2,23	6,70	3 - 25

Table 40

NELSON BAY CAVE : SCRAPERS

Plan form

(a) Total sample
(b) Quartzite omitted

STRATI-GRAPHIC UNIT		CODE 1		2		3		4		5		6		7	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%
IC	(a)	79	*65,8*	14	*11,7*	11	*9,2*	4	*3,3*	-	-	5	*4,2*	7	*5,8*
	(b)	78	*66,7*	14	*12,0*	10	*8,5*	3	*2,6*	-	-	5	*4,3*	7	*6,0*
BSC upper	(a)	7	*21,2*	4	*12,1*	9	*27,3*	4	*12,1*	2	*6,1*	6	*18,2*	1	*3,0*
	(b)	No quartzite													
BSC lower	(a)	9	*27,3*	1	*3,0*	7	*21,2*	11	*33,3*	1	*3,0*	4	*12,1*	-	-
	(b)	9	*28,1*	1	*3,1*	6	*18,8*	11	*34,4*	1	*3,1*	4	*12,5*	-	-
RA	(a)	7	*43,8*	-	-	2	*12,5*	1	*6,3*	-	-	5	*31,3*	1	*6,3*
	(b)	5	*45,5*	-	-	-	-	-	-	-	-	5	*45,5*	1	*9,1*
RB	(a)	1	*3,6*	4	*14,3*	1	*3,6*	17	*60,7*	1	*3,6*	2	*7,1*	2	*7,1*
	(b)	1	*11,1*	3	*33,3*	1	*11,1*	3	*33,3*	-	-	1	*11,1*	-	-
J	(a)	-	-	1	*11,1*	1	*11,1*	6	*66,7*	-	-	1	*11,1*	-	-
	(b)	-	-	-	-	-	-	2	*100,0*	-	-	-	-	-	-
BSBJ-GSL	(a)	1	*12,5*	2	*25,0*	-	-	2	*25,0*	1	*12,5*	2	*25,0*	-	-
	(b)	All quartzite													
BSL-YGL	(a)	4	*44,4*	2	*22,2*	3	*33,3*	-	-	-	-	-	-	-	-
	(b)	2	*28,6*	2	*28,6*	3	*42,9*	-		-		-		-	

Grouped units

		1 f	1 %	2 f	2 %	3 f	3 %	4 f	4 %	5 f	5 %	6 f	6 %	7 f	7 %
IC-RA	(a)	102	*50,5*	19	*9,4*	29	*14,4*	20	*9,9*	3	*1,5*	20	*9,9*	9	*4,5*
RB-GSL	(a)	2	*4,4*	7	*15,6*	2	*4,4*	25	*55,6*	2	*4,4*	5	*11,1*	2	*4,4*
BSL-YSL	(a)	4	*44,4*	2	*22,2*	3	*33,3*	-	-	-	-	-	-	-	-

Table 41

NELSON BAY CAVE : SCRAPERS

Position of retouch

(a) Total sample

(b) Quartzite omitted

STRATIGRAPHIC UNIT		CODE 6 f	6 %	7 f	7 %	8 f	8 %	9 f	9 %	10 f	10 %	11 f	11 %
IC	(a)	30	*25,0*	4	*3,3*	3	*2,5*	66	*55,0*	1	*0,8*	16	*13,3*
	(b)	28	*23,9*	4	*3,4*	3	*2,6*	65	*55,6*	1	*0,9*	16	*13,7*
BSC upper	(a)	25	*75,7*	-	-	-	-	7	*21,2*	-	-	1	*3,0*
	(b)	No quartzite											
BSC lower	(a)	21	*63,6*	2	*6,1*	1	*3,0*	8	*24,2*	1	*3,0*	-	-
	(b)	20	*62,5*	2	*6,3*	1	*3,1*	8	*25,0*	1	*3,0*	-	-
RA	(a)	9	*56,3*	-	-	-	-	5	*31,3*	-	-	2	*12,5*
	(b)	7	*63,6*	-	-	-	-	3	*27,3*	-	-	1	*9,1*
RB	(a)	18	*64,3*	9	*32,1*	-	-	1	*3,6*	-	-	-	-
	(b)	7	*77,8*	1	*11,1*	-	-	1	*11,1*	-	-	-	-
J	(a)	9	*100,0*	-	-	-	-	-	-	-	-	-	-
	(b)	2	*100,0*	-	-	-	-	-	-	-	-	-	-
BSBJ-GSL	(a)	5	*62,5*	1	*12,5*	1	*12,5*	1	*12,5*	-	-	-	-
	(b)	All quartzite											
BSL-YGL	(a)	5	*55,6*	-	-	-	-	4	*44,4*	-	-	-	-
	(b)	5	*71,4*	-	-	-	-	2	*28,6*	-	-	-	-
Grouped units													
IC-RA	(a)	85	*42,1*	6	*3,0*	4	*2,0*	86	*42,6*	2	*1,0*	19	*9,4*
RB-GSL	(a)	32	*71,1*	10	*22,2*	1	*2,2*	2	*4,4*	-	-	-	-
BSL-YGL	(a)	5	*55,6*	-	-	-	-	4	*44,4*	-	-	-	-

Table 42

Matrix of probability values (to left) and levels of significance (to right) for scraper lengths from the Kolmogorov-Smirnov two-sample test (see Appendix 2 for methodology)

	BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
	DGL	BLD-3	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
12	.883		0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
13	.848	.997		VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
14	.000	.000	.000		VHS	VHS	VHS	VHS	VHS	HS	VHS	VHS	0	0
15	.000	.000	.000	.001		VHS	VHS	HS	VHS	0	VHS	VHS	HS	0
21	.000	.000	.000	.000	.000		VHS	S	VHS	S	0	VHS	VHS	VHS
22	.498	.442	.289	.000	.000	.000		0	VHS	0	0	0	VHS	VHS
23	.457	.343	.332	.000	.004	.029	.654		VHS	0	0	0	VHS	HS
24	.000	.000	.000	.000	.000	.000	.000	.000		VHS	VHS	VHS	VHS	VHS
25	.373	.438	.336	.009	.087	.028	.932	.886	.000		0	0	HS	S
31	.379	.418	.594	.000	.000	.704	.122	.415	.000	.122		0	VHS	VHS
32	.408	.227	.150	.000	.000	.000	.837	.537	.000	.714	.168		VHS	VHS
33	.000	.000	.000	.290	.003	.000	.000	.000	.000	.003	.000	.000		0
34	.000	.000	.000	.517	.542	.000	.000	.008	.001	.024	.000	.000	.294	

SCRAPERS : LENGTH

KOLMOGOROV-SMIRNOV

Table 43

Matrix of probability values (to left) and levels of significance (to right) for scraper lengths from the Mann-Whitney U-test. 0 = no significant difference at p.05; S = p.05 - p.01; HS = p.01 - p.001; VHS = p less than .001

		BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
		DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
DGL	11		0	0	VHS	VHS	HS	0	0	VHS	0	S	0	VHS	VHS
BLD	12	.339		0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
BLA	13	.363	.997		VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
BRL	14	.000	.000	.000		HS	VHS	VHS	HS	VHS	HS	VHS	VHS	0	0
CL	15	.000	.000	.000	.000		VHS	VHS	HS	VHS	0	VHS	VHS	VHS	0
IC	21	.000	.000	.000	.000	.000		VHS	HS	VHS	HS	0	VHS	VHS	VHS
BSC	22	.242	.056	.057	.000	.000	.000		0	VHS	0	HS	0	VHS	HS
RA	23	.630	.417	.454	.012	.019	.003	.977		HS	0	0	0	HS	S
RB-GSL	24	.000	.000	.000	.000	.000	.000	.000	.000		HS	VHS	VHS	VHS	VHS
BSL-YGL	25	.236	.152	.147	.017	.070	.003	.477	.711	.001		S	0	VHS	S
SUR	31	.042	.099	.091	.000	.000	.277	.018	.111	.000	.040		0	VHS	VHS
HBC-GBL	32	.960	.399	.449	.000	.000	.000	.334	.548	.000	.320	.093		VHS	VHS
PBW-RBL	33	.000	.000	.000	.655	.000	.000	.000	.003	.000	.000	.000	.000		0
YBL-BBD	34	.000	.000	.000	.424	.240	.000	.000	.048	.001	.047	.000	.000	.362	

MANN-WHITNEY : SCRAPER LENGTHS

Table 44

Matrix of probability values for scraper width. See Tables 42 & 43.

	BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	VHS	0	0	VHS	0	HS	0	VHS	VHS
12	.343		0	VHS	VHS	VHS	0	0	VHS	0	S	0	VHS	VHS
13	.994	.182		VHS	VHS	VHS	0	0	VHS	0	HS	0	VHS	VHS
14	.000	.000	.000		VHS	VHS	VHS	VHS	HS	VHS	VHS	0	0	S
15	.000	.000	.000	.001		S	HS	0	VHS	0	VHS	HS	VHS	0
21	.000	.000	.001	.000	.011		0	0	VHS	0	VHS	VHS	VHS	VHS
22	.915	.309	.999	.000	.008	.094		0	VHS	0	HS	0	VHS	VHS
23	.572	.418	.404	.000	.509	.426	.745		VHS	0	S	0	VHS	0
24	.000	.000	.000	.000	.000	.000	.000	.000		HS	VHS	VHS	VHS	S
25	.443	.231	.457	.007	.679	.803	.741	.952	.003		HS	0	HS	0
31	.004	.023	.002	.000	.001	.000	.004	.013	.000	.022		S	VHS	VHS
32	.895	.651	.969	.000	.004	.001	.792	.727	.000	.309	.012		VHS	VHS
33	.000	.000	.000	.565	.000	.000	.000	.000	.000	.006	.000	.000		0
34	.000	.000	.000	1.000	.054	.000	.001	.062	.029	.099	.000	.001	.997	

SCRAPERS : WIDTH

KOLMOGOROV - SMIRNOV

Table 45

Matrix of probability values for scraper width. See Tables 42 and 43 for explanation.

	B O O M P L A A S				N E L S O N	B A Y	C A V E			K A N G K A R A			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBO
11		0	0	VHS	VHS	VHS	0	0	VHS	0	HS	0	VHS	VHS
12	.197		0	VHS	VHS	VHS	S	S	VHS	S	HS	0	VHS	VHS
13	.722	.075		VHS	VHS	VHS	0	0	VHS	0	HS	0	VHS	VHS
14	.000	.000	.000		VHS	VHS	VHS	HS	VHS	0	VHS	VHS	0	0
15	.000	.000	.000	.000		0	HS	0	VHS	0	VHS	VHS	VHS	HS
21	.000	.000	.000	.000	.099		HS	0	VHS	0	VHS	VHS	VHS	VHS
22	.290	.049	.415	.000	.008	.014		0	VHS	0	HS	0	VHS	VHS
23	.094	.040	.129	.010	.705	.747	.293		VHS	0	HS	0	HS	0
24	.000	.000	.000	.000	.000	.000	.000	.001		HS	VHS	VHS	VHS	HS
25	.066	.045	.096	.057	.924	.974	.195	.690	.010		HS	0	S	0
31	.004	.015	.002	.000	.000	.000	.002	.003	.000	.007		HS	VHS	VHS
32	.962	.268	.862	.000	.001	.001	.407	.135	.000	.088	.009		VHS	VHS
33	.000	.000	.000	.855	.000	.000	.000	.004	.000	.628	.000	.000		0
34	.000	.000	.000	.948	.009	.000	.000	.058	.009	.137	.000	.000	.997	

MANN-WHITNEY : SCRAPER WIDTH

Table 46

Matrix of probability values for scraper height. See Tables 42 and 43 for explanation.

	BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	0	0	0	VHS	S	0	S	VHS	VHS
12	.857		0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
13	.354	.968		VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	VHS
14	.000	.000	.000		HS	VHS	VHS	VHS	HS	0	VHS	VHS	0	0
15	.000	.000	.000	.003		VHS	VHS	VHS	0	0	VHS	VHS	VHS	HS
21	.104	.001	.000	.000	.000		VHS	0	VHS	HS	0	VHS	VHS	VHS
22	.065	.246	.761	.000	.000	.000		0	VHS	0	0	0	VHS	VHS
23	.324	.305	.310	.000	.000	.053	.563		VHS	0	0	0	VHS	S
24	.000	.000	.000	.012	.125	.000	.000	.000		S	VHS	VHS	VHS	HS
25	.043	.091	.094	.263	.145	.003	.232	.655	.040		0	0	0	0
31	.871	.486	.477	.000	.000	.625	.236	.211	.000	.095		0	VHS	VHS
32	.025	.094	.160	.000	.000	.000	.729	.415	.000	.213	.093		VHS	HS
33	.000	.000	.000	.402	.000	.000	.000	.000	.000	.318	.000	.000		0
34	.000	.000	.000	.092	.007	.000	.001	.028	.004	.820	.001	.010	.376	

SCRAPERS : HEIGHT OF PIECE

KOLMOGOROV-SMIRNOV

Table 47

Matrix of probability values for scraper height. See Tables 42 and 43 for explanation.

	BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	0	HS	S	VHS	HS	0	HS	VHS	VHS
12	.099		0	VHS	VHS	VHS	0	0	VHS	HS	0	S	VHS	VHS
13	.058	.642		VHS	VHS	VHS	0	0	VHS	VHS	S	0	VHS	VHS
14	.000	.000	.000		HS	VHS	VHS	HS	HS	0	VHS	VHS	0	S
15	.000	.000	.000	.007		VHS	VHS	HS	0	S	VHS	VHS	VHS	HS
21	.172	.001	.000	.000	.000		VHS	HS	VHS	VHS	0	VHS	VHS	VHS
22	.006	.068	.142	.000	.000	.000		0	VHS	0	HS	0	VHS	VHS
23	.038	.114	.178	.014	.004	.003	.654		VHS	0	HS	0	HS	0
24	.000	.000	.000	.002	.374	.000	.000	.001		HS	VHS	VHS	VHS	VHS
25	.004	.007	.000	.124	.026	.001	.051	.269	.009		HS	0	0	0
31	.191	.051	.035	.000	.000	.410	.009	.022	.000	.003		HS	VHS	VHS
32	.004	.035	.078	.000	.000	.000	.789	.574	.000	.060	.011		VHS	VHS
33	.000	.000	.000	.230	.000	.000	.000	.004	.000	.166	.000	.000		0
34	.000	.000	.000	.043	.002	.000	.000	.101	.001	.727	.000	.001	.098	

MANN-WHITNEY : SCRAPER HEIGHT

Table 48

Matrix of probability values for scraper w/l ratio. See Tables 42 and 43 for explanation.

	BOOMPLAAS					NELSON BAY CAVE					KANGKARA			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	0
12	.679		0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	0
13	.497	.572		VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	0
14	.000	.000	.000		0	VHS	0	S	0	0	0	VHS	0	0
15	.000	.000	.000	.524		VHS	HS	HS	0	S	S	VHS	0	0
21	.000	.000	.000	.000	.000		VHS	HS	VHS	0	VHS	VHS	VHS	VHS
22	.386	.545	.313	.066	.004	.000		0	VHS	0	0	0	S	0
23	.432	.609	.566	.014	.004	.002	.326		HS	0	0	0	HS	0
24	.000	.000	.000	.171	.685	.000	.001	.003		HS	HS	VHS	0	0
25	.348	.561	.721	.082	.029	.339	.361	.792	.009		0	0	0	0
31	.492	.369	.359	.163	.036	.000	.734	.211	.011	.236		0	0	0
32	.994	.600	.549	.000	.000	.000	.688	.433	.000	.462	.533		VHS	0
33	.000	.000	.000	.900	.636	.000	.023	.013	.442	.066	.097	.000		0
34	.324	.419	.430	.918	.552	.000	.840	.389	.242	.431	.851	.385	.876	

SCRAPERS : W/L RATIO

KOLMOGOROV-SMIRNOV

Table 49

Matrix of probability values for scraper w/l ratios. See Tables 42 and 43 for explanation.

	BOOMPLAAS				NELSON BAY CAVE						KANGKARA			
	DGL	BLD	BLA	BRL	CL	IC	BSC	RA	RB-GSL	BSL-YGL	SUR	HBC GBL	PBW RBL	YBL BBD
11		0	0	VHS	VHS	VHS	HS	0	VHS	0	VHS	0	VHS	0
12	.648		0	VHS	VHS	VHS	0	0	VHS	0	0	0	VHS	0
13	.291	.378		VHS	VHS	VHS	0	S	VHS	0	0	0	VHS	0
14	.000	.000	.000		0	VHS	S	0	0	HS	0	HS	0	0
15	.000	.000	.000	.185		VHS	HS	HS	0	HS	S	VHS	S	0
21	.000	.000	.000	.000	.000		VHS	HS	VHS	0	VHS	VHS	VHS	VHS
22	.002	.235	.071	.005	.000	.000		0	VHS	0	0	0	HS	0
23	.390	.551	.030	.008	.001	.001	.271		HS	0	0	0	HS	0
24	.000	.000	.000	.050	.483	.000	.000	.000		HS	HS	VHS	0	0
25	.211	.250	.426	.006	.003	.066	.123	.428	.002		0	0	HS	0
31	.264	.226	.174	.120	.034	.000	.730	.163	.005	.140		0	0	0
32	.068	.614	.287	.000	.000	.000	.536	.389	.000	.202	.320		VHS	0
33	.000	.000	.000	.651	.047	.000	.001	.003	.102	.007	.074	.000		0
34	.142	.118	.071	.460	.167	.000	.360	.140	.069	.083	.662	.160	.358	

MANN WHITNEY : SCRAPER W/L RATIO

NBC : Descriptive statistics for backed microliths

SQUARE	STRATIGRAPHIC UNIT	SUB-CLASS		LENGTH mm	WIDTH mm	HEIGHT mm	RAW MATERIAL
D4	IC	Segment		15	7	2	Silcrete
C5	IC	Segment		13	7	2	Quartz
C5	IC	Segment		17	9	4	Quartz
C5	IC	Segment		15	8	3	Quartz
C5	IC	Segment		15	7	2	Quartz
C5	IC	Segment		14	7	3	Quartz
C5	IC	Segment		12	6	2	Quartz
C5	IC	Segment		16	8	3	Quartz
C5	IC	Segment		16	13	5	Quartz
C5	IC	Segment		20	8	2	Chalcedony
C5	IC	Segment		20	9	4	Silcrete
B4	IC	Segment		21	12	5	Quartz
B5	IC	Segment		13	7	2	Quartz
B5	IC	Segment		12	7	3	Quartz
B6	IC	Segment		16	7	3	Quartz
B6	IC	Segment		13	8	2	Chalcedony
B6	IC	Segment		13	10	4	Chalcedony
D5	IC	Segment		14	8	4	Quartz
D6	IC	Segment		19	9	2	Chalcedony
D5	IC	Segment		18	9	4	Chalcedony
D5	IC	Segment		15	9	5	Quartz
D6	IC	Segment		13	8	3	Quartz
C4	IC	Segment		10	7	2	Quartz
C4	IC	Segment		13	6	2	Silcrete
D5	IC	Segment		19	10	3	Chalcedony
Means for IC segments:			f				
		$\bar{x}$	25	15,28	8,24	3,04	
		Sx		2,89	1,69	1,06	
		$S\bar{x}$		0,58	0,34	0,21	
B6	IC	Broken backed		16	11	2	Chalcedony
C5	IC	Broken backed		14	7	5	Silcrete
C5	IC	Broken backed		16	10	3	Chalcedony
C5	IC	Broken backed		12	7	3	Chalcedony
D8	IC	Broken backed		11	8	4	Quartz
D6	IC	Backed flake		59	37	8	Quartzite
D3	BSC	Segment		15	10	5	Quartz
D8	BSC	Segment		13	6	2	Quartz
D4	BSC	Segment		11	4	2	Chalcedony
C5	BSC	Segment		12	5	2	Chalcedony
B4	BSC	Segment		12	5	2	Chalcedony
D3	BSC	Segment		18	10	2	Chalcedony
B1	BSC	Segment		8	7	1	Quartz
Means for BSC segments:			f				
		$\bar{x}$	7	12,71	6,71	2,29	
		Sx		3,15	2,43	1,25	
		$S\bar{x}$		3,15	0,92	0,47	
C4	BSC	Backed bladelet		10	5	1	Quartz
D4	BSC	Backed bladelet		13	5	2	Quartz
D3	BSC	Broken backed		17	10	4	Chalcedony
D3	BSC	Broken backed		15	6	4	Quartz

Table 50 contd

NBC: Descriptive statistics for backed microliths

SQUARE	STRATIGRAPHIC UNIT	SUB-CLASS	LENGTH mm	WIDTH mm	HEIGHT mm	RAW MATERIAL
B5	RA	Segment	15	8	4	Chalcedony
B5	YSL	Backed flake	17	8	4	Silcrete
B4	YGL	Segment	20	6	4	Quartz
D7	YGL	Segment	16	6	2	Chalcedony
D3	YGL	Broken backed	8	6	3	Quartz
D3	YGL	Large segment/ backed flake	50	19	12	Quartzite

Table 51

KANGKARA : SCRAPERS

(a) Total sample
(b) Quartzite omitted

Length

UNIT		f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
SUR	(a)	16	9,94	5,00	0,56	2,24	6 - 14
HBC	(a)	22	10,59	6,83	0,56	2,61	8 - 17
	(b)	29	11,90	12,45	0,66	3,53	6 - 19
SGL+DGL	(a)	30	13,5	92,4	1,76	9,61	6 - 61
	(b)	38	13,63	55,05	1,20	7,42	5 - 39
GBL	(a)	41	14,3	66,1	1,27	8,13	5 - 39
	(b)	16	19,81	45,63	1,69	6,76	7 - 31
PBW	(a)	26	21,8	51,3	1,40	7,16	7 - 33
	(b)	34	24,38	100,85	1,72	10,04	8 - 47
LPW	(a)	48	27,1	126,5	1,62	11,25	8 - 58
	(b)	21	23,14	28,03	1,16	5,29	14 - 37
RBL	(a)	25	23,2	33,5	1,16	5,79	11 - 37
YBL	(a)	6	21,33	58,67	3,13	7,66	9 - 30
	(b)	5	19,20	31,70	2,52	5,63	13 - 28
BD+BBD	(a)	8	24,38	143,1	4,23	11,96	13 - 48
GROUPED							
SUR+HBC	(a)	38	10,3	6,0	0,40	2,45	6 - 17
	(b)	67	12,88	36,90	0,74	6,07	5 - 39
SGL - GBL	(a)	71	13,99	76,19	1,04	8,73	5 - 61
	(b)	77	22,86	67,23	0,93	8,20	7 - 47
PBW-YBL	(a)	105	24,56	85,92	0,91	9,27	7 - 58
	(b)	5	19,20	31,70	2,52	5,63	13 - 28
BD+BBD	(a)	8	24,38	143,1	4,23	11,96	13 - 48

Table 52

KANGKARA : SCRAPERS

Width

UNIT	f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
SUR	16	11,94	8,86	0,74	2,98	7 - 16
HBC	22	13,77	9,14	0,64	3,02	9 - 20
SGL+DGL	30	16,07	67,93	1,51	8,24	9 - 54
GBL	41	16,59	51,1	1,12	7,15	8 - 46
PBW	26	25,85	58,70	1,50	7,66	14 - 48
LPW	48	26,79	111,02	1,52	10,54	11 - 52
RBL	25	20,84	17,81	0,84	4,22	13 - 29
YBL	6	21,67	61,47	3,20	7,84	15 - 37
BD+BBD	8	27,38	89,98	3,35	9,49	12 - 41
			GROUPED			
SUR/HBC	38	13,00	9,62	0,50	3,10	7 - 20
SGL/GBL	71	16,37	57,41	0,90	7,58	8 - 54
PBW/YBL	105	24,85	77,78	0,86	8,82	11 - 52
BD/BBD	8	27,38	89,98	3,35	9,49	12 - 41

Table 53

KANGKARA : SCRAPERS

Width/Length ratio

UNIT	f	MEAN	VARIANCE	STD ERROR	STD DEVIATION	RANGE
SUR	16	124,66	1889,89	10,87	43,47	77 - 267
HBC	22	135,03	1245,74	7,53	35,30	82 - 200
SGL-DGL	30	127,87	1035,94	5,88	32,19	74 - 233
GBL	41	130,36	2060,52	7,09	45,39	65 - 267
PBW	26	128,97	2437,48	9,68	49,37	75 - 260
LPW	48	104,47	1091,34	4,77	33,04	55 - 236
RBL	25	96,83	1504,19	7,76	38,78	57 - 218
YBL	6	108,73	1266,52	14,53	35,59	67 - 167
BD-BBD	8	119,45	1027,92	11,34	32,06	75 - 163

Table 54

KANGKARA : SCRAPERS

Piece height

UNIT	f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
SUR	16	3,69	1,83	0,34	1,35	2 - 6
HBC	22	4,46	2,17	0,31	1,47	2 - 8
SGL+DGL	30	5,90	22,23	0,86	4,72	2 - 28
GBL	41	5,63	8,54	0,46	2,92	2 - 14
PBW	26	8,58	15,45	0,77	3,93	5 - 24
LPW	48	10,33	19,76	0,64	4,45	2 - 21
RBL	25	9,76	11,44	0,68	3,38	4 - 20
YBL	6	7,67	11,87	1,41	3,45	3 - 12
BD+BBD	8	8,13	9,55	1,09	3,09	5 - 15
				GROUPED UNITS		
SUR/HBC	38	4,13	2,12	0,24	1,46	2 - 8
SGL/GBL	71	5,75	14,12	0,45	3,76	2 - 28
PBW/YBL	105	9,61	16,59	0,40	4,07	2 - 24
BD/BBD	8	8,13	9,55	1,09	3,09	5 - 15

Table 55

KANGKARA : SCRAPERS

Position of retouch

		- Code -											
		6		7		8		9		10		11	
UNIT	f	f	%	f	%	f	%	f	%	f	%	f	%
SUR	16	12	75,0					4	25,0				
HBC	22	10	45,5	2	9,1			10	45,5				
SGL/DGL	30	20	66,7	3	10,0			7	23,3				
GBL	41	22	53,7	7	17,1	1	2,4	11	26,8				
PBW	26	12	46,2	7	26,9			6	23,1	1	3,8		
LPW	48	29	60,4	14	29,2	1	2,1	2	4,2	2	4,2		
RBL	25	10	40,0	13	52,0	1	4,0	1	4,0				
YBL	6	3	50	2	33,3			1	16,7				
BD/BBD	8	6	75,0					2	25,0				
GROUPED													
SÚR+HBC	38	22	57,9	2	5,3			14	36,8				
SGL-GBL	71	42	59,2	10	14,1	1	1,4	18	25,4				
PBW-YBL	105	54	51,4	36	34,3	2	1,9	10	9,5	3	2,9		

Plan form

		- C O D E -													
		1		2		3		4		5		6		7	
UNIT	f	f	%	f	%	f	%	f	%	f	%	f	%	f	%
SUR	16	4	25,0			7	43,8	3	18,8	2	12,5				
HBC	22	10	45,5	1	4,5	6	27,3	4	18,2			1	4,5		
SGL/DGL	30	7	23,3	3	10,0	8	26,7	4	13,3			8	26,7		
GBL	41	14	34,1			15	36,6	5	12,2	1	2,4	6	14,6		
PBW	26	10	38,5	4	15,4	4	15,4	4	15,4			4	15,4		
LPW	48	7	14,6	4	8,3	11	22,9	18	37,5	2	4,2	6	12,5		
RBL	25	4	16,0	1	4,0	3	12,0	13	52,0	2	8,0	2	8,0		
YBL	6	1	16,7			3	50,0	2	33,4						
BD/BBD	8	4	50,0			2	25,0	1	12,5			1	12,5		
GROUPED															
SUR + HBC	38	14	36,8	1	2,6	13	34,2	7	18,4	2	5,3	1	2,6		
SGL-GBL	71	21	29,6	3	4,2	23	32,4	9	12,7	1	1,4	14	19,7		
PBW-YBL	105	22	21,0	9	8,6	21	20,0	37	35,2	4	3,8	12	11,4		

Table 56

KANGKARA : SCRAPERS

Height of retouch

UNIT	f	MEAN	VARIANCE	STANDARD ERROR	STANDARD DEVIATION	RANGE
SUR	16	3,06	1,13	0,27	1,06	2 - 5
HBC	22	3,77	1,52	0,26	1,23	2 - 6
SGL+DGL	30	4,40	3,49	0,34	1,87	2 - 10
GBL	41	4,78	4,23	0,32	2,06	2 - 11
PBW	26	6,58	4,57	0,42	2,14	3 - 12
LPW	48	7,73	7,73	0,40	2,78	2 - 15
RBL	25	7,88	6,78	0,52	2,60	3 - 13
YBL	6	7,50	12,3	1,43	3,51	3 - 12
BD+BBD	8	6,63	5,41	0,82	2,33	4 - 11
GROUPED UNITS						
SUR/HBC	38	3,47	1,45	0,20	1,20	2 - 6
SGL/GBL	71	4,62	3,90	0,23	1,97	2 - 11
PBW/YBL	105	7,47	7,02	0,26	2,65	2 - 15
BD/BBD	8	6,63	5,41	0,82	2,33	4 - 11

KANGKARA : SCRAPERS

Raw materials (%)

UNIT	f	Quartz	Quartzite	Hornfels	Chalcedony	Silcrete
SUR	16	68,8	-	-	18,8	12,5
HBC	22	77,3	-	4,5	18,2	-
SGL+DGL	30	80,0	3,3	-	3,3	13,3
GBL	41	29,3	7,3	-	39,0	24,4
PBW	26	11,5	38,5	-	3,8	46,2
LPW	48	12,5	29,2	2,1	10,4	45,8
RBL	25	8,0	16,0	4,0	36,0	36,0
YBL	6	16,7	-	-	50,0	33,3
BD+BBD	8	-	37,5	-	12,5	50,0

Table 57

BPA : Descriptive statistics for scrapers

MEMBER	f	MEAN	STD DEVIATION	STD ERROR	VARIANCE	RANGE
(a) Length						
DGL	157	12,41	5,42	0,43	29,33	5 - 39
BLD	377	11,81	4,78	0,25	22,88	4 - 35
BLA	213	11,55	3,97	0,27	15,78	5 - 41
BRL	93	25,83	12,38	1,28	153,27	7 - 71
CL	80	20,21	10,07	1,13	101,41	7 - 78
(b) Width						
DGL	157	15,15	5,07	0,41	25,72	9 - 47
BLD	377	14,61	4,66	0,24	21,71	8 - 43
BLA	213	14,87	3,66	0,25	13,37	9 - 30
BRL	93	25,83	11,03	1,14	121,75	9 - 70
CL	80	20,41	16,28	1,82	265,06	8 -115
(c) Height of piece						
DGL	157	4,46	2,20	0,18	4,85	1 - 16
BLD	377	4,69	2,09	0,11	4,37	1 - 17
BLA	213	4,67	1,82	0,13	3,32	2 - 15
BRL	93	10,41	4,74	0,49	22,51	2 - 30
CL	80	12,74	6,60	0,74	43,56	2 - 50
(d) W/L Ratio						
DGL	157	130,24	36,79	2,94	1353,74	60 - 250
BLD	377	132,86	42,21	2,17	1781,58	46 - 325
BLA	213	137,54	43,27	2,97	1872,22	54 - 262
BRL	93	109,07	36,12	3,75	1304,34	59 - 233
CL	80	102,85	39,00	4,36	1520,81	38 - 229

(e) Plan form (%) CODE

		1	2	3	4	5	6	7	8	9	10
DGL	157	26,1	10,8	23,6	34,7	-	3,8	-	-	-	-
BLD	377	30,0	5,0	27,6	13,3	1,9	19,4	2,9	-	-	-
BLA	213	27,7	2,8	33,3	6,6	0,9	25,8	2,8	-	-	-
BRL	93	12,9	5,4	47,3	16,1	7,5	8,6	2,2	-	-	-
CL	80	17,5	16,2	12,5	21,2	6,3	1,2	8,7	1,2	8,7	6,3

(f) Position of retouch (%) CODE

		6	7	8	9	10	11
DGL	157	72,6	1,3	-	25,5	-	0,6
BLD	377	61,8	6,9	1,1	26,8	1,6	1,9
BLA	213	61,5	5,2	0,5	28,6	1,9	2,3
BRL	93	64,5	17,2	2,2	12,9	3,2	-
CL	80	67,5	18,8	-	10,0	-	3,7

(g) Raw material (%)

		Quartz	Quartzite	Hornfels	Chalcedony	Silcrete
DGL	157	79,0	-	3,2	14,0	3,8
BLD	377	74,8	-	8,2	15,6	1,3
BLA	213	79,8	-	4,2	16,0	-
BRL	93	55,9	-	29,0	12,9	2,2
CL	80	63,7	3,7	3,7	8,7	20,0

Table 58

BPA : Descriptive statistics for adzes.

MEMBER	f	MEAN	STD DEVIATION	STD ERROR	VARIANCE	RANGE
(a) Length						
DGL	38	35,55	8,50	1,38	72,25	18 - 52
BLD	87	32,70	8,56	0,92	73,12	18 - 60
BLA	14	32,86	5,05	1,35	25,52	25 - 42
BRL	4	31,00	8,37	4,18	70,00	24 - 43
CL	9	46,22	19,21	6,40	368,94	20 - 78
(b) Width						
DGL	38	23,05	6,65	1,08	44,16	12 - 36
BLD	87	18,61	5,59	0,60	31,26	3 - 31
BLA	14	17,43	6,67	1,78	44,42	11 - 38
BRL	4	15,50	4,73	2,36	22,33	12 - 22
CL	9	24,33	11,18	3,73	125,00	13 - 48
(c) Height of piece						
DGL	38	10,84	3,25	0,53	10,57	5 - 18
BLD	87	9,54	3,25	0,35	10,53	3 - 19
BLA	14	7,14	1,92	0,51	3,67	4 - 11
BRL	4	9,75	5,68	2,84	32,25	4 - 16
CL	9	14,11	5,47	1,82	29,86	6 - 22
(d) Height of retouch (1)						
DGL	38	7,76	1,97	0,32	3,86	4 - 12
BLD	87	6,62	1,89	0,20	3,56	3 - 13
BLA	14	5,21	1,12	0,30	1,26	3 - 7
BRL	4	5,75	1,50	0,75	2,25	4 - 7
CL	9	8,67	3,32	1,11	11,00	3 - 13
(d) Height of retouch (2)						
DGL	38	3,92	1,00	0,16	0,99	2 - 6
BLD	87	3,56	0,91	0,10	0,83	3 - 10
BLA	14	2,93	0,27	0,07	0,07	2 - 3
BRL	4	3,00	-	-	-	3
CL	9	3,89	1,27	0,42	1,61	2 - 6

(e) Plan form (%)

		CODE					
		1	2	3	4	5	6
DGL	38	47,4	5,3	26,3	10,5	5,3	5,3
BLD	87	54,0	18,4	11,5	12,8	1,1	1,1
BLA	14	42,9	35,7	14,3	-	-	7,1
BRL	4	50,0	50,0	-	-	-	-
CL	9	33,3	22,2	11,1	33,3	-	-

Table 59. BPA : Descriptive statistics for segments (in mm). Data for BLD do not include measurements for one large segment.

MEMBER	DIMENSION	f	MEAN	STANDARD DEVIATION	STANDARD ERROR	RANGE
DGL	Length	2	11,00	1,41	1,00	10-12
BLD		17	14,76	3,44	0,83	9-20
BLA		19	14,79	4,16	0,95	8-23
BRL		2	11,50	1,12	1,50	10-13
CL		7	11,86	2,27	0,86	9-16
DGL	Width	2	4,00	-	-	4
BLD		17	6,24	1,71	0,42	3-10
BLA		19	6,11	1,79	0,41	3-8
BRL		2	5,00	1,41	1,00	4-6
CL		7	5,43	1,72	0,65	3-8
DGL	Height	2	2,00	-	-	2
BLD		17	2,29	0,85	0,21	1-4
BLA		19	2,32	0,75	0,17	1-4
BRL		2	1,50	0,71	0,50	1-2
CL		7	1,71	0,95	0,36	1-3

Table 60. BPA : Descriptive statistics for backed flakes and bladelets (in mm)

MEMBER	DIMENSION	f	MEAN	STANDARD DEVIATION	STANDARD ERROR	RANGE
BLD	Length	24	10,75	5,96	2,21	8-17
BLA		6	12,50	4,81	1,96	10-22
BLD	Width	24	5,96	2,14	0,44	3-11
BLA		6	4,83	2,14	0,87	3-8
BLD	Height	24	2,21	0,78	0,16	1-4
BLA		6	1,50	0,71	0,50	1-3

Table 61

Matrix summarizing the number of times two samples were not significantly different at p.05 in Tables 42 - 49.

Approx age BP	SITE CODE	DGL 11	BLD 12	1C 21	SUR 31	HBC-GBL 32	BSC 22	BLA 13	RA 23	PBW-RBL 33	BRL 14	10-14 24	YBL-RBD 34	CL 15	15-18 25
1700	11														
2000	12	8													
4800	21	2	0												
5000	31	5	6	4											
5355	32	6	7	0	8										
6000	22	6	7	1	4	8									
6400	13	8	8	0	6	8	8								
7000	23	7	7	3	6	8	8	7							
7-9000	33	0	0	0	2	0	0	0	0						
9-10 500	14	0	0	0	2	1	1	0	1	8					
9-11 000	24	0	0	0	0	0	0	0	0	2	2				
9-12 000	34	2	2	0	2	2	2	2	5	8	6	2			
12-14 000	15	0	0	1	0	0	5	0	2	6	2	4	5		
12-18 000	25	6	6	4	4	8	8	7	8	3	4	0	6	5	

Assemblages are sorted by approximate age to demonstrate similarity between samples of similar age at an inter-site level.
Site code: 11-15 = Boomplaas; 21-25 = Nelson Bay Cave; 31-34 = Kangkara

Table 62. NBC : Frequency of worked bone and ostrich eggshell fragments and beads

OSTRICH EGGSHELL	IC	BSC	RA	RB	J	BSBJ	CS	GSL	BSL	YSL	YGL
Ostrich eggshell fragments	140	3	11	5	5	35	448	3	26	6	1130
Ostrich eggshell beads	3	9	10	4	7	6	72	2	6	8	-
Unfinished OES beads	2	1	-	1	-	-	53	-	-	-	1
WORKED BONE											
Grooved bone	-	-	-	-	-	-	1	-	-	-	-
Bone pendant	1	-	-	1	-	-	-	1	-	-	-
Bone beads	-	-	-	-	-	-	1	-	1	-	-
Multi-ringed tube	-	-	-	-	-	-	1	1	-	-	-
Polished tusk	-	1	-	1	-	-	-	-	-	-	-
Flat, smoothed bone pieces	1	-	-	-	-	3	1	1	1	1	2
Smoothed articular ends	-	1	4	4	1	2	1	1	-	1	-
Polished bone shafts	2	5	3	2	1	3	-	-	1	1	-
Polished bone tube	1	-	-	-	-	-	-	-	-	-	-
Broken bone points/linkshafts	-	3	-	2	1	1	6	1	-	2	-
Blunted points/linkshafts	-	-	1	1	1	2	1	-	-	1	-
Spatulas	-	2	-	1	-	-	-	-	-	-	-
Spatulate points	-	-	-	-	-	-	2	-	-	-	-
Bone points	7	2	6	8	-	1	1	-	-	-	-
Fish gorges	-	-	6	4	3	22	25	1	2	-	-
TOTAL WORKED BONE	12	14	20	24	7	34	40	6	5	6	2

Table . Boomplaas A : Frequencies of ostrich eggshell and marine and freshwater shell fragments and crab remains

CLASS	DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Ostrich eggshell fragments	951	1560	462	183	569	154	1708	648	1865	5127	2572	4269	1592	2308	45	80	10866
Decorated fragments	5	28	8	-	-	-	4	4	11	19	60	17	-	2	-	-	79
OES beads	105	148	37	14	17	10	47	17	22	127	51	50	27	35	1	-	164
Unfinished OES beads	4	9	15	8	10	1	29	8	6	62	11	28	5	8	-	-	52
OES water container apertures	1	3	1	-	1	-	2	-	5	8	1	-	-	2	-	-	3
OES pendants	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OES pendant blanks	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Broken OES pendants	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL WORKED OES	116	191	62	22	28	11	82	29	44	216	123	95	32	47	1	-	298
Unworked marine and freshwater shell																	
Donax Left	-	1	-	-	1	1	2	1	10	15	3	-	-	1	-	-	4
Right	1	2	-	-	2	-	2	2	10	16	5	1	-	-	-	-	6
Number of squares in which fragments of *Donax* were present	6	7	4	-	1	3	1	12	9	38	64	22	7	3	-	-	32
Bivalve frags.	17	2	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
Patella frags.	-	4	-	-	-	-	2	1	-	3	-	-	2	3	-	-	5
Cafferia frags. L	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R	1	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perna perna L	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worked marine and estuarine shell																	
Natica beads	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nassa beads	32	86	1	4	2	3	17	2	1	29	-	-	-	-	-	-	-
Polished siffie	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
Perforated *Cypraea* sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bullia sp.	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glycimeris sp	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Periwinkle	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polished shell pendants & buttons	1	12	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL WORKED SHELL	39	107	5	4	2	3	18	2	1	30	-	-		-	-	-	
Crab claws	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-

L & R counts for bivalves represent the number of left and right apical fragments with hinge attachment.

Table 64. Boomplaas : Frequencies of potsherds from DGL and BLD Members
Kangkara : Frequency of potsherds

UNIT	TOTAL SHERDS	SHERDS JOINED	WORKING TOTAL	PLAIN RIMS	DECORATED RIMSHERDS	OTHER DECORATED	SPOUT	BASES	ESTIMATED MINIMUM NO OF VESSELS
DGL	264	34	230	11	-	7	1	2	5
DGL 1	313	7	306	2	4	13	-	-	4
DGL 2	104	5	99	1	4	9	-	-	1
DGL 3	63	3	60	-	-	1	-	1	-
DGL 4	50	1	49	-	1	1	-	-	1
BLD 1	111	11	100	1	3	5	-	-	2
BLD 1-2	39	3	36	1	-	-	-	-	1
BLD 2	45	-	45	1	-	2	-	-	1
BLD 2a	74	2	72	3	-	-	-	-	2
TOTAL DGL MEMBER	1063	66	997	20	12	38	1	3	17
BLD 3 = BLD MEMBER	44	2	42	-	1	1	-	-	-

Note: Sherds from BLD 3 were a localized occurrence in a disturbed area and are probably derived from the overlying BLD 2a unit.

KANGKARA									
SUR	-	-	-	-	-	-	-	-	-
HBC	4	-	4	-	-	-	-	-	1

Table 65. Ochre frequencies at BPA and NBC

BPA

STRATIGRAPHIC UNIT	f
DGL	112
BLD	144
BLA	90
BRL 1	24
BRL 2	34
BRL 3	9
BRL 4	88
BRL 5	47
BRL 6	215
TOTAL BRL	377
BRL 7	223
CL 1	214
CL 2	67
CL 3	145
CL 4	6
GWA	24
TOTAL CL	679

NBC

STRATIGRAPHIC UNIT	f
IC	86
BSC	183
RA	50
RB	49
J	58
BSBJ	39
CS	65
GSL	69
BSL	21
YSL	55
YGL	41

PORTFOLIO OF STONE ARTEFACT DRAWINGS

FIGS 113-137

ILLUSTRATING THE RANGE OF FORMAL AND UTILIZED TOOLS AND CORES FROM THE LATE PLEISTOCENE AND HOLOCENE SEQUENCES AT NELSON BAY CAVE, KANGKARA AND BOOMPLAAS

FIG. 113

NBC: STONE ARTEFACTS FROM IC AND BSC

1-10: Small scrapers

11-16, 19-21: Segments

17: Large scraper

18: Borer

22-32: Small scrapers

1-16 : From IC

17-32: From BSC

1, 16, 17: Quartzite

2,3,6,11: Silcrete

5,9,12,20,21,22,23,24,25,28,30,31: Chalcedony

All the rest are quartz

FIG. 113

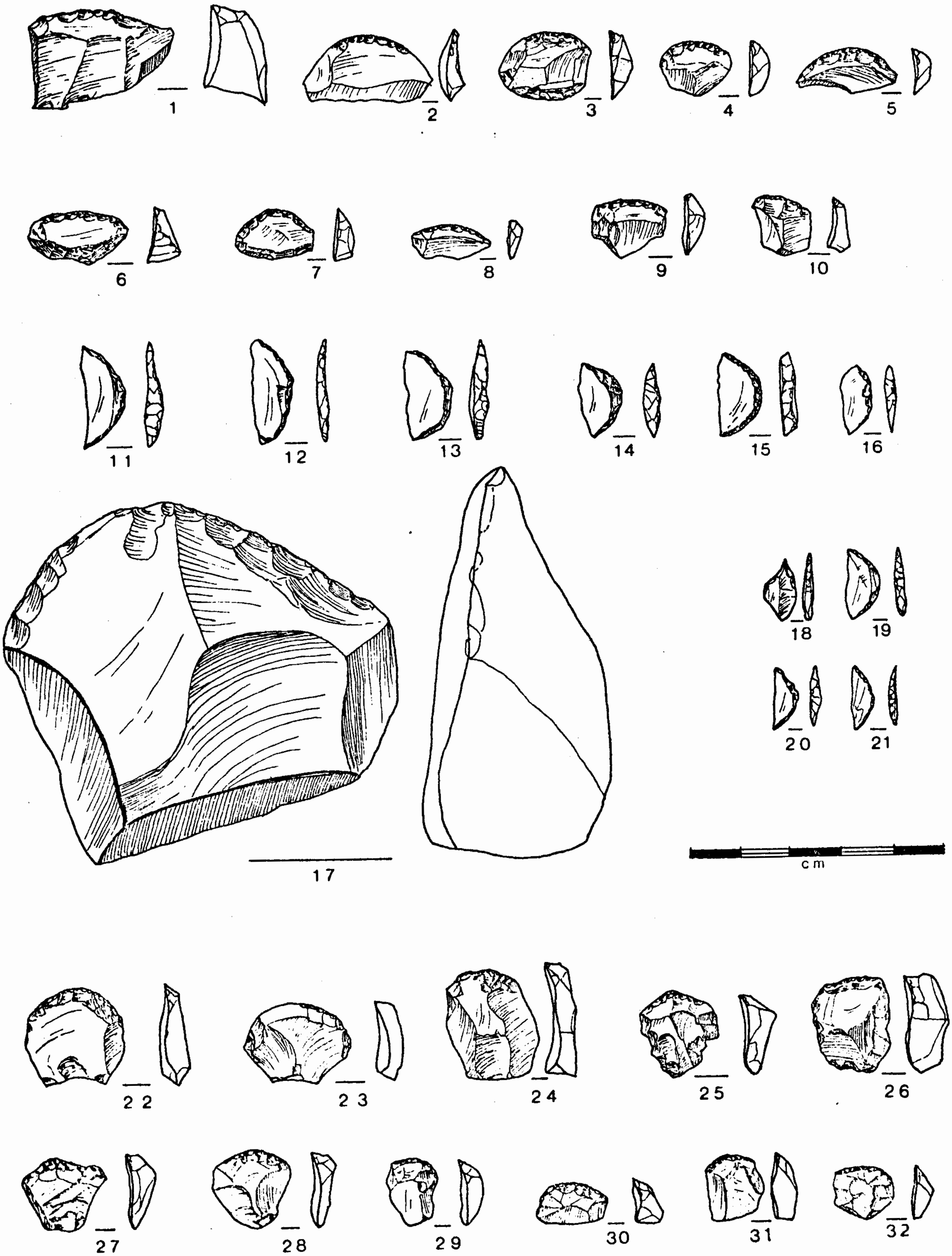

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
cm
22
23
24
25
26
27
28
29
30
31
32

FIG. 114

NBC: STONE ARTEFACTS FROM RA AND RB UNITS

1-5. 12.13: Small scrapers

7-9, 14-16: Large scrapers

10,11: Medium scrapers

6: Segment

1-9: From RA

10-16: From RB

1,2,3,4,5,12,13: Quartz

6: Chalcedony

All the rest are quartzite

FIG. 114

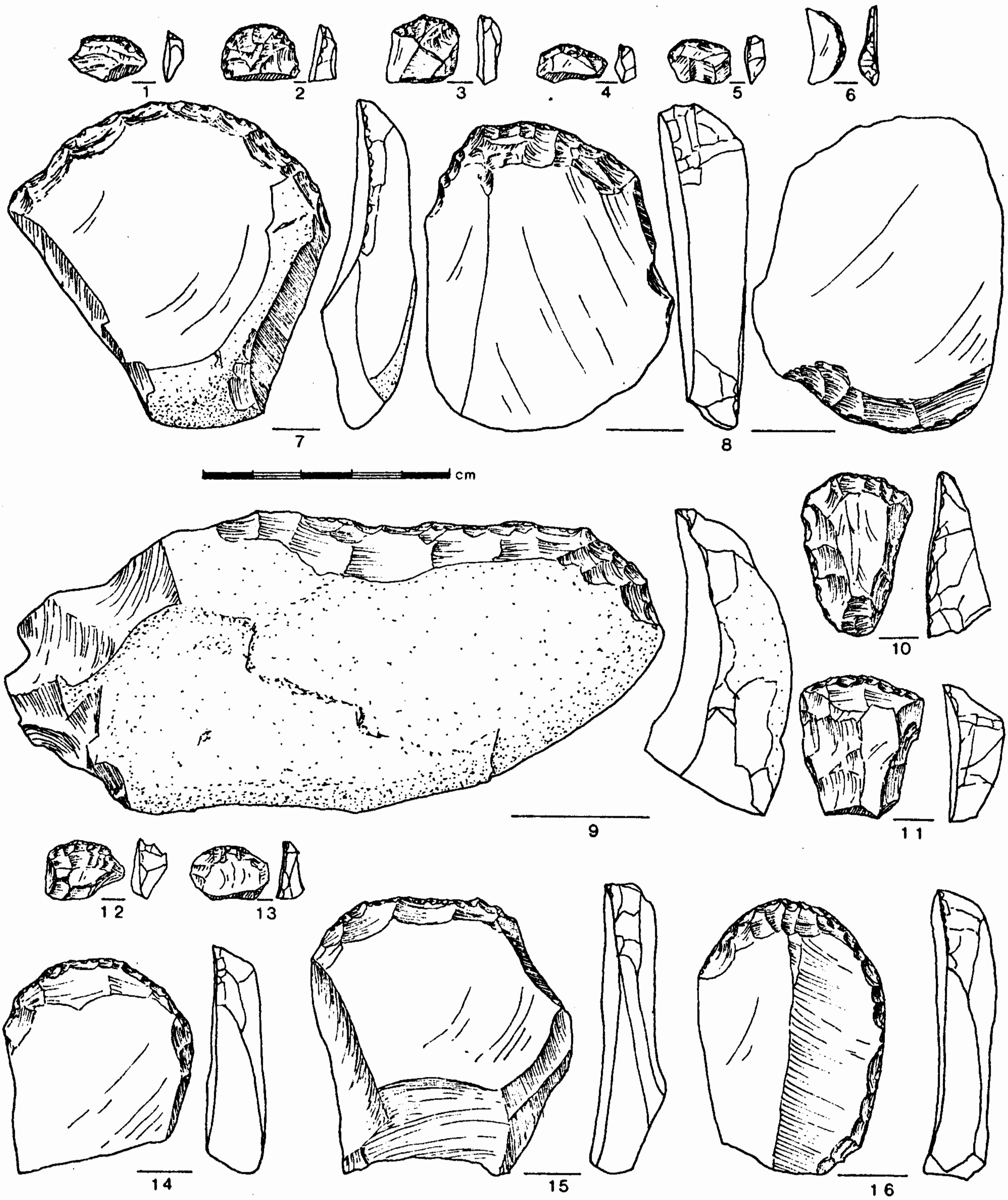


FIG. 115

NBC: STONE ARTEFACTS FROM J, BSBJ AND GSL

1-9: Large and medium scrapers

1-5: From J

6-8: From BSBJ

9: From GSL

4,5: Chalcedony

All the rest are quartzite

FIG. 115

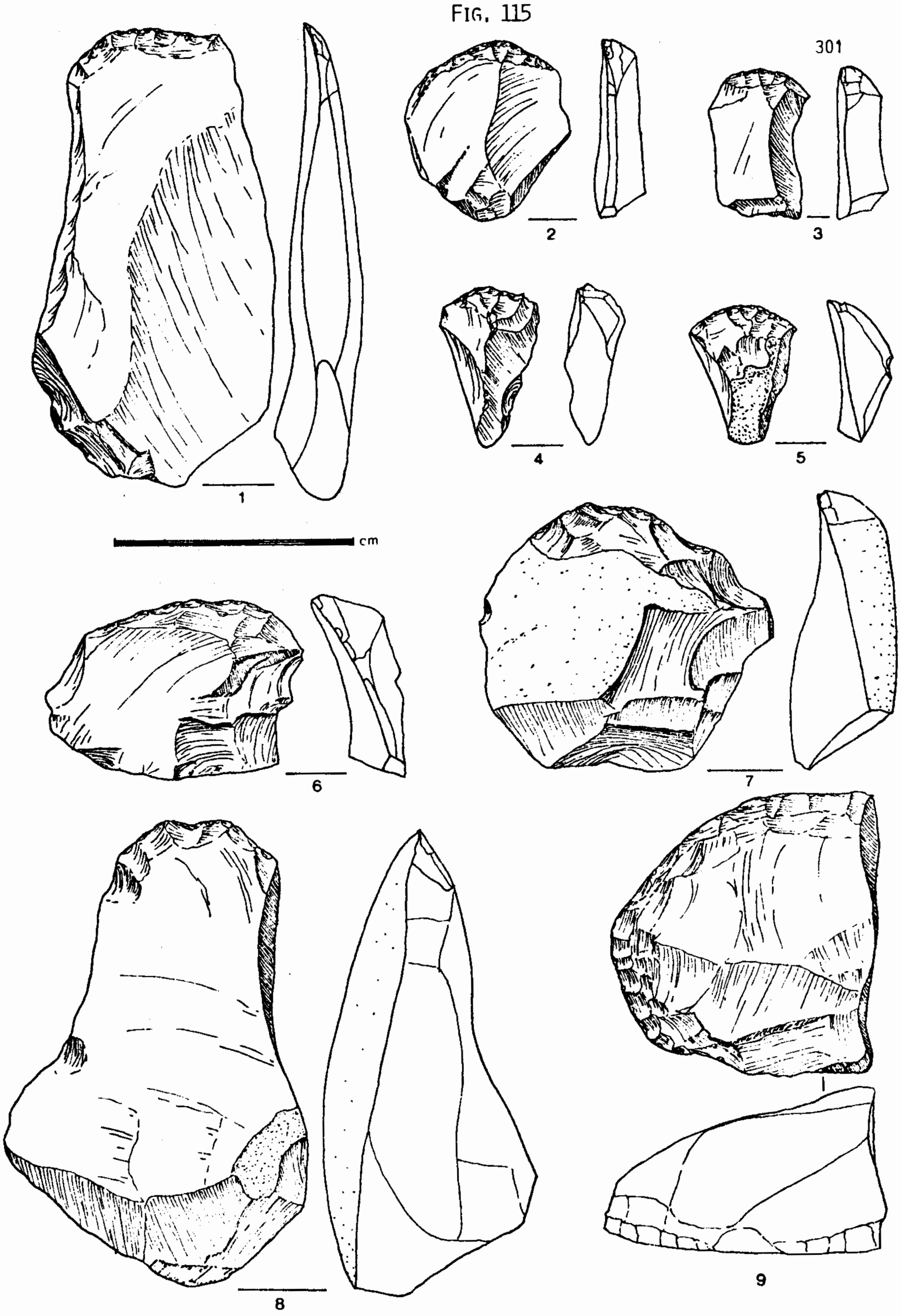


FIG. 116

NBC: STONE ARTEFACTS FROM BSL, YSL AND YGL UNITS

1: Large scraper

2: Medium scraper

3-9: Small scrapers

10-14: Backed tools

3: From BSL

4,5, 8-10: From YSL

6,7, 11-14: From YGL

11,14: Quartzite

9,13: Chalcedony

All the rest are Quartz

FIG. 116

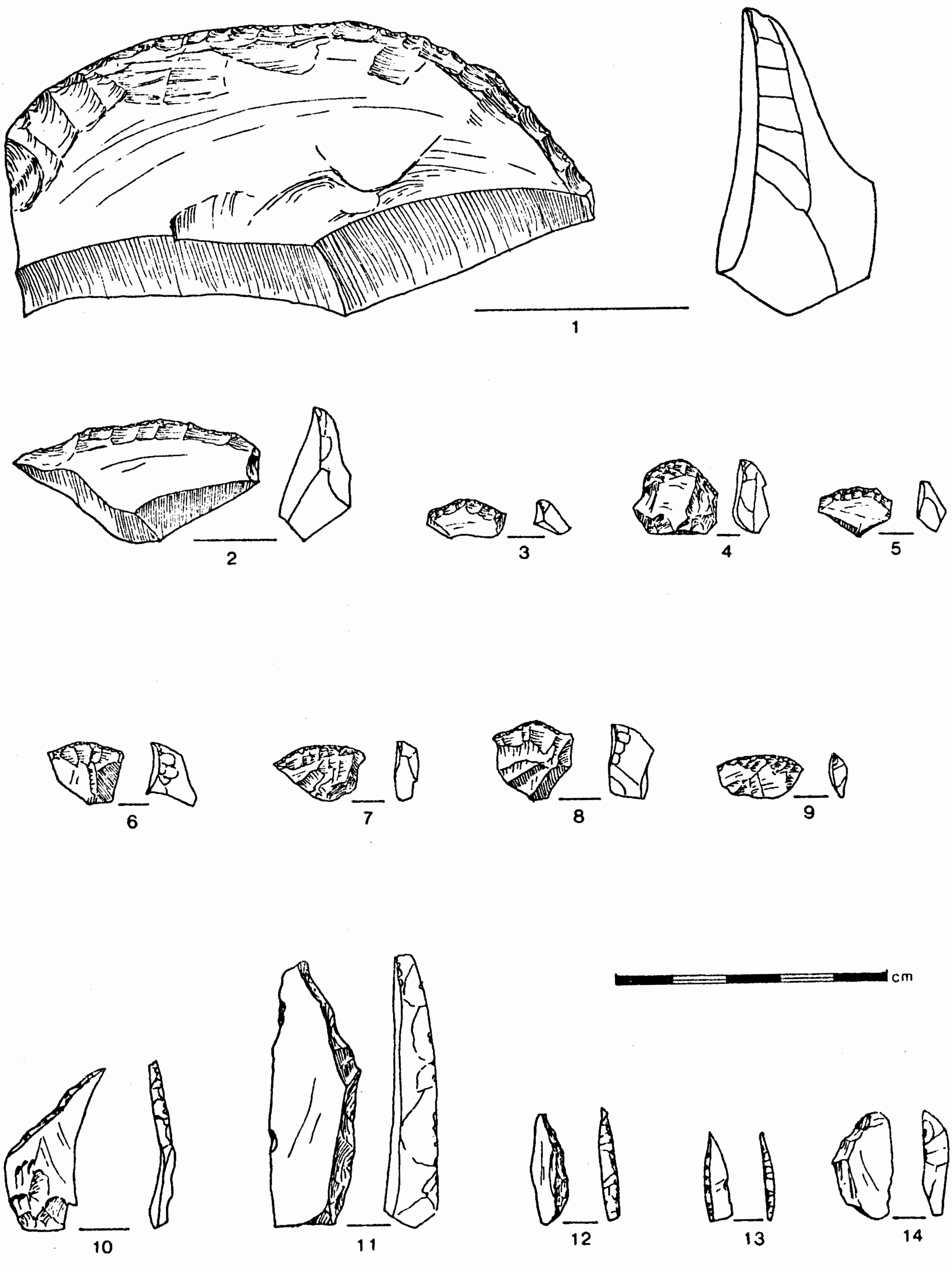


FIG. 117

NBC: BLADELET CORES FROM YSL AND YGL UNITS

2,3,5,6,7,11,15,16: From YSL

All the rest are from YGL

1: Chalcedony

2,3,5-10: Silcrete

4: Quartzite

All the rest are quartz

FIG. 117

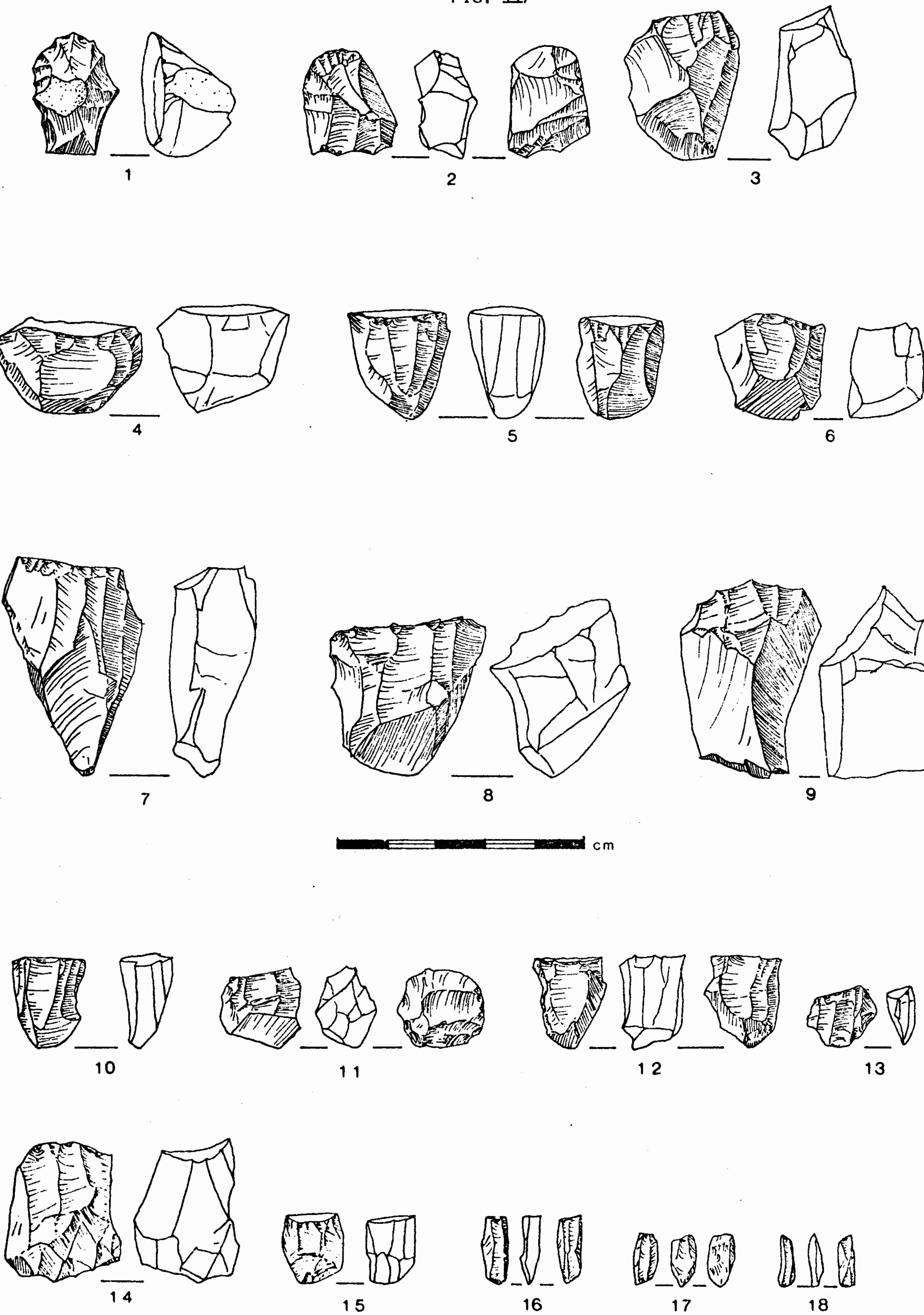


FIG. 118

KANGKARA : Scrapers from SUR to LPW. All from test pit A1.

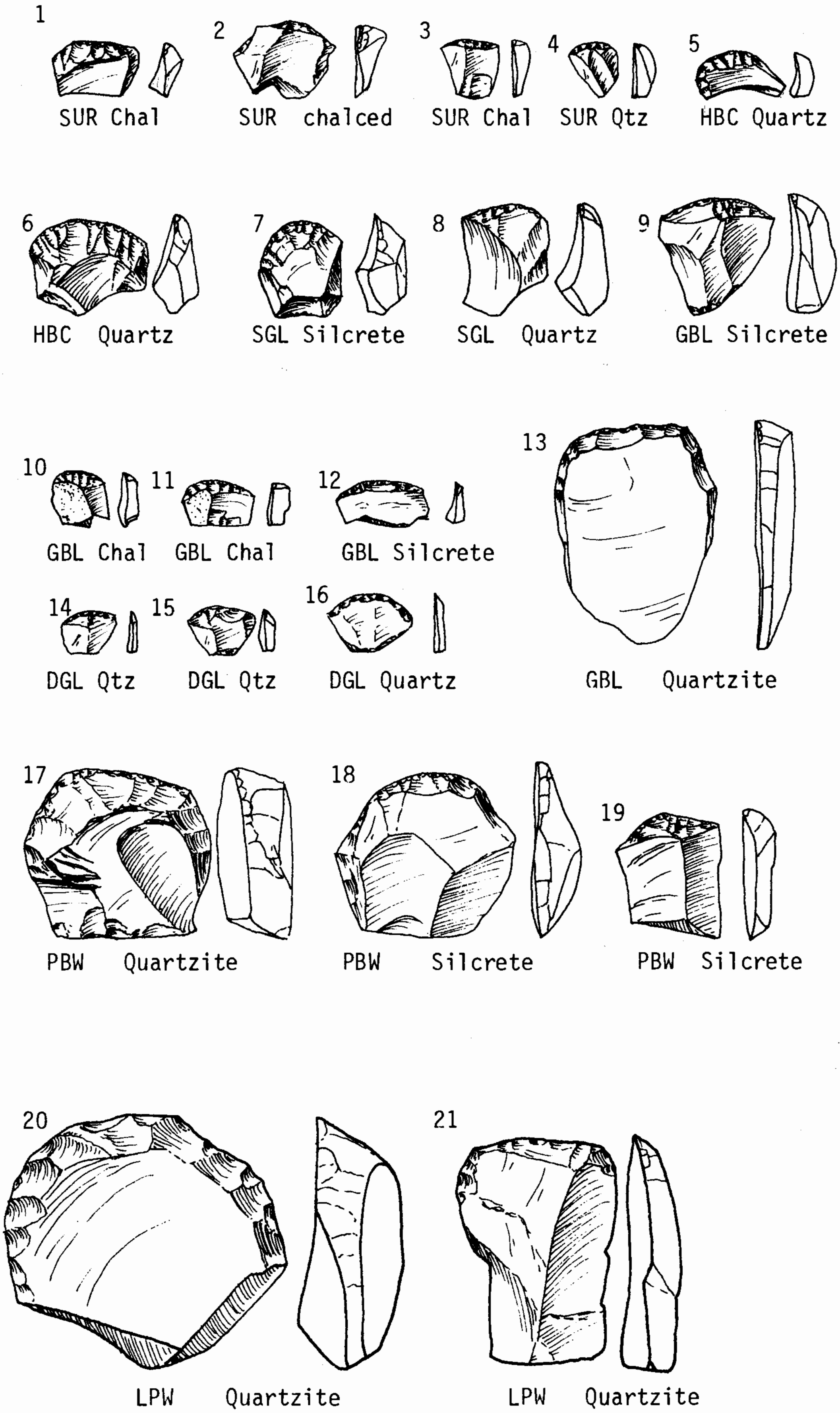


FIG. 119. KANGKARA CAVE: Scrapers and backed tools

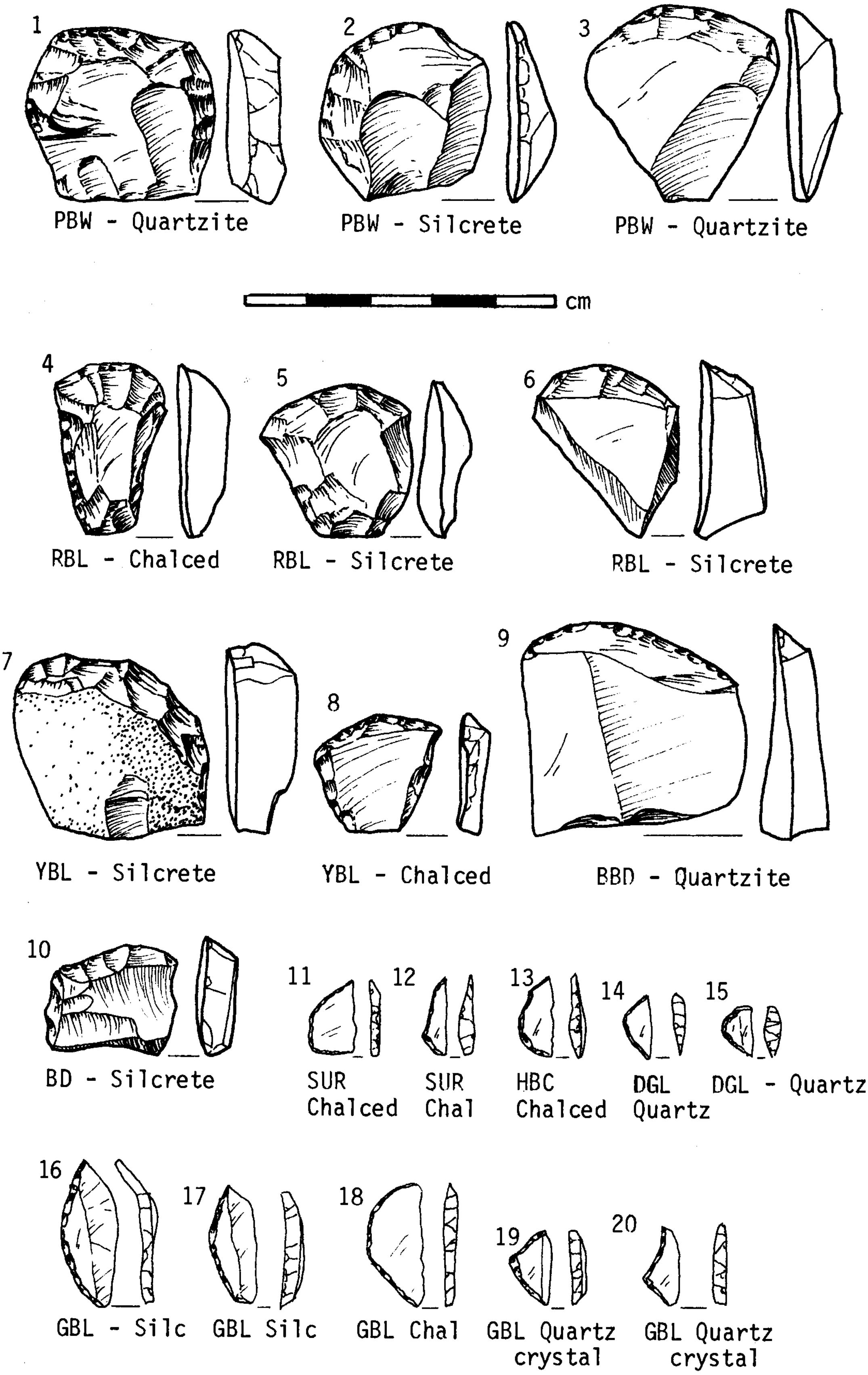


FIG. 120

BOOMPLAAS CAVE: STONE ARTEFACTS FROM THE DGL MEMBER. 1-24: SCRAPERS; 25-27: ADZES; 34: BACKED BLADELET; 35: SEGMENT; 36: BORER; 37: BORED SHALE PIECE; 28-30: UTILIZED FLAKES; 38-41: MISCELLANEOUS RETOUCHED PIECES; 31-33: CORES; 42-44: CORE REDUCED PIECES.

1,26,29,33,37: HORNFELS; 20,23,24,27,28,32,38,39: CHALCEDONY

8,25: QUARTZ ALL THE REST IN QUARTZ

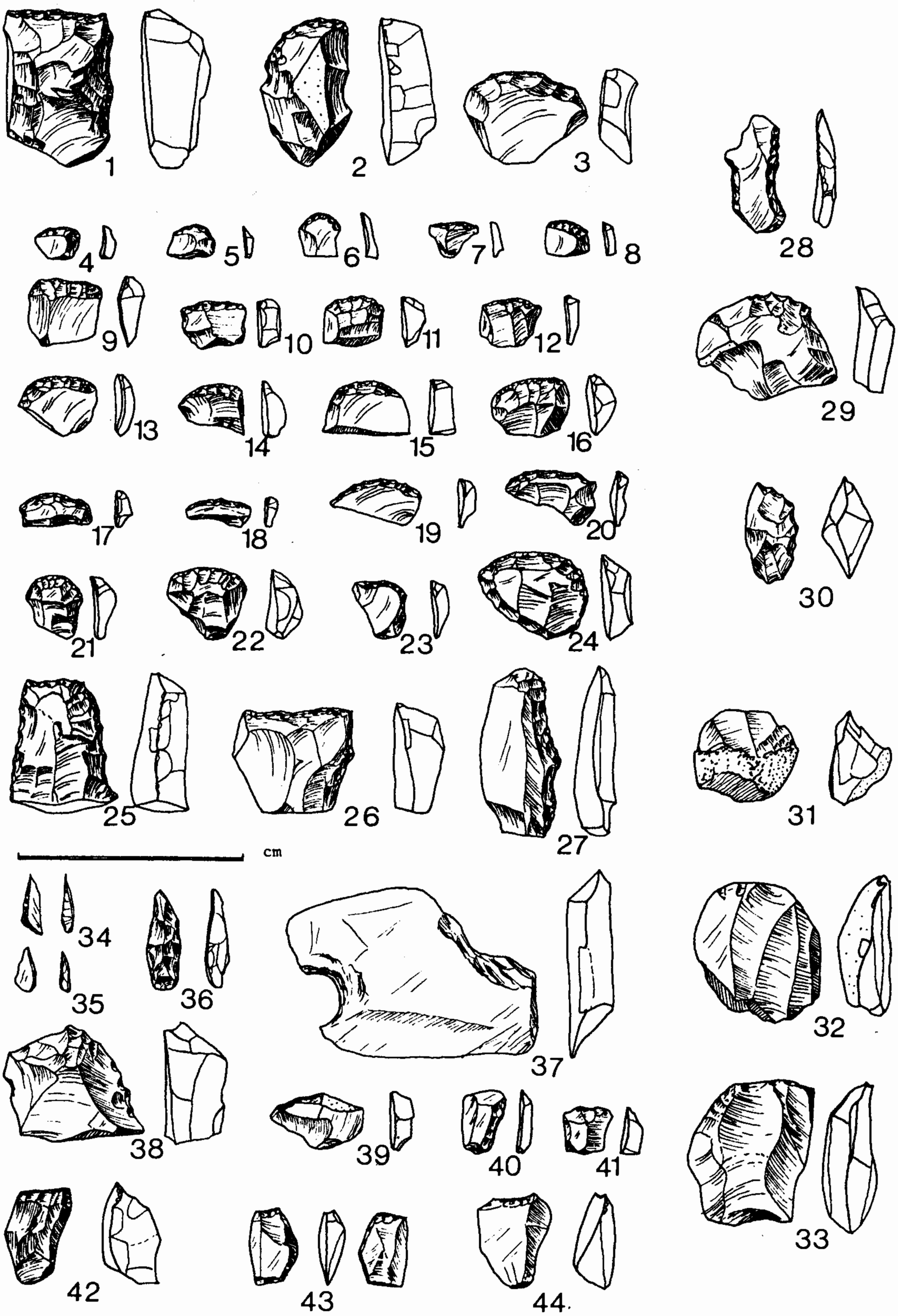


FIG. 121

BOOMPLAAS CAVE: 1: LARGE SEGMENT; 2-24: BACKED MICROLITHS; 25-32: BORERS
ALL FROM BLD MEMBER

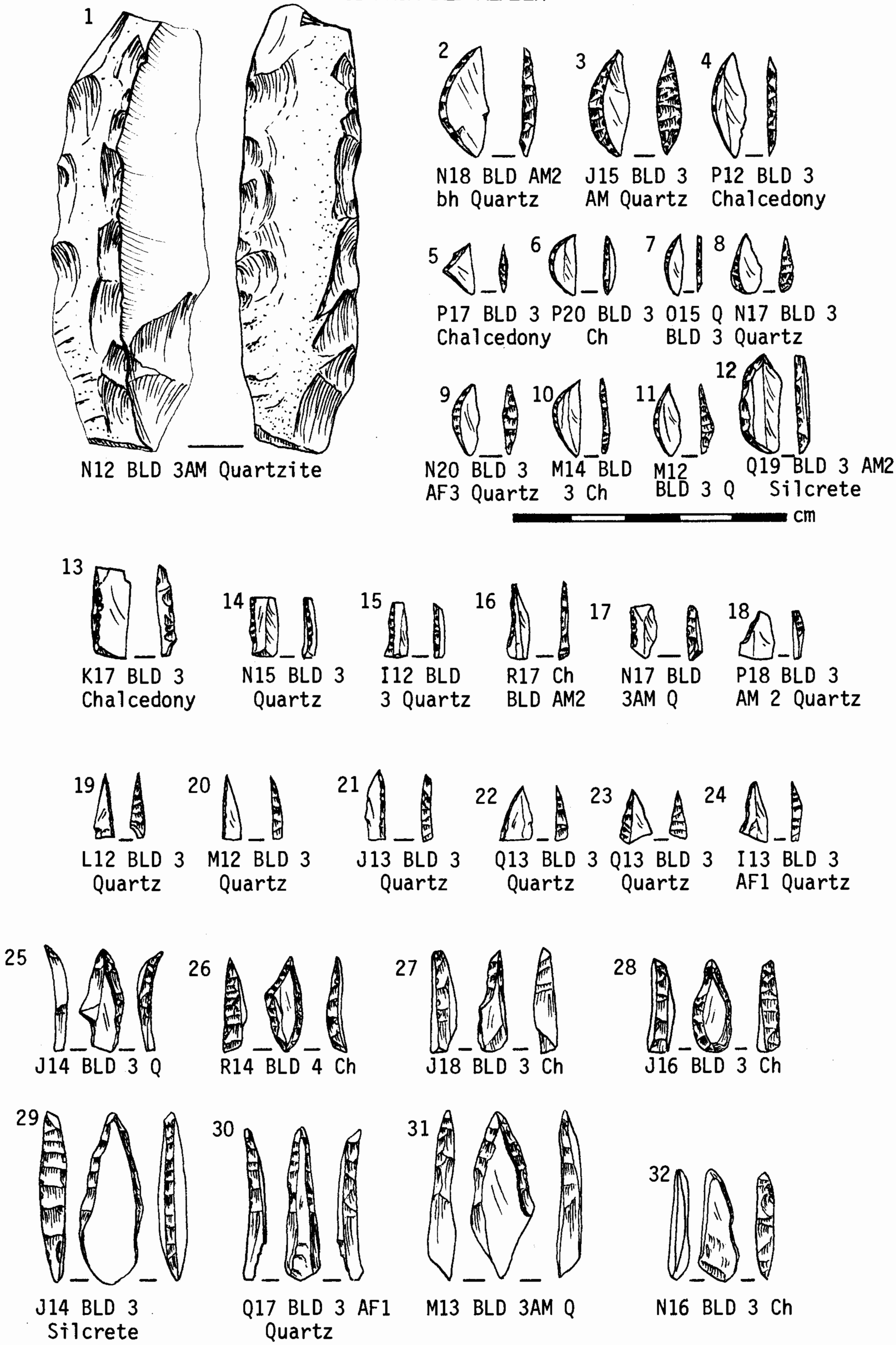


FIG. 122

BOOMPLAAS CAVE: ADZES FROM THE BLD MEMBER

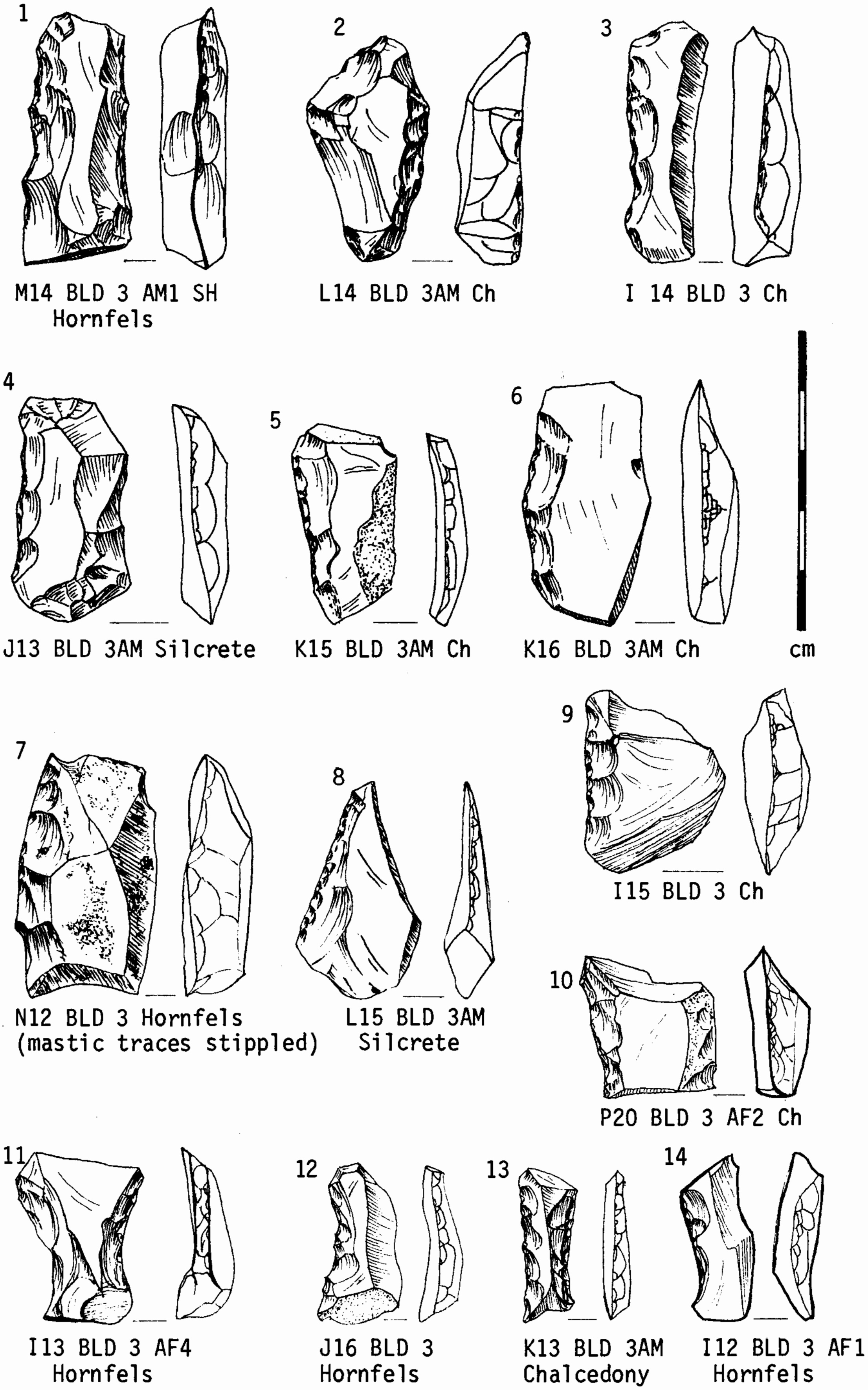
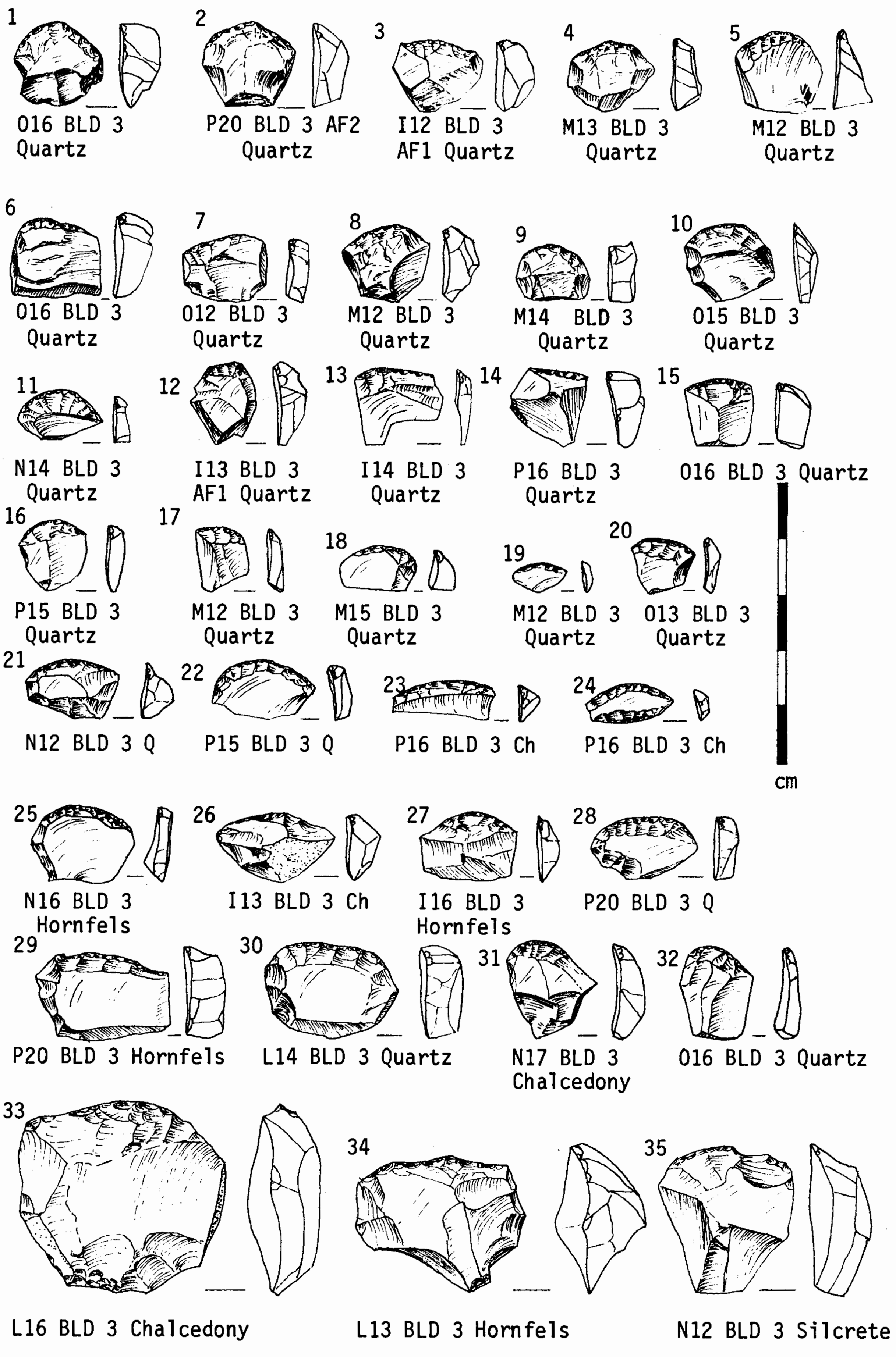
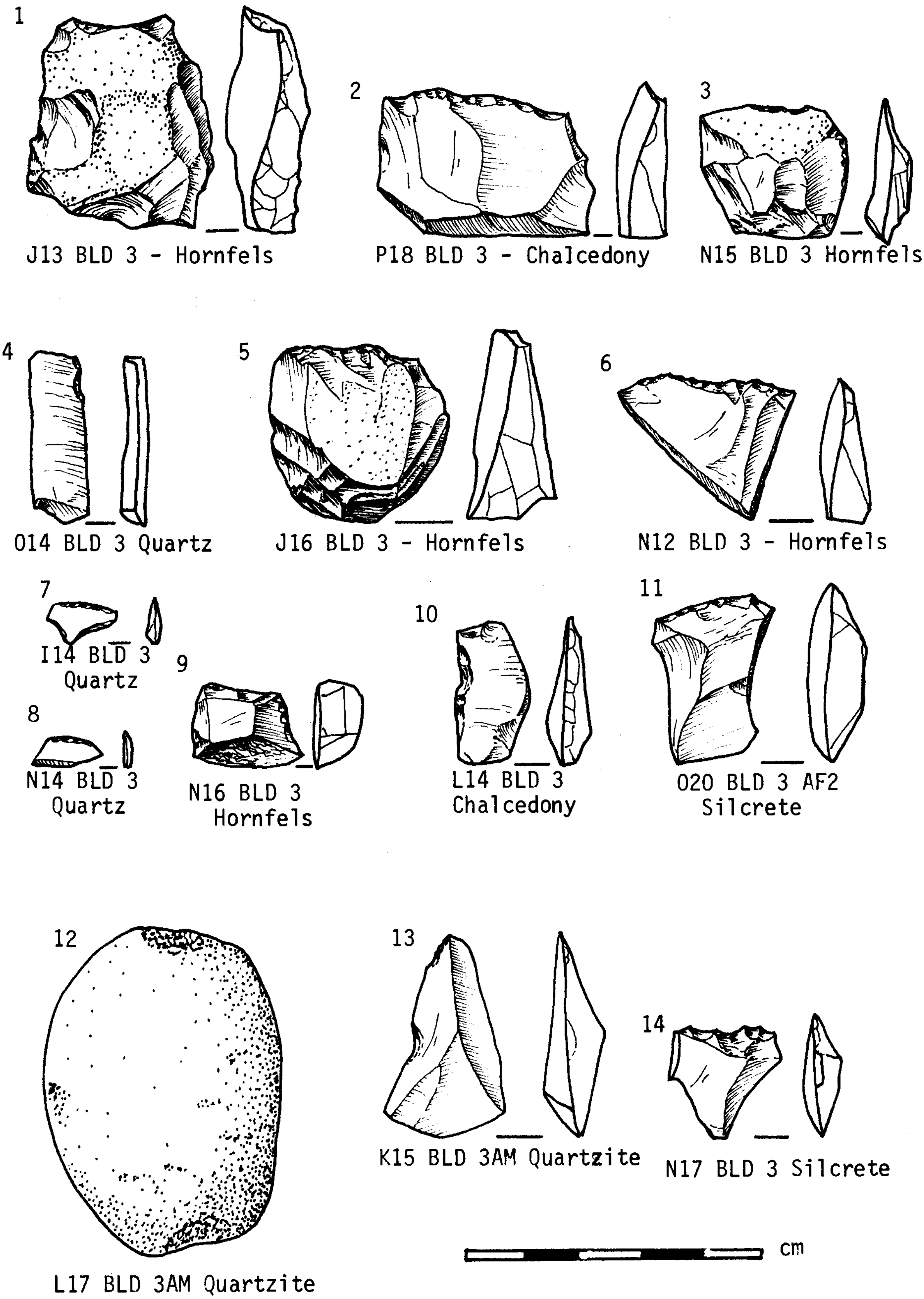


FIG. 123

BOOMPLAAS CAVE: SCRAPERS FROM THE BLD MEMBER

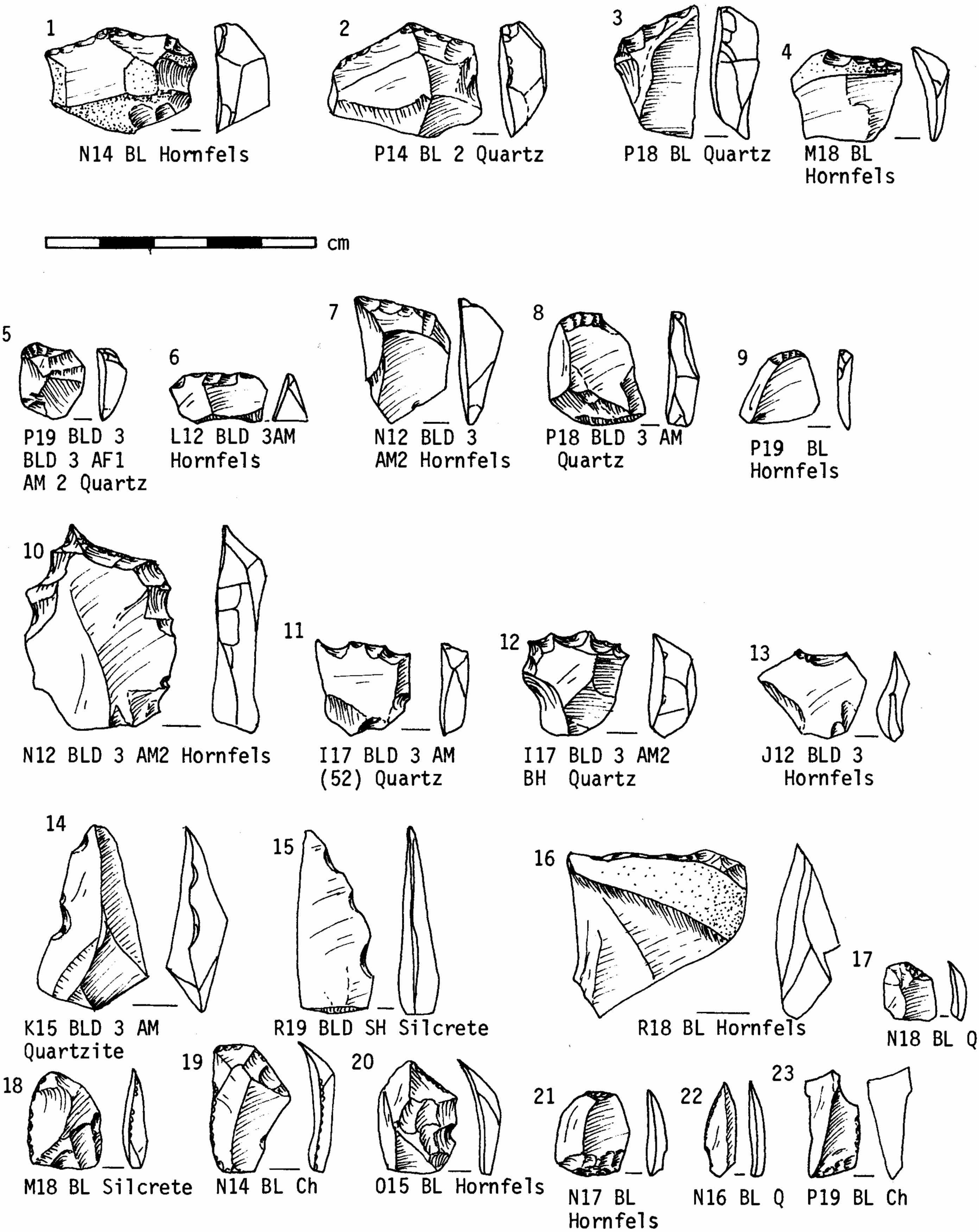




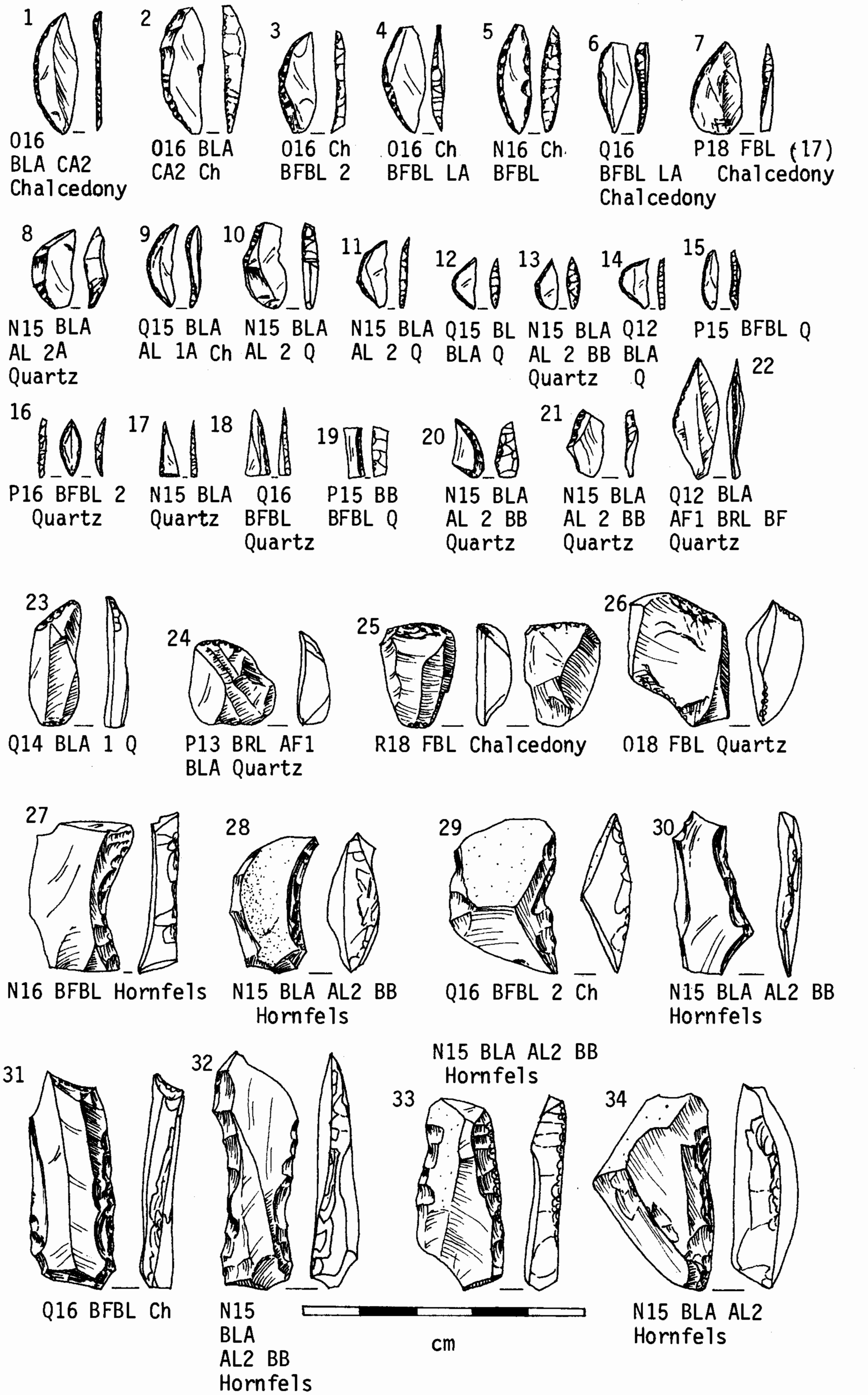
BOOMPLAAS : Utilized flakes and hammerstone from BLD Member.
12: Hammerstone, rest utilized flakes.

FIG. 125

BOOMPLAAS: BLD Member. Utilized flakes. 1-9: steep; 10-15: notched; 16-25: edge.



BOOMPLAAS CAVE: 1-22: BACKED MICROLITHS; 23-26: MISCELLANEOUS RETOUCHED PIECES; 27-34: ADZES. ALL FROM THE BLA MEMBER.



BOOMPLAAS CAVE: SCRAPERS FROM BLA MEMBER

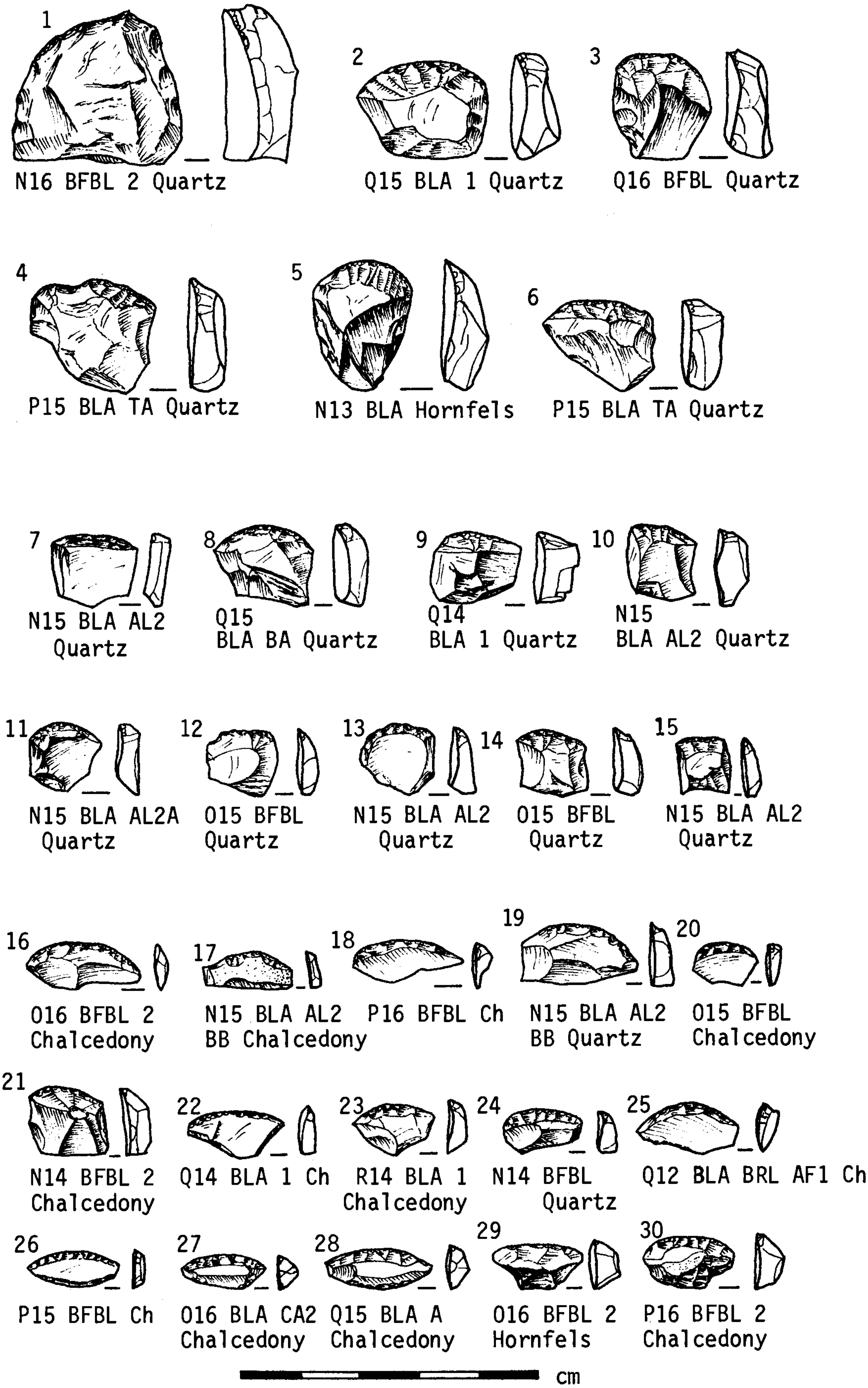


FIG. 128

BOOMPLAAS CAVE: SCRAPERS FROM BRL 1 AND BRL 2

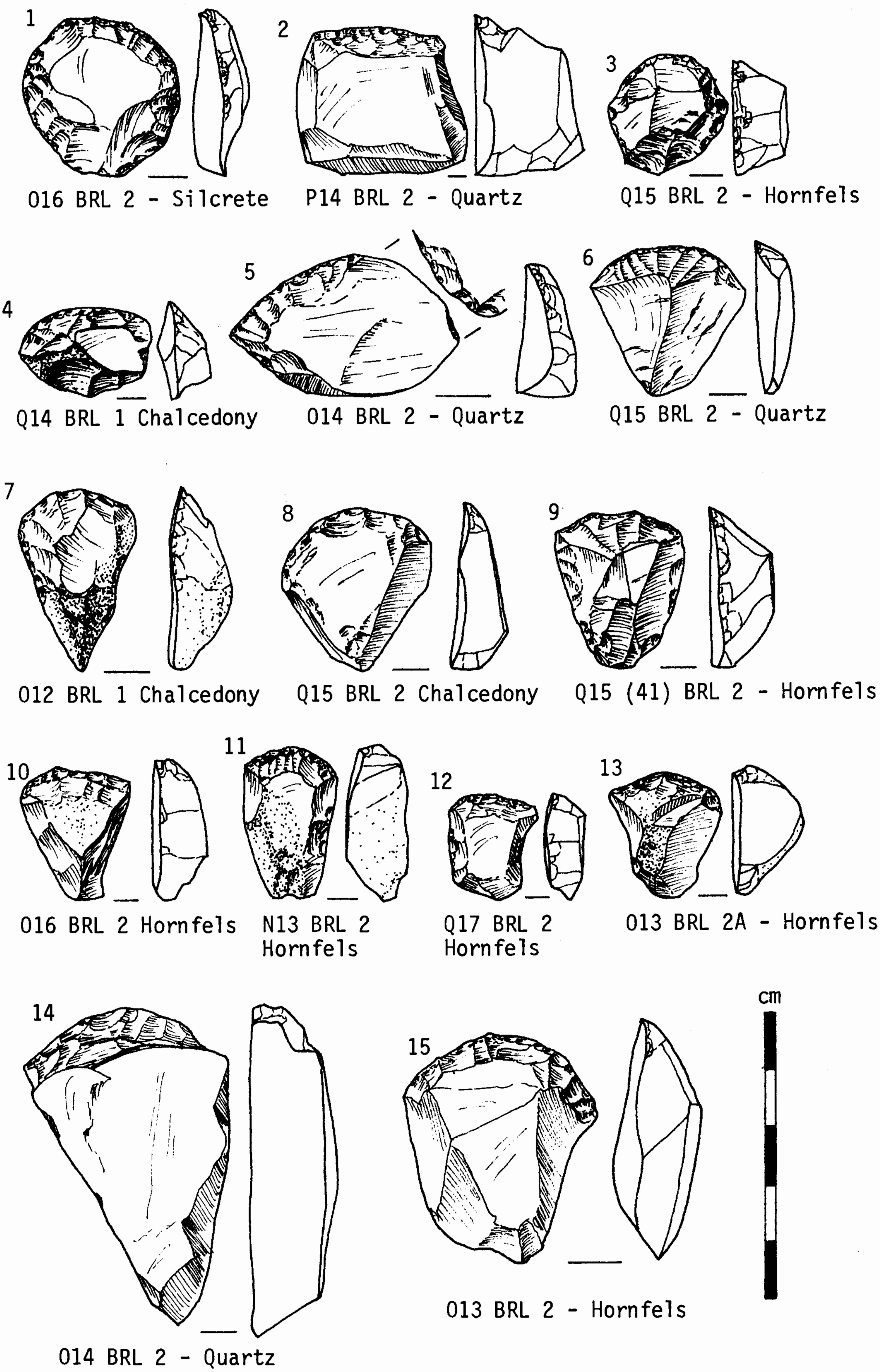


FIG. 129

BOOMPLAAS CAVE: SCRAPERS FROM BRL 3 AND BRL 4

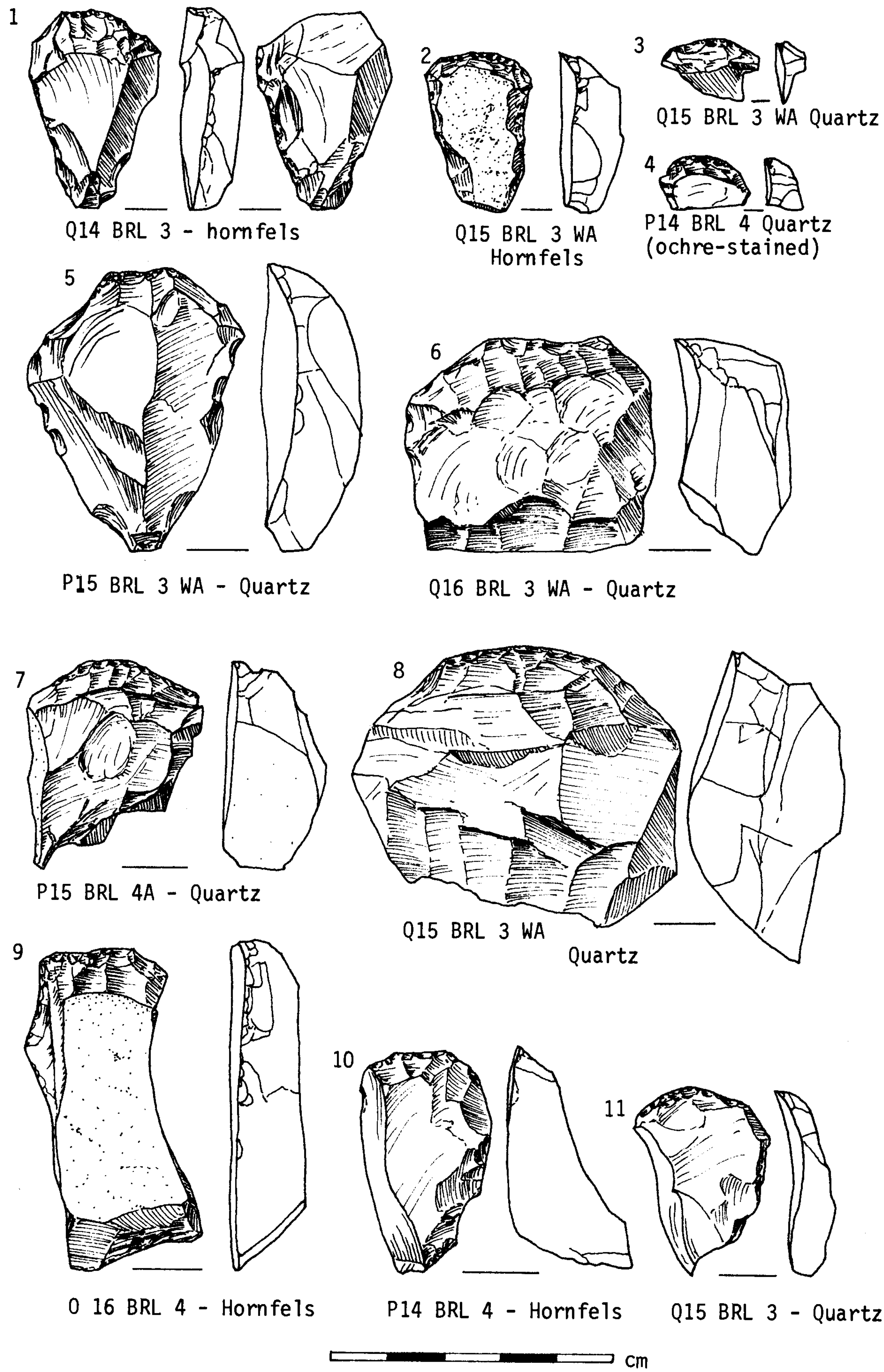


FIG. 130

BOOMPLAAS: BRL Member. 1,3,4: miscellaneous retouched pieces; 2: 'MSA' flake; 5: segment; 6-10: core reduced pieces.

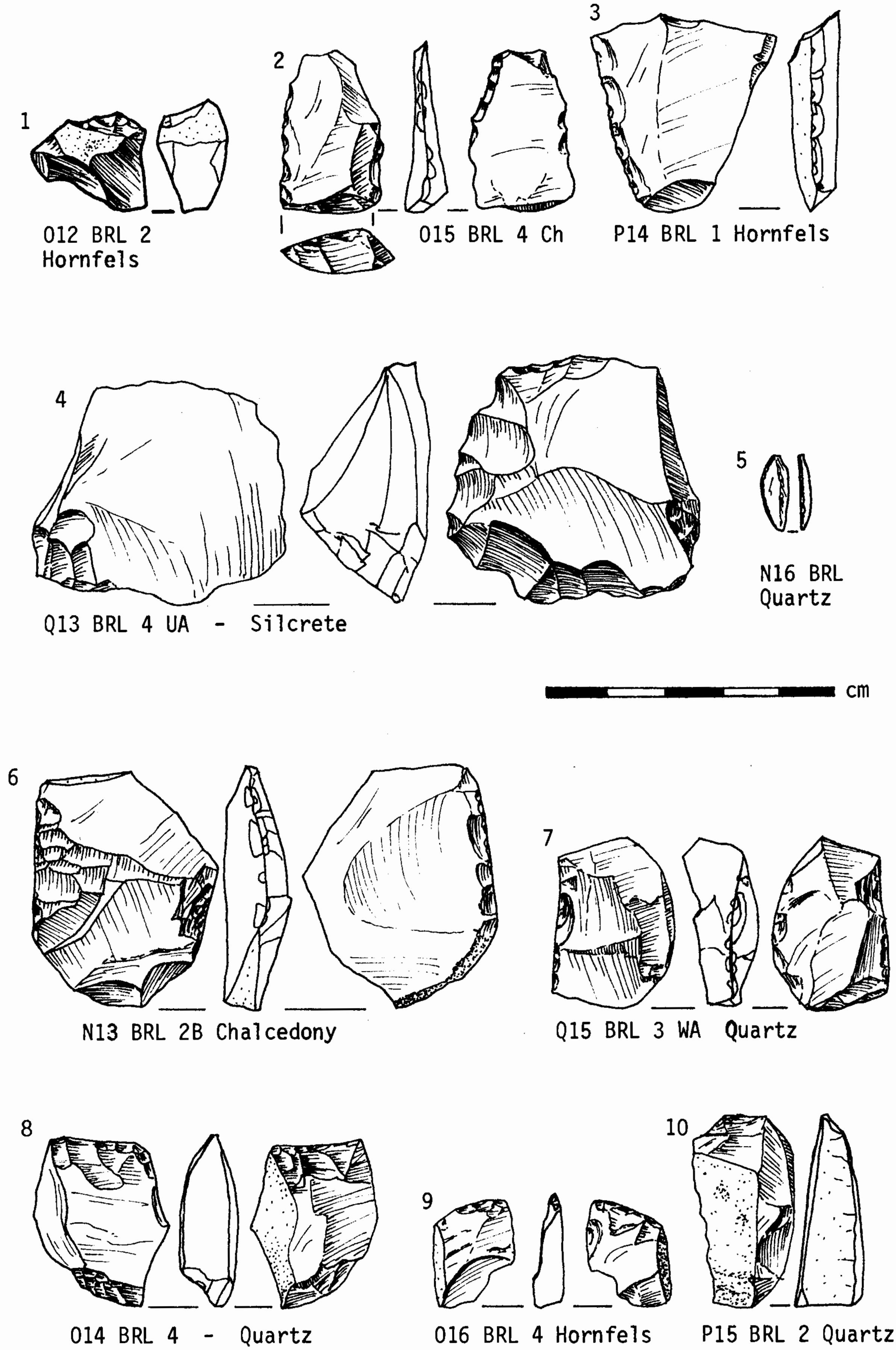


FIG. 131

BOOMPLAAS CAVE: SCRAPERS FROM THE CL MEMBER

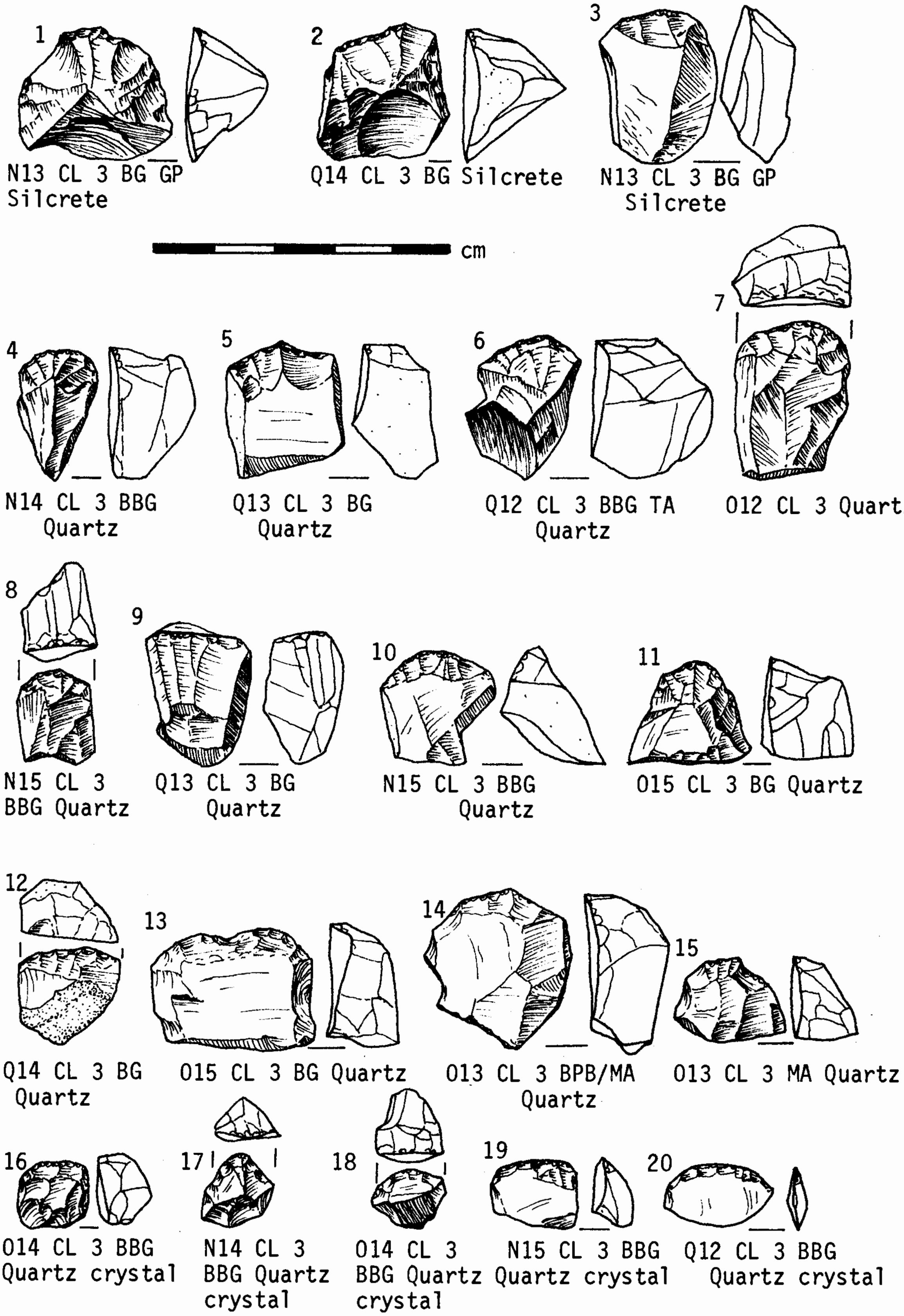


FIG. 132

BOOMPLAAS CAVE: STONE ARTEFACTS FROM THE CL MEMBER - 1-7: BACKED MICROLITHS; 8,9: BORERS; 10-15: ADZES

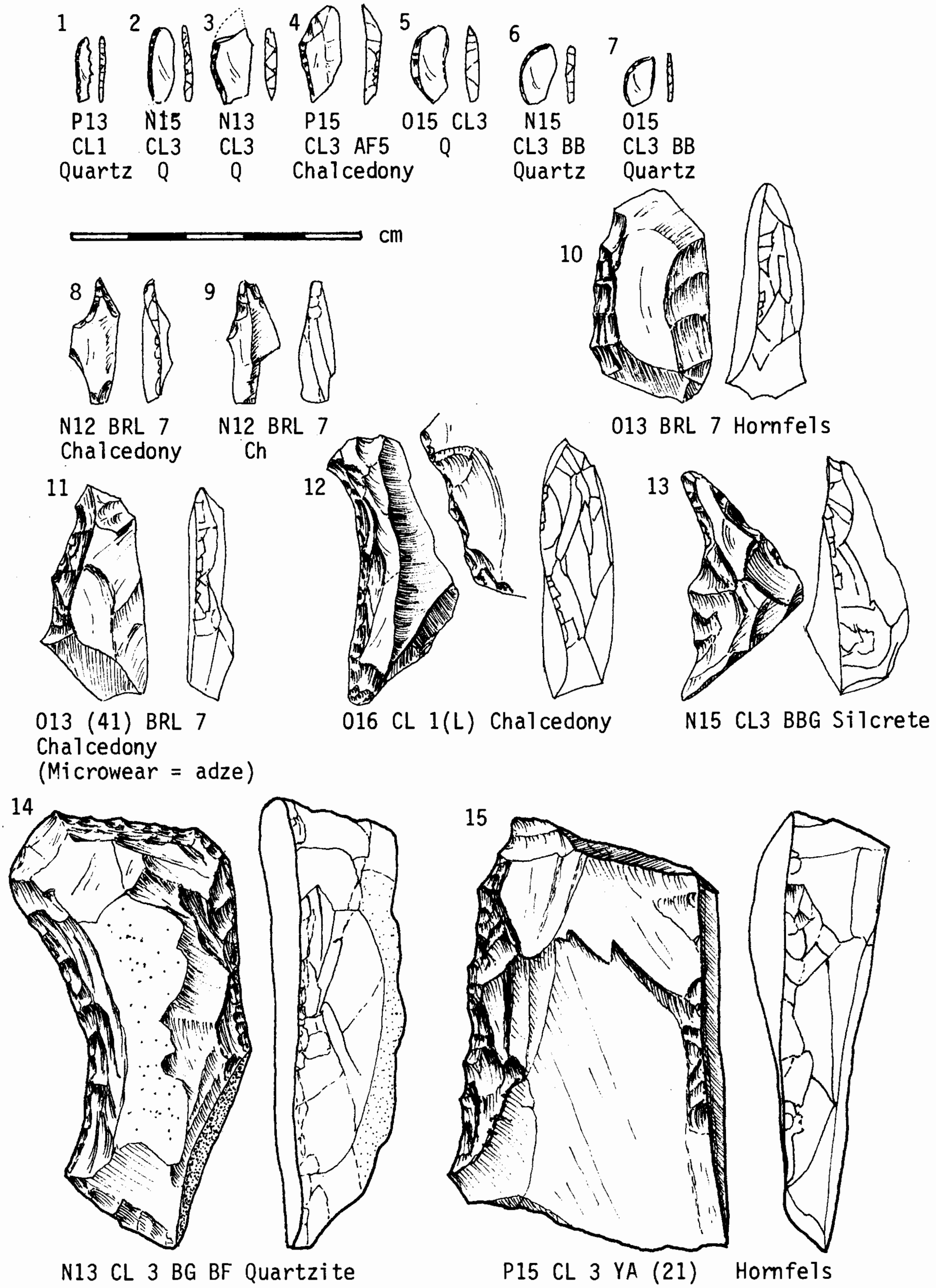


FIG. 133

BOOMPLAAS CAVE: SCRAPERS FROM CL MEMBER

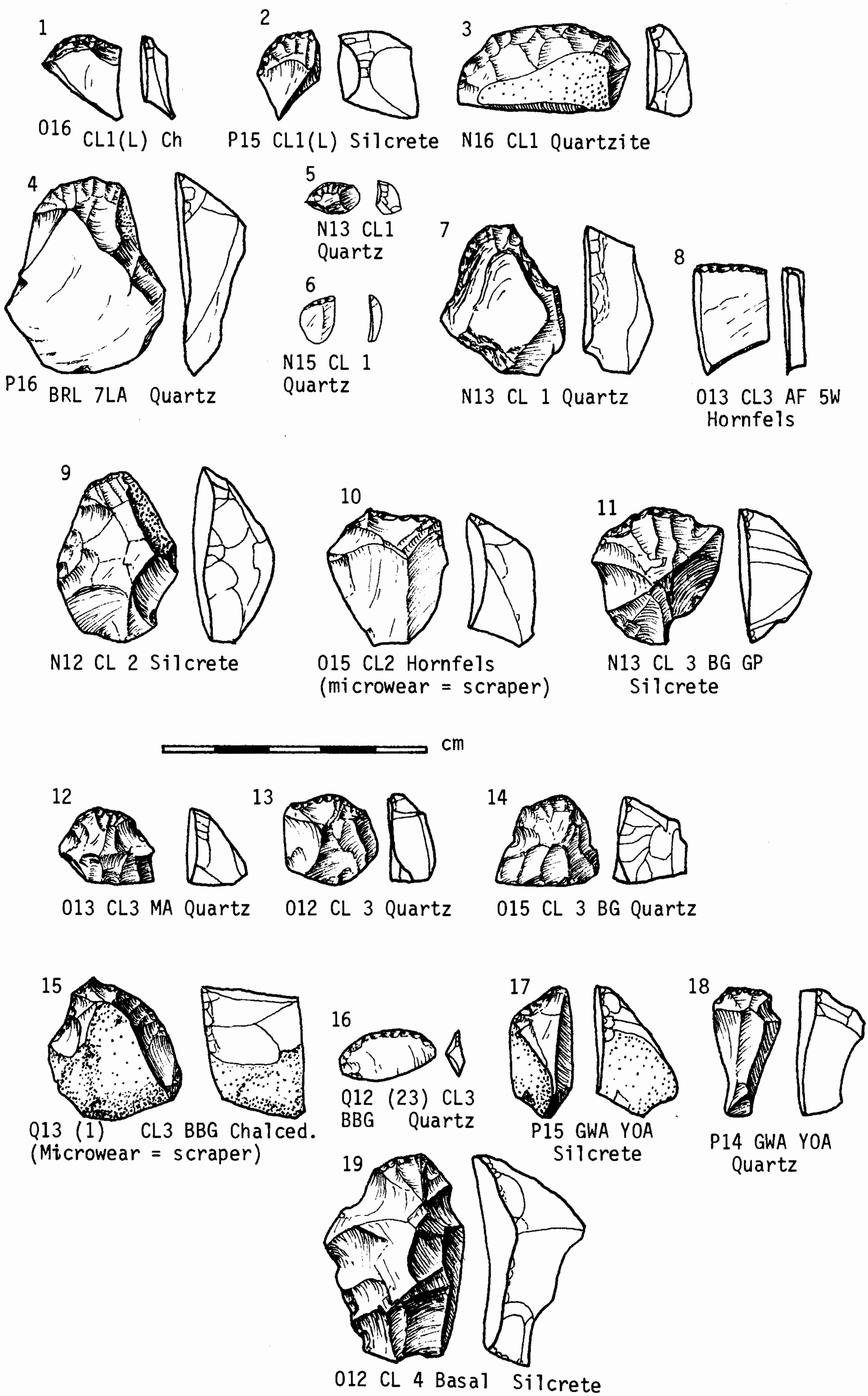
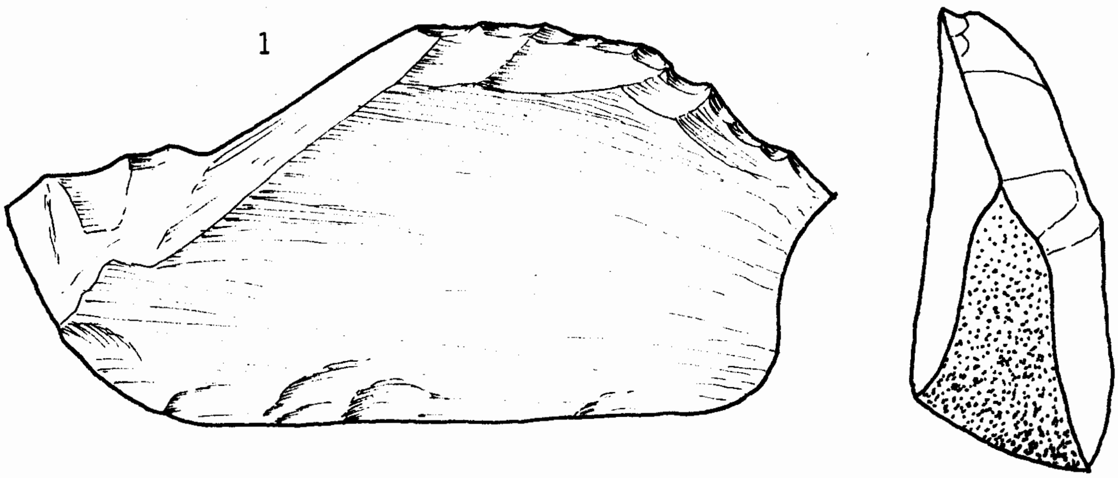


FIG. 134

BOOMPLAAS CAVE: LARGE SCRAPERS FROM CL MEMBER

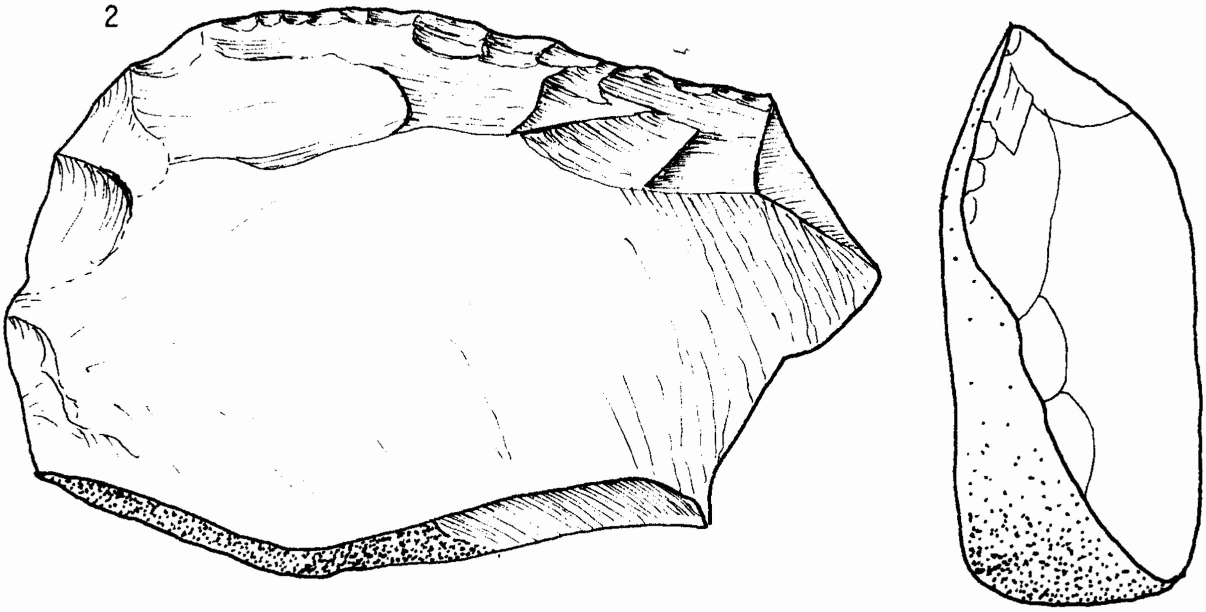
1



Q15 (19) CL 3 BP Quartzite

cm

2



N15 (9) CL 3 YA Quartzite

BOOMPLAAS CAVE: CORES FROM CL MEMBER. 1-7: SINGLE PLATFORM BLADELET; 8-13: SMALL FLAT BLADELET; 14-16: IRREGULAR

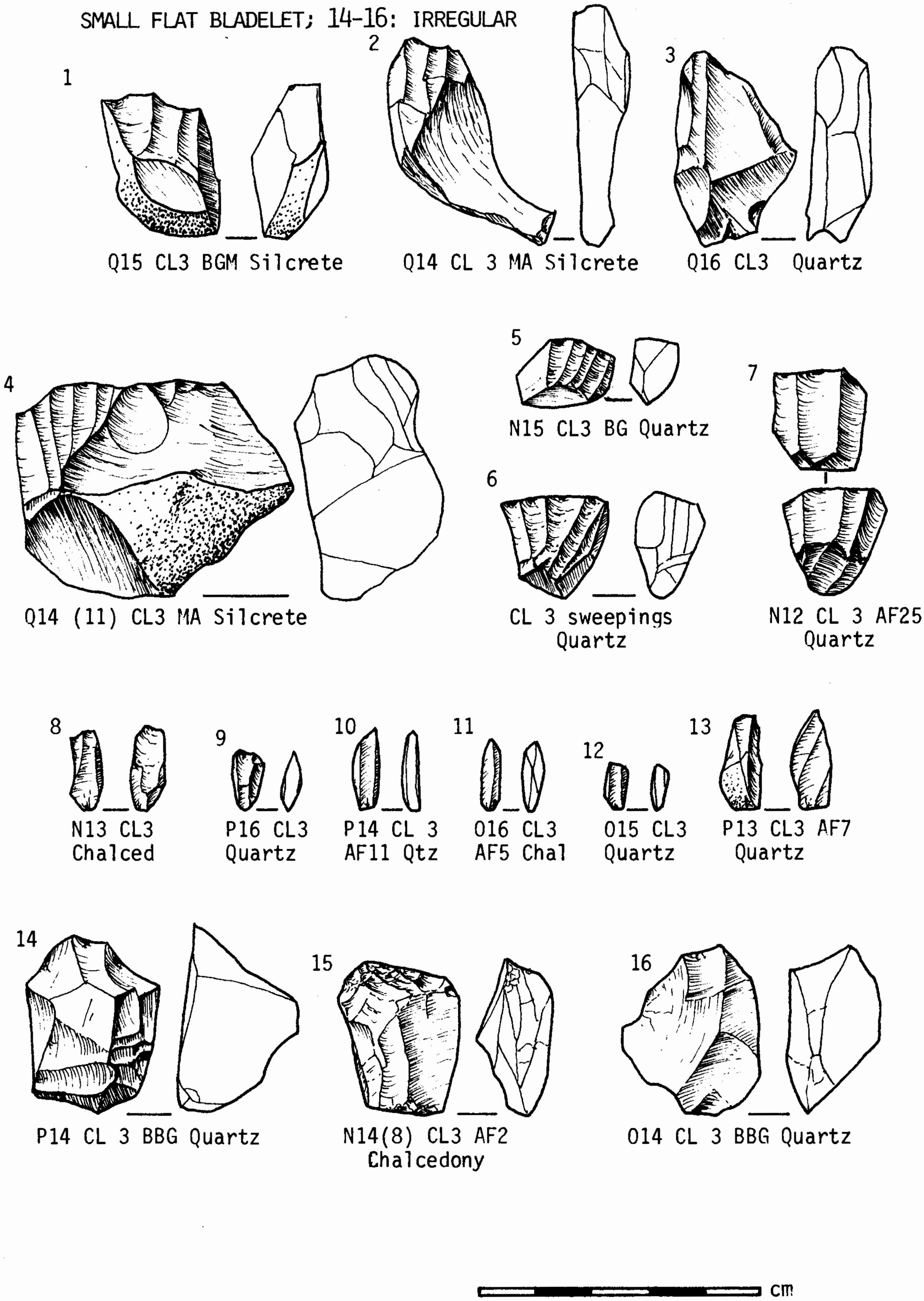
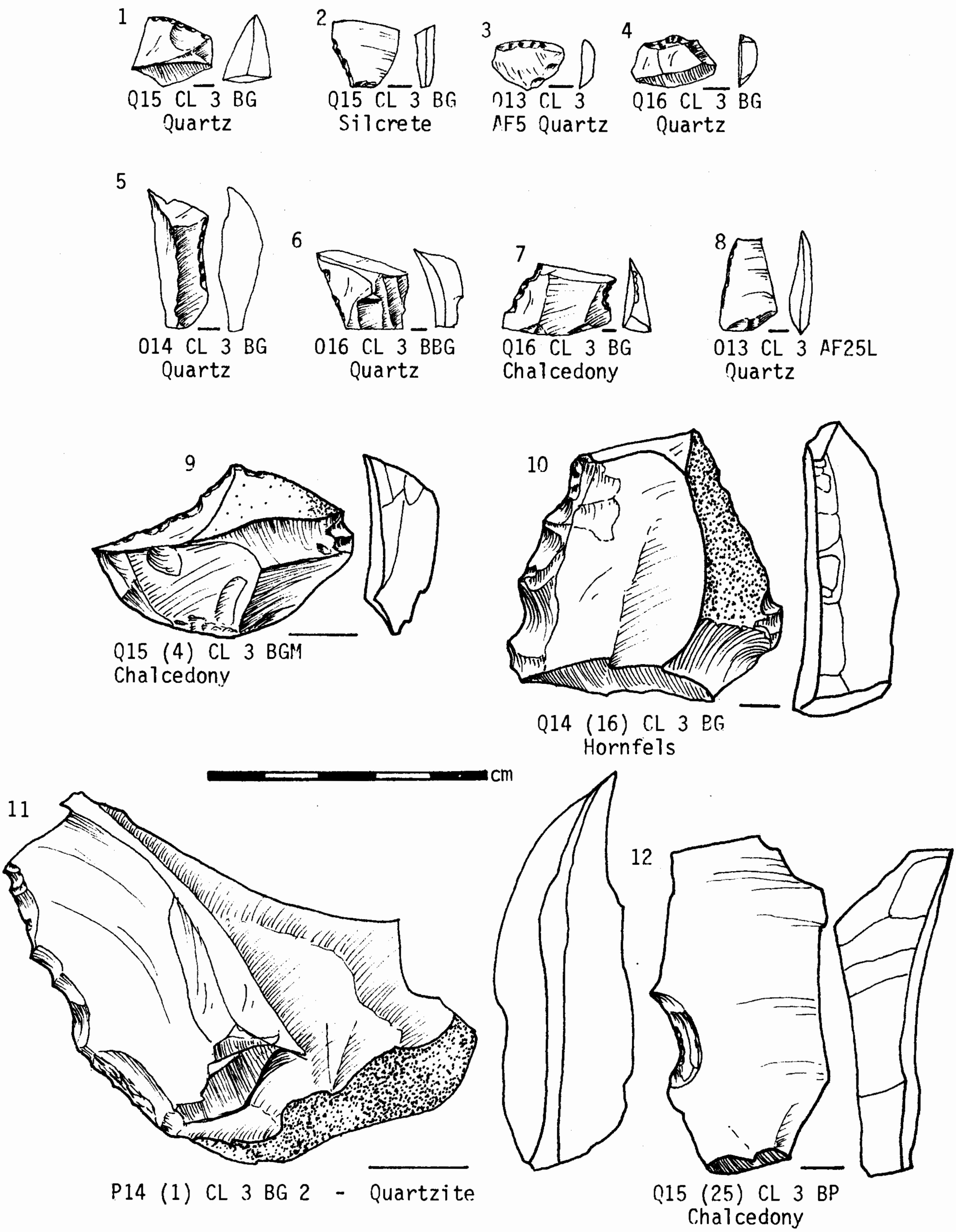
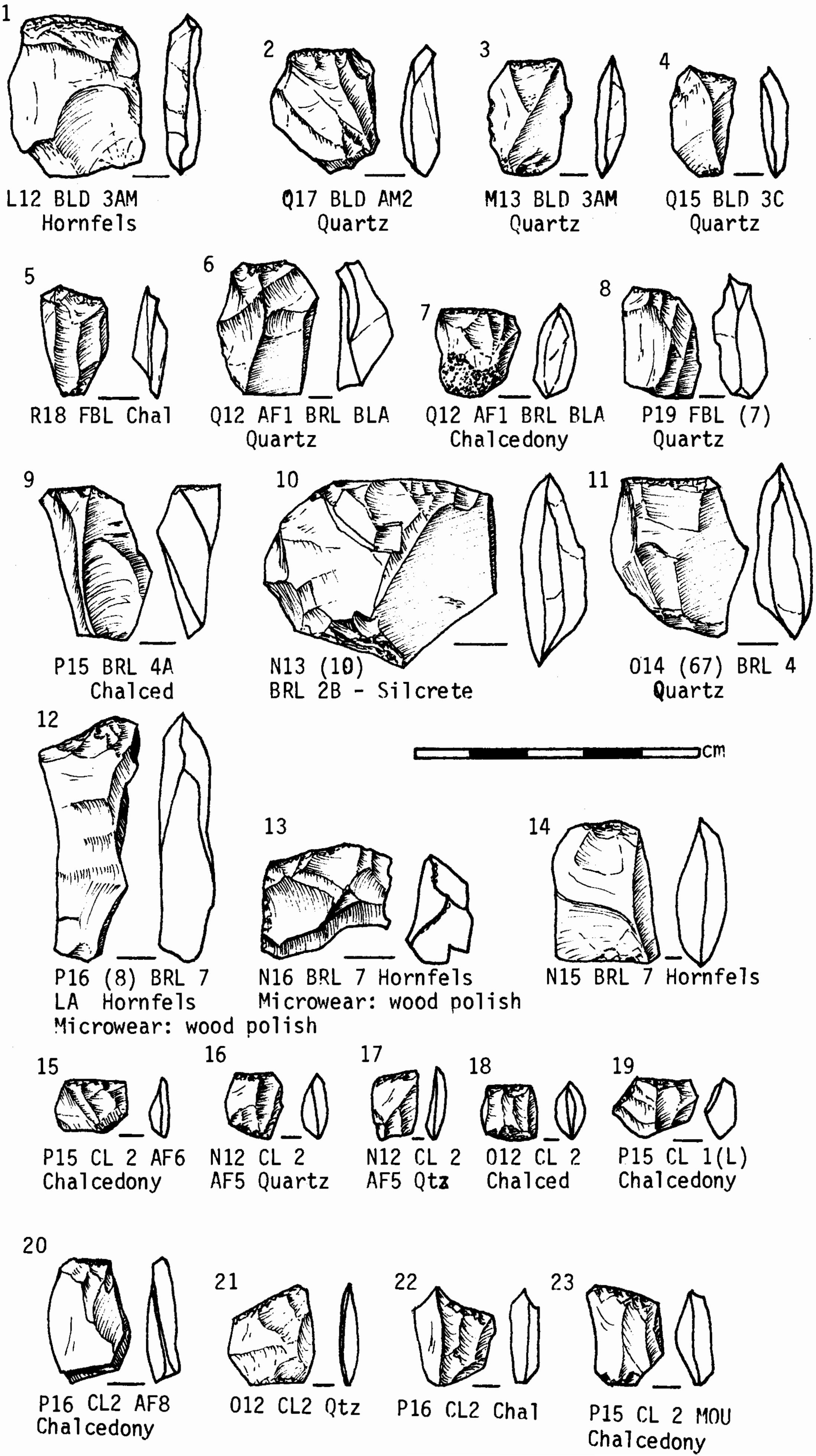


FIG. 136

BOOMPLAAS : Utilized flakes from the CL 3 unit of the CL Member



BOOMPLAAS : Core reduced pieces. 12 and 13 have been analyzed for microwear by J N F Binneman and show wood polish at the striking platform end.



6

PATTERNS OF CHANGE

PATTERNS OF CHANGE IN THE SOUTHERN CAPE AND FURTHER AFIELD

The fact that many of the changes in frequency, size and variety of artefacts described in the previous chapter were coincident at all three sites indicates that the stimuli for change were not site-specific, while the fact that different variables show different patterns of change through time suggests that the stimuli initiating changes were derived from several sources. Furthermore, it is apparent that at least two different scales of change can be seen that may be likened in a very general way to the macro- and micro-evolutionary scales of change identified in biological systems. These are described here as innovative changes, in which new items appear in the toolkit, and post-innovative changes, in which modifications are made to the frequency, size and shape of the artefacts through time. These two processes, introduction/innovation and subsequent modification are traced through the NBC and BPA sequences, they are then compared to the patterns of change noted in modern technology to identify characteristics common to technological systems, and these are finally related to changes in environmental variables to test for any temporal correspondences.

Traditional models of both social (Durham 1976) and technological change (Van Wyk 1979) assume that change is primarily functional. Whether the individuals who initiated the changes were aware of it or not, the concept demands the belief that they contributed to the ability of the people to survive and reproduce in their habitat. Under this assumption, change is by definition adaptive (Durham 1976: 91) because we believe that people will only do those things that are in some way advantageous to them. This view can be contrasted with

that which sees certain inventions as virtually 'inevitable' because of the stage of technological development that has been reached (White 1949:168, 210), or because of the re-networking of existing components in a way that is similar to genetic mutation (Clarke 1968:60, 89) and has little to do with goal-seeking behaviour or adaptation (Bray 1973: 81).

The traditional stimuli to change, particularly at the macro-evolutionary level of the invention and subsequent spread of new technological items, have been (i) environmental change which is assumed to have triggered new adaptive responses; (ii) social/demographic change which has stimulated the diffusion of ideas through either migration, demographic reorganization or existing communication networks; and (iii) technological development stimulated by evolutionary momentum within the technological system. The identification of one or more of these stimuli in the archaeological record is not a simple matter. While well-dated data on environmental changes at BPA and, to a lesser extent, at NBC make it possible to test for temporal correspondence between environmental and technological changes in the southern Cape, there can be no certainty of a causal relationship should such correspondences be demonstrated. Palaeoenvironmental changes are documented on a relatively gross scale and there may be important subtleties of human ecology that cannot be discerned but may nevertheless have speeded up or delayed technological responses to such an extent that relationships may be obscured. While elegant cause-and-effect scenarios can be constructed, caution is advised for even in cases where people can be questioned about their motives, argument still rages about the causes of cultural practices (Diener & Robkin 1978) and the reasons for technological change (Bernard & Pelto 1972:1).

The viewpoint to be stressed in this chapter is that technological change in the LSA during the last 20 000 years in the southern Cape was the result of a number of different factors - environmental, social/demographic and technological - which operated at both the macro- and micro-evolutionary levels. The way in which the three could have interacted is hypothesized in the flow chart in Fig. 138, but these interactions do not explain the direction taken by technological change; they only suggest ways in which the change could have been stimulated. Although environmental and social explanations have been offered to account for change in the past, the momentum of technological evolution has been studied only as a post hoc phenomenon at a very general level in Stone Age studies. In the modern idiom, however, it is known in more detail and it is therefore of interest to examine the 'general laws' of modern technological change to test them against the changes we can observe in the Later Stone Age samples from the southern Cape. This type of approach was suggested as a useful device by Beaumont (1978) and more recently Spratt (1982) has attempted to apply the theory of modern innovation processes to the prehistoric record.

GENERAL TRENDS IN MODERN TECHNOLOGICAL CHANGE

The documented history of technology should have much to offer studies of prehistoric technological change in that it provides a useful analogue for long-term change and the factors which stimulate technological development in the absence of similar data from ethnographic sources. Historic sources have proved to be a source of real data, not an abstraction of what we suppose happened as is the case with the theory of biological evolution and although prehistoric systems lacked modern advertising and communication networks, some of the general trends are nevertheless thought to be comparable.

Van Wyk (1979:282) defines technology as "the standardization of procedure for achieving chosen goals" and the logical extension of this definition is to assume that technological change indicates an alteration in the procedure and/or the goal. Change is assumed to improve the efficiency of tools by reducing the cost (or input) and improving the capability (or output). For the purposes of modern technology, Van Wyk (op. cit.) has identified four evolutionary trends: increasing complexity of artefacts, increasing efficiency, improved size characteristics and improved time characteristics. The direction of evolutionary development in technology involves one or more of these trends and, if they are indeed 'general laws' covering the development of technology, they ought to have general parallels in the Stone Age as well.

1. <u>Increasing complexity</u>

Complexity is cumulative and the majority of inventions or new artefacts borrow "a form and principle from one functional context for the purpose of substituting them in another context formerly serviced by a different form and principle" (Barnett 1942:17-17). More complex tools therefore harness energy in a different way than was possible with simpler artefacts, although the tasks for which they were designed are not always new. An example of increasing complexity can be seen in the regular hafting of scrapers, adzes and backed microliths in the Later Stone Age which required a new combination of previously known scraper and other tool designs, mastic and the use of wood or bone handles. In the case of the development of the bow and arrow, this required the appreciation of the use of the bow to propel the arrow as well as a knowledge of poisons, all of which combined to harness energy in a different way to improve the efficiency of hunting. It does not, however, imply that hunting was unknown before this time. Another example is that of the bored stone used to weight a digging stick. It is interesting that the earliest bored stones found in the archaeological record (see Chapter 7) are too small to have been used very effectively as digging stick weights and here we may be seeing the substitution of the principle of boring stones already known for thousands of years for a new and more complex tool, namely the weight on a digging stick. In the archaeological record inventions of this kind are marked by an increase in the frequency of one or more of the component parts now used in a different context, coupled in some cases with a change in design that may not be very great. Such developments mark changes in procedure in tool manufacture and changes in goal in that the tool is now used for a different purpose.

2. Increased efficiency

Without ethnographic analogues this is a difficult factor to measure from archaeological data, but Van Wyk (1979:189) notes that in general greater efficiency in modern technology requires greater control in the design features of tools. This is achieved through greater standardization and improvements in manufacturing procedure. Standardization is a marked feature amongst formal tools of the mid-late Holocene. Where preservation is good, these tools frequently retain mastic traces indicating that they were hafted and we can thus assume that hafting placed limits on the range in size and shape of the stone inserts that was not as necessary in former times when it was less common or simply less efficient. By analogy with modern tools we can thus suggest that standardization increased efficiency amongst hafted tools during the Holocene and that the standardization of bladelet cores and bladelet production during the late Pleistocene may also have represented a move towards increased efficiency. What is not clear, however, is why there was an apparent 'regression' in artefact design at some periods. The standardization amongst bladelets of the late Pleistocene, for example, was lost after 12 000 B.P., while in a broader time perspective that achieved for formal tool production in Howiesons Poort-type assemblages of the last interglacial was 'lost' during the intervening glacial cycle.

3. Improved time characteristics

Because technological advance attempts to reduce the ratio of output to input, an obvious trend through time is the miniaturization of artefacts. This is observable in a very broad way throughout the Stone Age although, as we have seen, there is some variability. Thus, although we can explain a decrease in artefact size in terms of improved efficiency through time, there is no modern analogue for explaining a size increase, except in terms of a different method of production or use. In modern technological items it has been observed that when an artefact cannot be made any smaller because of the properties of the materials involved, the outcome of the solution is what Bright (1978: 193) calls 'encapsulation'. This involves an increase in the number of functions housed in the artefact of minimal dimensions, enabling it to be used in a number of different ways. It is not yet clear if or how this principle may have operated in the Later Stone Age, but small hafted tools may have been used for a number of different functions. For example, backed microliths are known from historical records to have been mounted as arrowhead inserts (Goodwin 1945; Clark et al 1974), but microwear studies by Clark & Prince (1978) and by Binneman (1982) show that backed microliths were also used for plant fibre preparation and on hard gritty surfaces. This is not to deny, however, that the larger backed tools of the Howiesons Poort-type assemblages were not also multi-purpose tools and we may not be able to demonstrate that the principle of encapsulation operated during the Stone Age only as a result of miniaturization.

4. Improved time characteristics

When technological change improves the time characteristics of an artefact, it improves the rate of output or the speed of processing, or both. Here we may assume this to be reflected in the discard rate of stone artefacts and with improved time characteristics we would expect to see an increase in the number of tools made and discarded. Archaeological data indicate that in both the MSA and LSA an increase in formal tool frequencies was accompanied by a gross increase in the range of formally retouched pieces. Here again, however, we are led to assume that an increase in formal tools = an increase in efficiency and we are left with the problem of explaining periods such as that during the last glacial cycle when the production of formal tools was extremely rare. Are we to assume that efficiency was less important at such times or that regression is part of the evolutionary process and that even in the modern idiom we should allow for it ?

GENERAL TRENDS IN LSA TECHNOLOGICAL CHANGE

The predictions we could propose from these generalized time trends observable in modern technology are that we should see a gradual progression within the LSA towards increasing complexity, greater standardization and miniaturization if no negative factors were involved in disrupting the evolutionary momentum of the artefact system. What we see, in fact, is the achievement of these expectations by the mid-Holocene with the development of relatively complex composite tools that is accompanied by hafting, standardization and miniaturization, but the development is not a regular one. There are oscillations or cyclic changes through time in the toolmaking methods and in the raw materials and size and shape of the artefacts suggesting that factors other than purely evolutionary considerations were involved. As noted above, there are different scales of change in LSA technology, namely innovative changes which mark the initial appearance of new items or new combinations of old ones, and post-innovative changes and it is important to differentiate between the two before attempting to identify their patterns of change.

Innovative changes

The use of the term Later Stone Age embodies the concept that the constellation of artefacts which make up LSA assemblages is

Table 66

Dating of occurrence x 1000 years B.P.	Polished bone points	Decorated OES	OES Beads	OES Water flasks	Grooved stones	Borers	Bored stones	Reamers	Painted stones	Engraved stones	Tortoiseshell bowls	Eyed needles	Bone fish hooks	Stone sinkers	Pottery
95	KRM	AP													
65															
45															
40	BC		BC				ZOM								
30			HK				BC LH		AP						
20	BPA		BPA				MAT								
19			AP												
18			HK NBC												
17															
16	P						N								
15		MHB	MHB		AP										
14		BPA	BPA	BPA		BPA	KAL				BPA				
13															
12	B														
11	NBC *	BY *	BY *	BY			MR			BAM					
10	*	* *	* *	MHB *						WK					
9	* *	*	*	*	P MR		*				P	B P			
8	*	* *	* *	* *											
7	* *	*	*	*			*		BPA						
6	*	* *	* *	* *	BUF MIR	* *			MR					NBC	
5	* *	*	*	*	*	*	*	G	KRM	WK WK		A			
4	*	* *	* *	* *		* *			ROB	WK				*	
3	* *	*	*	*	*	*	* *	GE DKF		WK	DK		BEL DRI		
2	*	* *	* *	* *	*	* *	*	AP	BPA		* *		COL	*	*
1	*	*	*	*		*	* *	*			*			*	* *

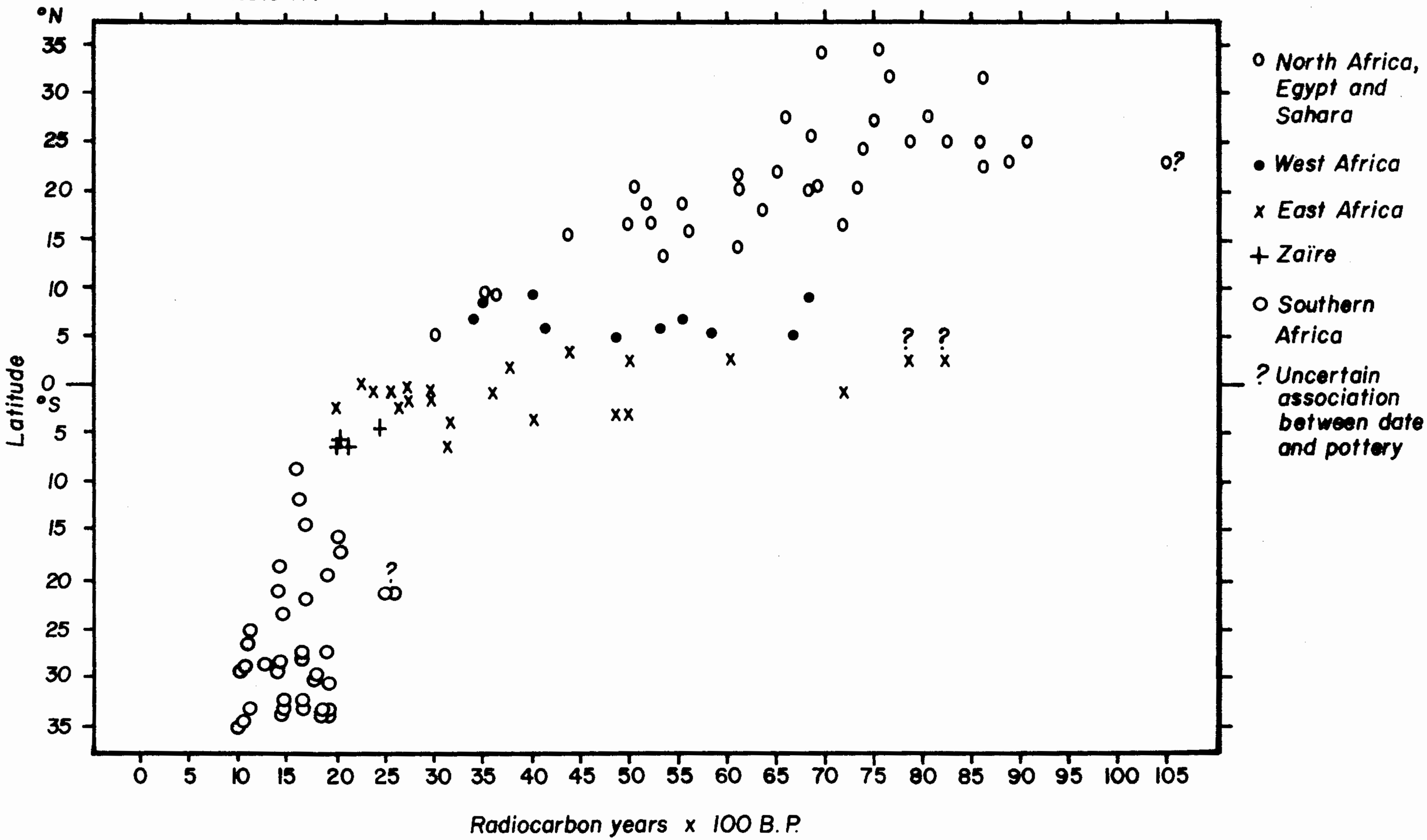
Earliest occurrences of innovations during the Later Stone Age in southern Africa. Site names underlined indicate Middle Stone Age associations. Asterisks indicate common or fairly common occurrence of item after initial appearance. Site names may be identified in Table 72.

different from that which would make up a Middle Stone Age one. The basis for the differentiation is the appearance in the archaeological record of a number of innovative items which fulfil the expectation of increasing complexity in technology. The bored stone was introduced as a digging stick weight, backed microliths were adapted for use as arrowheads, ostrich eggshell and marine shells were used for personal adornment while tortoiseshells and ostrich eggshells and, eventually, pottery were used as containers. These items brought with them specialized tools for their manufacture such as reamers and borers, and also made use of old tools in new designs such as scrapers and adzes which were now hafted, and a wider range of bone tools such as fish gorges and eyed needles. The innovations do not all appear simultaneously at the onset of the LSA as is clear in Table 66 and although some of them may have been developed independently in southern Africa, it is likely that many were derived from neighbouring regions to the north for they are all widely known in Africa and further afield. It is thus of little value to see the appearance of each of these items as a specific response to environmental change in southern Africa from the last glacial maximum through the Holocene, and indeed examination of Table 66 will show that there is no patterning, for example, in an increase in the number of new items at times of major environmental adjustment (compare Fig. 7). It is, however, useful to contrast the diachronic patterns of two innovations for which we have data to demonstrate the variability that may occur; these are pottery and the increase in formal tool frequencies during the Holocene that is assumed to herald the introduction of a new method of hafting which required smaller inserts and greater standardization.

Hodgen (1942, 1945, 1974) has studied the processes which underlie the spread of technological innovations in dated historical contexts. She notes that elements common to the spread of glass, paper, the printing press, windmills, watermills and Christianity in western Europe can be described as follows: (i) the initial innovations were in each case the unquestionable expression of individual initiative; (ii) the appearance of this individual initiative in secondary centres was from among people who were foreign or alien to the communities which ultimately accepted the changes; and (iii) the innovations spread through this initiative to urban environments that were within

FIG. 139

Early radiocarbon dates for pottery associated with Stone Age artefacts in Africa. Time (horizontal axis) is plotted against latitudinal position of the sites (vertical axis) to demonstrate the spread of pottery southwards. Dates are from Alessio et al (1978), Close (1980) and from lists published in the journal Radiocarbon up to 1982. Southern African dates are listed again in more detail in Table 77.

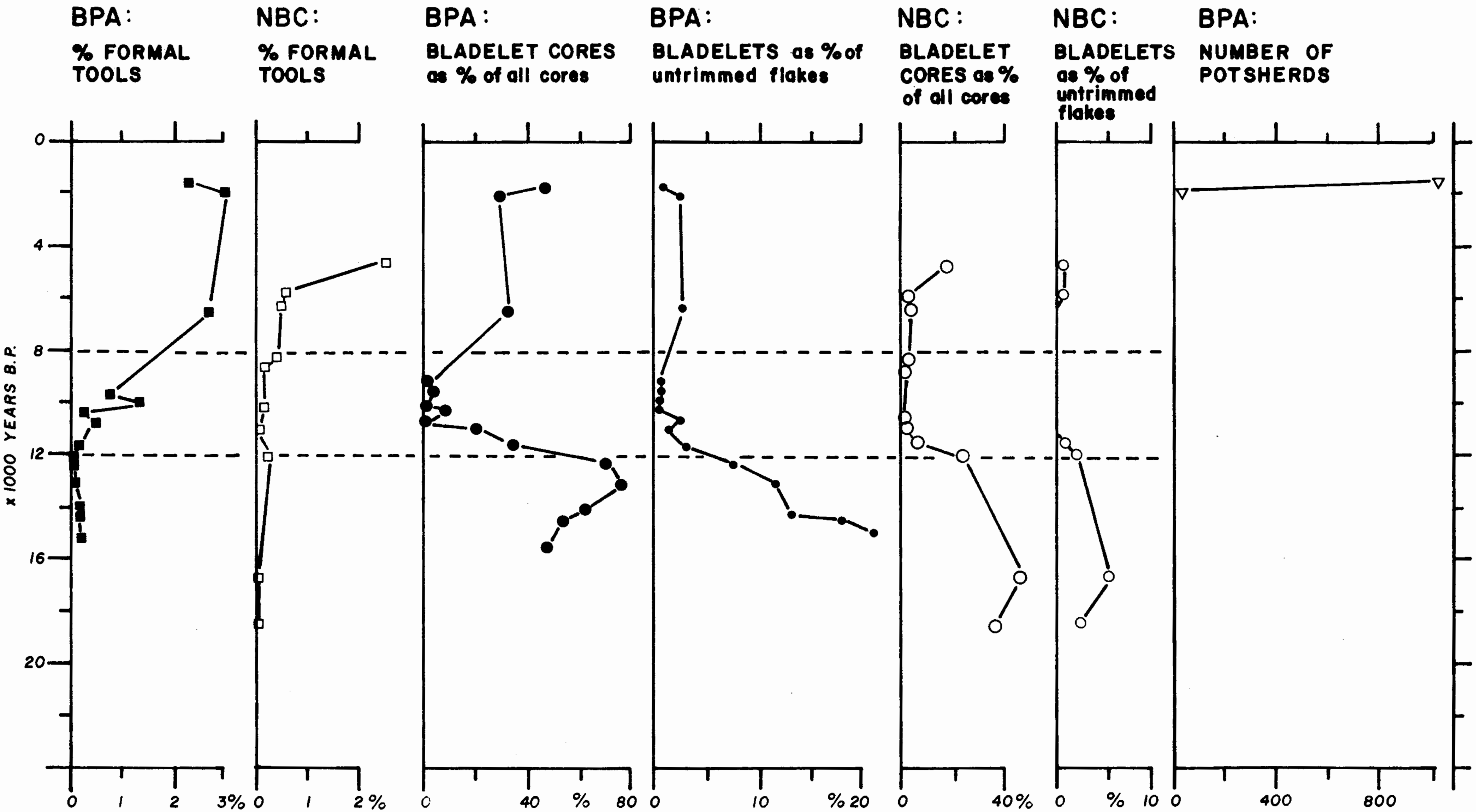


easy access to various means of contemporary communication (Hodgen 1974:72). The innovations and their subsequent spread were not the outcome of some natural principle of cultural growth or evolution, but were the consequences of personal effort by wandering or migrating initiators. The speed with which the innnovations spread is dependent on the motivation of the initiators and their disciples, the maturity of the communication network and the spatial distribution of the communities. The better the communication network and the closer the communities were to each other, the faster the diffusion process would have operated under enthusiastic initiators. Had the initiators lost momentum, the diffusion process would have halted until fresh enthusiasm started a further diffusion wave. From these observations we could hypothesize that very rapid diffusion of an item is likely to be the result of the movement of highly motivated immigrant individuals or groups, while slower movement would indicate either poor communications, dispersed populations or a break in momentum amongst the initiators, or all three. Other generalizations about more modern items such as tractors and washing machines (Hagerstrand 1967; Spratt 1982) identify other contributing factors which are unique to modern times and these have not therefore been considered.

The earliest dates for pottery in LSA contexts in Africa are plotted against their latitudinal positions in Fig. 139 to show that while it took about seven millennia for pottery to diffuse from 35°N to 5°S, on present evidence it appeared virtually simultaneously from 5°S to 35°S about 2000 years ago. The close correlation between early pottery and the appearance of domesticated sheep in South Africa (Table 77) has led to the assumption that both were introduced by immigrant herders who moved southward from Botswana after they had acquired sheep from their neighbours to the north and east. Certainly the speed with which the pottery was dispersed would support a migration hypothesis (see Chapter 7 for fuller discussion). The pattern of innovation and the speed with which pottery was introduced into the archaeological record is illustrated in Fig. 140 for the BPA data which demonstrate a virtual absence of pottery at the site 2000 years ago and its presence in some quantity 300 years later. The implications are that highly motivated immigrants brought sheep and pottery into the southern Cape and that they were not obstructed by unsuitable

FIG. 140

BPA and NBC: Changes through time in the frequency of items regarded as innovations in the artefact record of the last 20 000 years



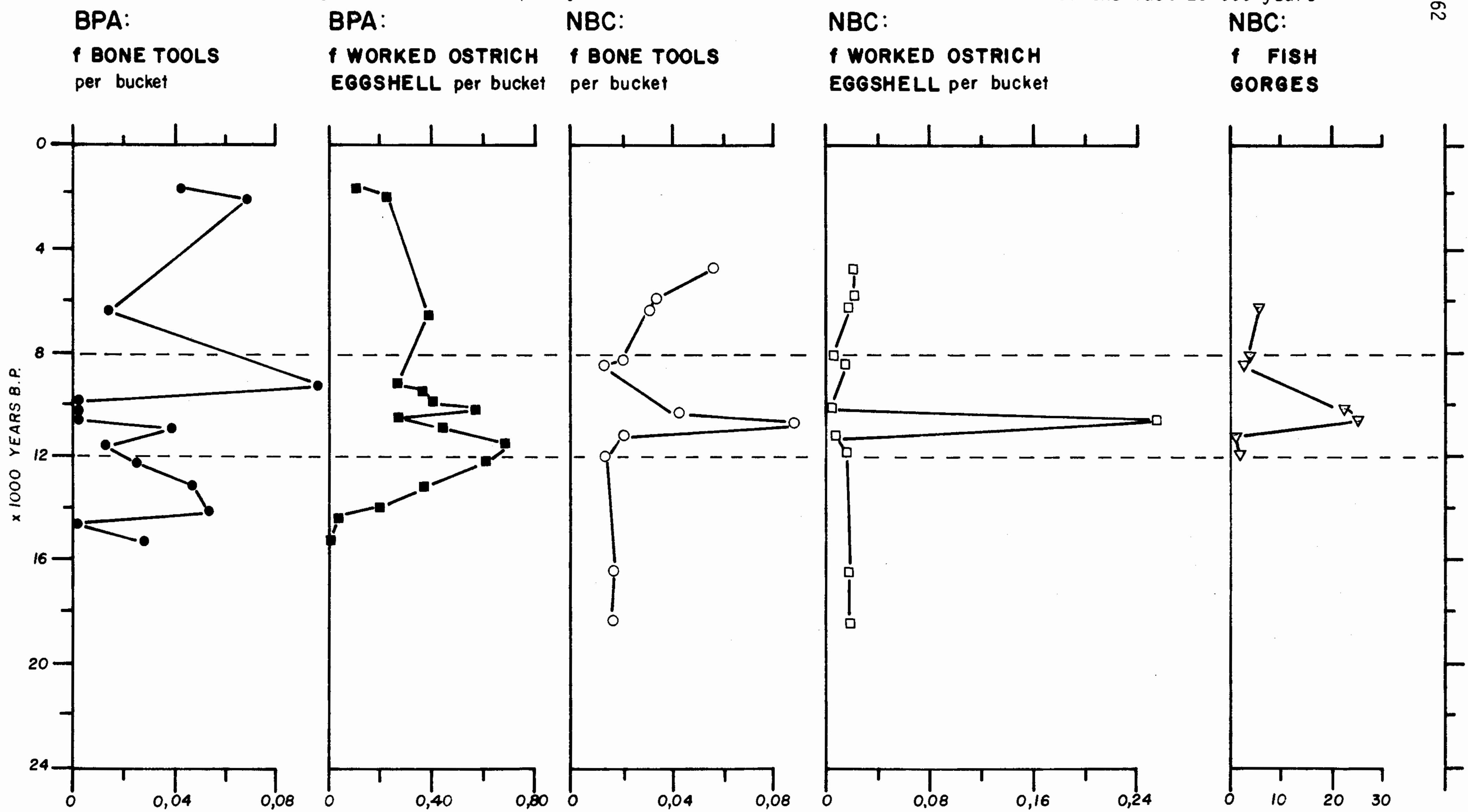
local conditions.

Fig. 140 illustrates the changes through time at BPA and NBC in the frequency of formal tools to demonstrate that at both sites there is a relatively sudden increase in the actual frequencies of these artefacts some 6500 years ago. The process in this case was different from that involved in the spread of pottery. While the latter represented an entirely new technological process that needed experienced potters to teach others, the formal tool increase meant the using of well established tool designs in new combinations so that the pattern of change through time is not one of presence/absence as in the case of pottery, but one of an increase in frequency. We have insufficient data to trace the geographic spread of this feature, but on present evidence (discussed in detail in Chapter 7), it seems that larger formal tool numbers were established in Zimbabwe from ca 10 000 B.P., in Namibia from ca 9000 B.P. and in the northern Cape at Wonderwerk from ca 8000 B.P. while in the southern Cape it dates from ca 6500 B.P. If these dates are substantiated by further research, it would seem that the diffusion time was much longer than that observed for pottery indicating that it was probably not the result of a population migration but of the borrowing of the idea of hafting along established lines of inter-group communication. Instead of the new ideas being promoted by individual innovators who were keen to spread their ideas and themselves, it appears to have been a case of gradual diffusion which took some 2-3000 years to spread from Zimbabwe to the southern Cape. Once introduced it was adopted rapidly because it did not involve the learning of a new craft so much as adapting and re-combining artefacts already known. The tracing of this innovation is in the increase in frequency of the formal tools and not in their presence or absence and any inter-regional comparisons should bear this in mind.

A third item which may be the result of an innovation process is bladelets and their bladelet cores that are so characteristic of late Pleistocene assemblages at NBC and BPA. Their diachronic patterns are illustrated in Fig. 140 to show that they too appear somewhat suddenly in the archaeological record but, with a longer time span involved, we can also see their later demise. The archaeological record is still too patchy to attempt a time/space reconstruction of the spread of these bladelet cores and bladelet production but it would seem to be more of a presence/absence innovation than one involving the adaptation of old ideas. Other presence/absence innovations would include

FIG. 141

BPA and NBC: Changes through time in the frequency of non-lithic items in the artefact record of the last 20 000 years



worked ostrich eggshell and polished bone tools (Fig. 141, Table 66). The variability in the frequencies of all these items after their initial introduction is typical of that documented for other innovations both prehistoric (Spratt 1982:87), early historic (Hodgen 1942) and modern (Hagerstrand 1967) but, as pointed out by Spratt (1982:87) and others, it is relatively easy to plot the appearance of an item through time, but it is far more difficult to identify the factors which affected its 'cash flow' or life history.

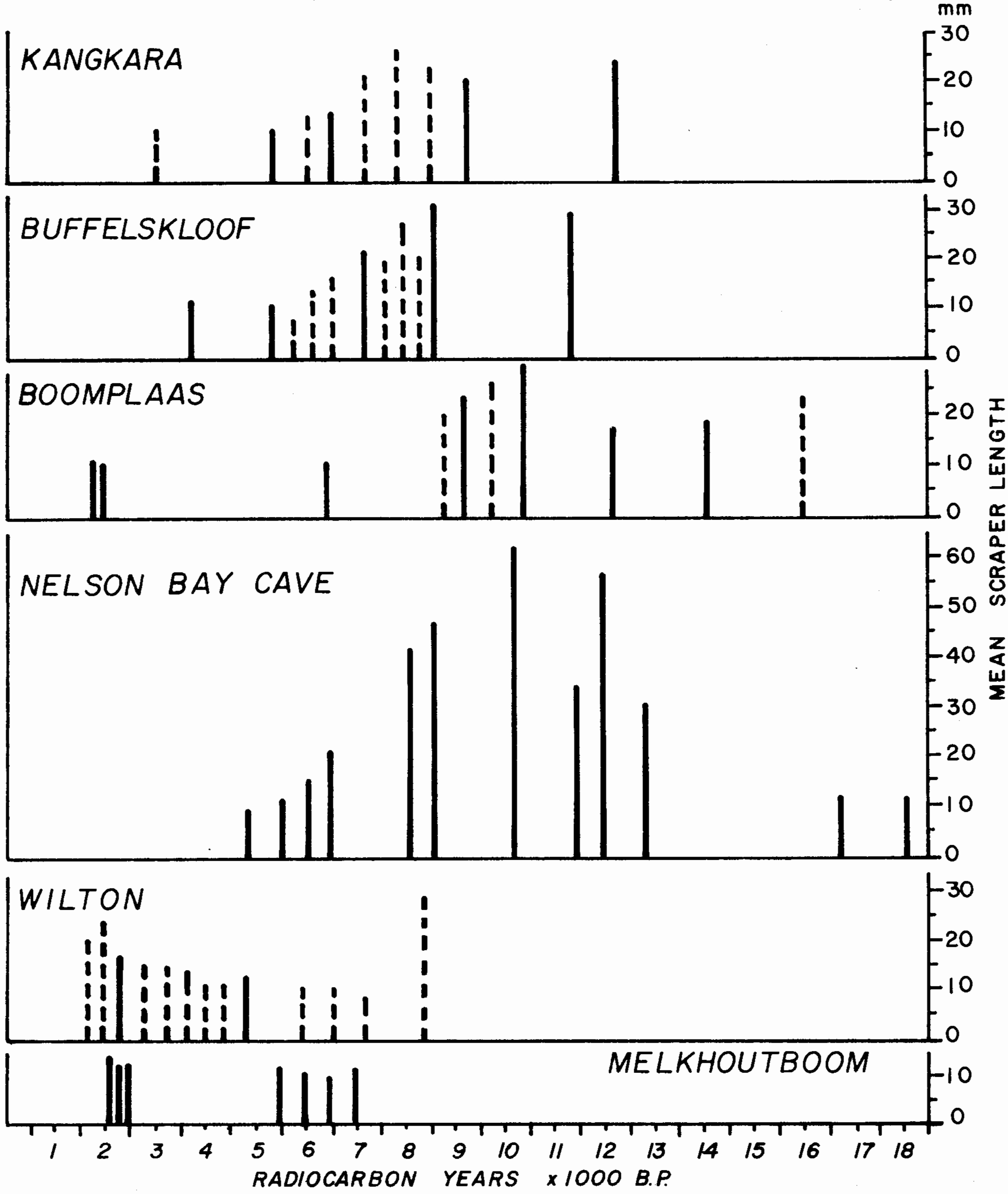
Post-innovative changes

Post-innovative changes can be measured either by the relative frequency of the items concerned, which will show production peaks and fall-offs and the eventual disappearance of the item, or they can show changes in the size, shape and raw materials of the artefact. While the former characteristics can be related to factors which operate to promote or discourage production and therefore concern the success of the item, the latter are related to questions of style. A number of researchers (for example, Sackett 1973:320; Thomas 1974; Pollnac & Rowlett 1977:170; Dunnell 1978:199) have noted that variables oscillating around a norm in a cyclic fashion usually have to do with the stylistic mode of the artefact because they can vary without affecting the primary function of the tool. Modern analogues can be seen in the changes in women's dress design (Richardson & Kroeber 1947), in gravestones (Dethlefsen & Deetz 1966) and grandfather clocks (Hughes 1963) and in prehistoric items such as projectile points (Binford 1963). In each of these cases there is no doubt that the function of the item remained constant as stylistic aspects changed through time.

As has been shown in Chapter 5, the size and shape of scrapers changed through time at all three sites (NBC, KRA and BPA) and other sites in the southern Cape are added for comparison in Fig.142 to demonstrate that they also follow the same general pattern of change in scraper length. Time trends in width, w/l ratio and height can be seen in Figs 70, 71, 77, 78 and 84 to follow broadly those of length, except that the shape of the scrapers (as evident from the w/l ratio) shows greater variation at NBC. We would therefore suggest that changes in the style of scraper manufacture show a regional trend through the last 20 000 years in the southern Cape with short, round and high scrapers as well as a few very large D-shaped ones are characteristic

FIG. 142

Changes through time in the mean length of scrapers at six southern and eastern Cape sites. Solid lines indicate samples with associated dates, dashed lines indicate interpolated dates.



of late Pleistocene assemblages to ca 12 000 B.P., longer wider and more elongated forms predominate between ca 12 000 and 7000 B.P. with a relatively high frequency of end scrapers with side retouch or blank preparation between 9000 and 7000 B.P., and the shortest, narrowest and flattest forms predominate between ca 7000 B.P. and the end of the LSA record. There is a variation in the eastern Cape, however, with end-Holocene samples at Wilton and Melkhoutboom tending to be longer than those of the mid-Holocene and this trend is further exaggerated in the Middle Orange River area within the last 2000 years (Sampson 1972).

To be sure that these changes in size and shape are indeed stylistic and that the different shapes and sizes were not functional adjustments to changed goals, the functional integrity of the scraper class needs to be established. This can be done both by the definition of a scraper in terms of its working edge morphology rather than its size and shape (Appendix 1) and by microwear analyses. Binneman (1982) has shown that scrapers from all members at BPA share the same microwear pattern consistent with their having been used for working skin and leather. Scrapers are not unique to the LSA and a pattern of oscillatory or cyclic changes could be demonstrable in scraper parameters from the earliest Oldowan scrapers (Leakey 1971) through to those of the LSA, although long-term changes have also occurred in the morphology of the working edge over the last 2 million years. Variations noted within the LSA timespan include greater standardization of the retouched edge, the use at one time of what appears to have been bladelet cores as scrapers, the addition of some very large scrapers in the repertoire and the addition of what may have been adze retouch down the sides of elongated scrapers. The variability has not, however, changed the fact that both the morphology of the working edge and the microwear evident on these edges has remained essentially constant over the last 20 000 years. Thus variations in size and shape are seen as stylistic rather than functional. Function may be involved at a secondary level, however, in features of scrapers that were designed to facilitate hafting. Thus the adze-like retouch and blank shaping of early Holocene end scrapers may be such a functional feature as is the reduction in size and standardization of mid-Holocene scrapers seen as the result of a different hafting method.

FIG. 143

Changes through time in the mean lengths of untrimmed flakes and scrapers at NBC and at BPA

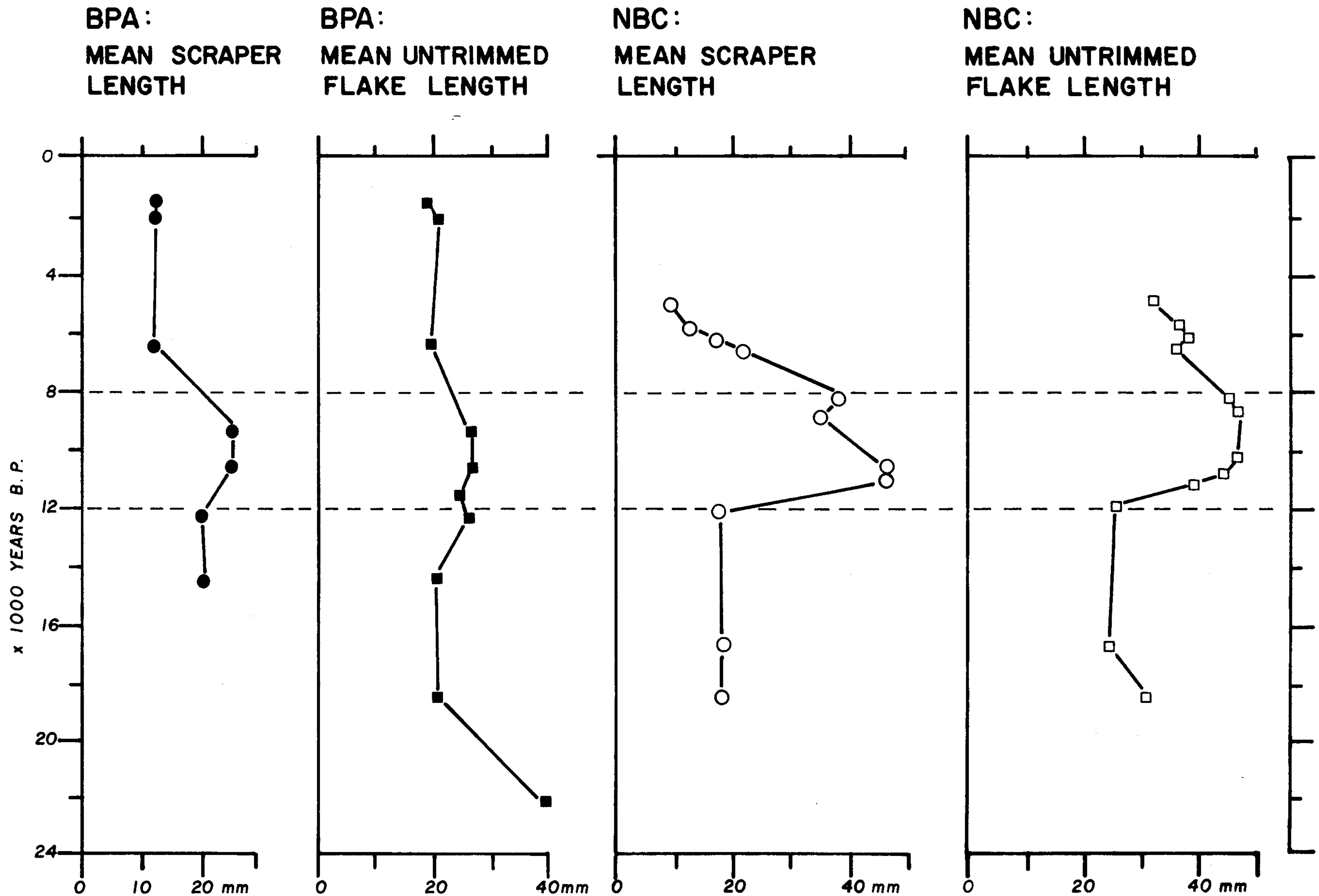


FIG. 144

Changes through time in the incidence of untrimmed flakes, quartz and quartzite at NBC and BPA

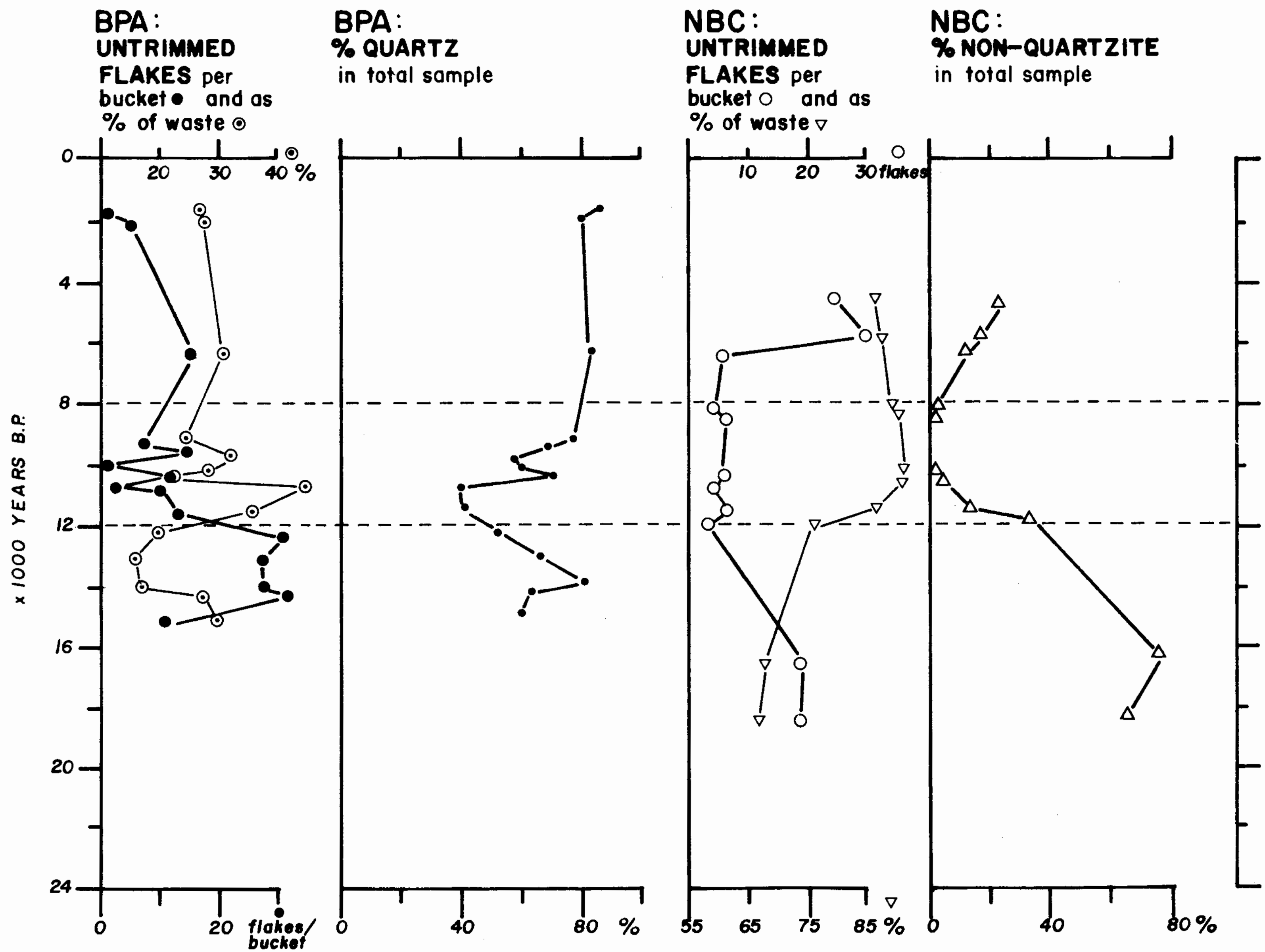
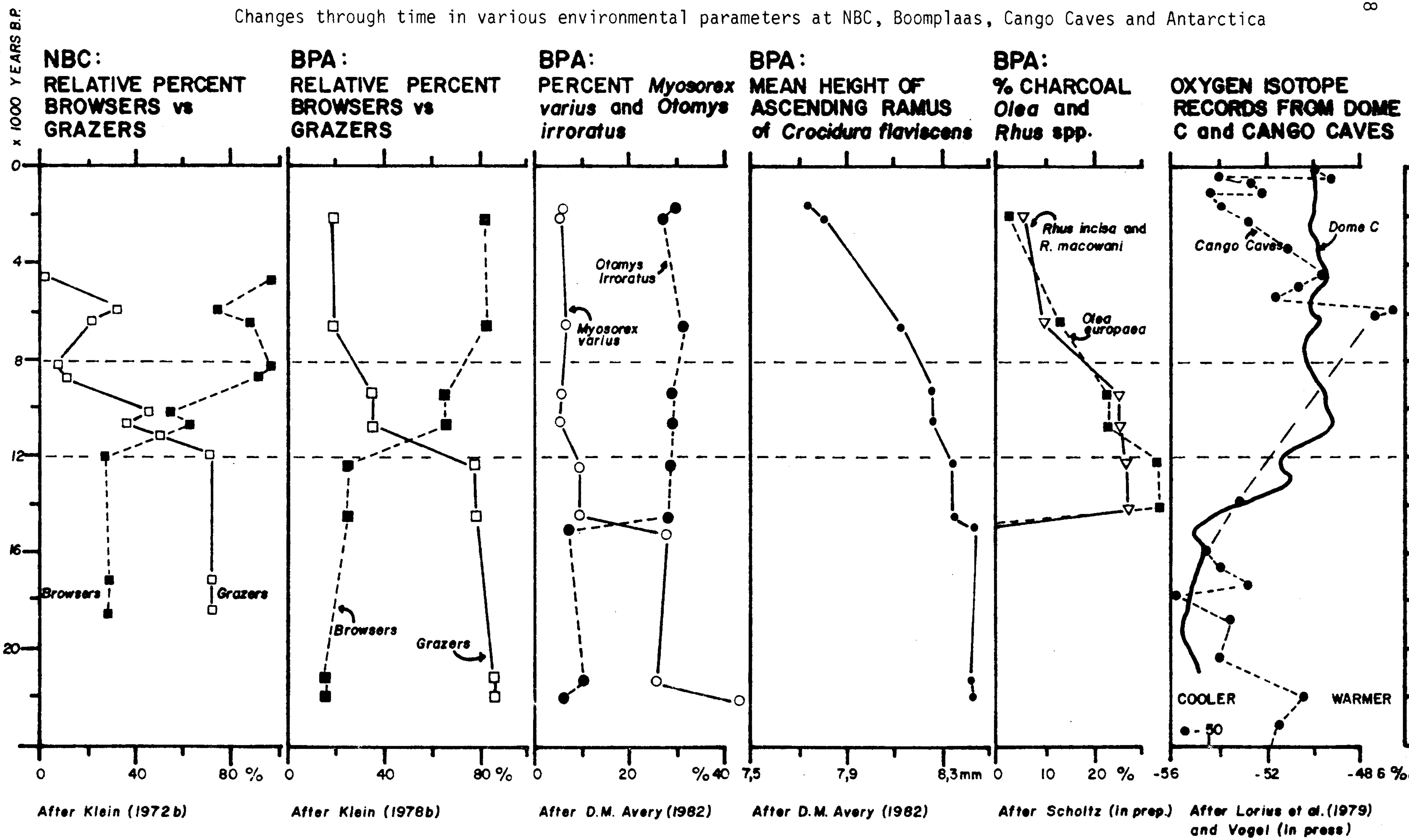


FIG. 145

Changes through time in various environmental parameters at NBC, Boomplaas, Cango Caves and Antarctica



Other artefacts which show similar oscillations in size and shape are untrimmed flakes (Fig. 143) in which the function of the tool is again considered to have been held constant. However the complex interrelationship of variables is shown in the changes in percentage frequencies of raw materials(quartz at BPA and non-quartzite at NBC are illustrated in Fig. 144) and gross frèquencies of untrimmed flakes which show that in samples with longer flakes these tend to be made on materials which yield larger nodules and correlate with fewer flakes per bucket between 12 000 and 8000 B.P.

Comparison between the changes expected in LSA technology from principles derived from modern technology has shown that macro-evolutionary changes in the form of innovation towards more complex artefacts, smaller tools and greater standardization do occur, but at the micro-evolutionary scale of post-innovative changes in the style of manufacture of some artefacts there is a marked oscillation between 12 000 and 8000 B.P. which interrupts the expected flow of change. Thus, while we can explain the direction of many of the changes through time in the LSA as the 'natural' result of technological development, we need to find a correlate for the stylistic variations that have been observed.

COINCIDENCE OF ARTEFACT AND ENVIRONMENTAL CHANGES

Fig. 7 is reproduced as Fig. 145 to demonstrate the timing of changes in environmental variables over the last 20 000 years in the southern Cape. Horizontal lines have been drawn across this figure and Figs 140, 141, 143 and 144 to demonstrate that the period of maximum change in the larger mammal faunas, between ca 12 000 and 8000 B.P., is also the period of maximum change in many of the artefact variables, particularly those involving post-innovative changes in the frequency, size and shape of the artefacts. These stylistic shifts are not apparently related to specific climatic/environmental characteristics because smaller scrapers, for example, are not consistently covariant with the hunting of smaller bovids nor with a particular climatic regime. There was a time lag of about 2-4000 years between the major shifts in vegetation and climate in the southern Cape (as evident from the changes in wood charcoals, pollens and micromammalian fauna) and a major shift in hunting pattern at the end of the Pleistocene. The technological response follows the timing of the change in the larger mammals or just pre-dates it and takes the form of an increase in the size of untrimmed flakes and scrapers together with a change in the choice of raw materials towards those that were found in larger nodules, and a marked reduction or cessation in the making of bladelets from bladelet cores. After 8000 B.P. these apparently regressive tendencies were reversed with the introduction of hafting smaller formal tools that was accompanied by an increase in formal tool numbers and classes and a decrease in the size of both untrimmed flakes and scrapers that was broadly coincident with a change in raw materials towards finer grained materials in smaller nodules. This return to the general evolutionary trend was not this time accompanied by a second change in the large mammal fauna, however, but apparently only by the spread of the Holocene hafting tradition. Similarly, the social changes at the end of the Holocene which must have been generated by the spread of herding and pottery were also not clearly associated with environmental changes for their spread pre-dates the cooler conditions of the 'Little Ice Age' by several hundred years.

The secular trends or cyclic oscillations in the lengths and other parameters of untrimmed flakes and scrapers follow a similar pattern to that observed in European dress fashions of the last three centuries (Richardson & Kroeber 1947) although the periodicity of the changes in the case of stone artefacts is in the region of four thousand years and that for dresses in the region of one hundred years. The interpretation of the latter changes by Richardson & Kroeber (1947: 149) are nevertheless of particular interest for they conclude that:

> "The best explanation that we are able to suggest for these phenomena is that of a basic pattern of women's dress style, toward which European culture of recent centuries has been tending as an ideal... As these proportions are achieved, there are equilibrium, relative stability and low variability. The pattern may be said to be saturated. At other times, most or all of the proportions are at the opposite extreme, which may be construed as one of strain, and variability rises high...Generic cultural or historic influences can ... be assumed to affect dress-style changes. Sociocultural stress and unsettlement seem to produce fashion strain and instability. However, they exert their influence upon an existing stylistic pattern, which they dislocate or invert."

FIG. 146

BPA: Changes through time in the density of bone and stone artefacts/bucket

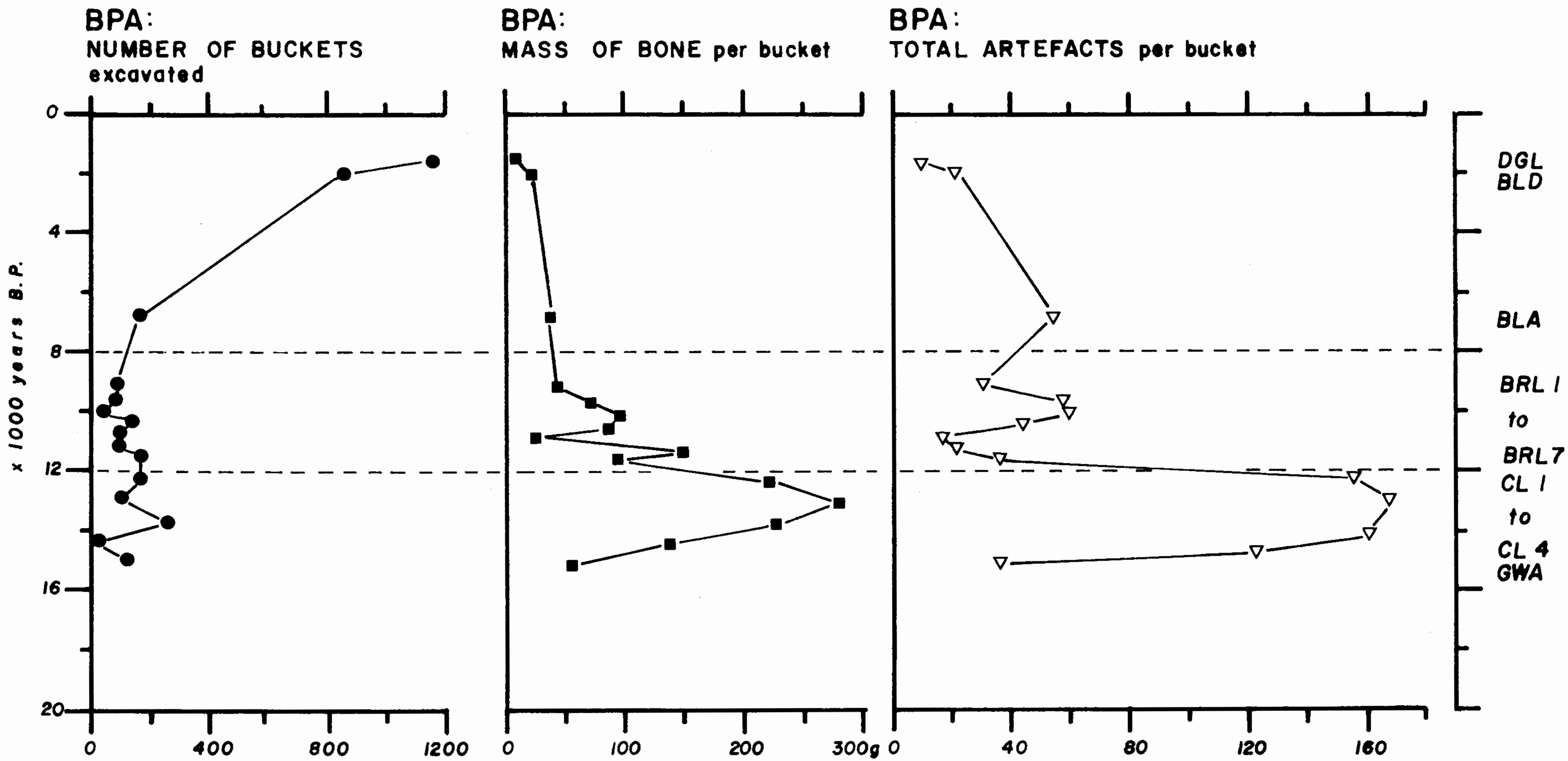


FIG. 147A

BPA: SCATTER DIAGRAM SHOWING A LINEAR CORRELATION BETWEEN THE TOTAL ARTEFACTS/BUCKET AND THE MASS OF BONE/BUCKET

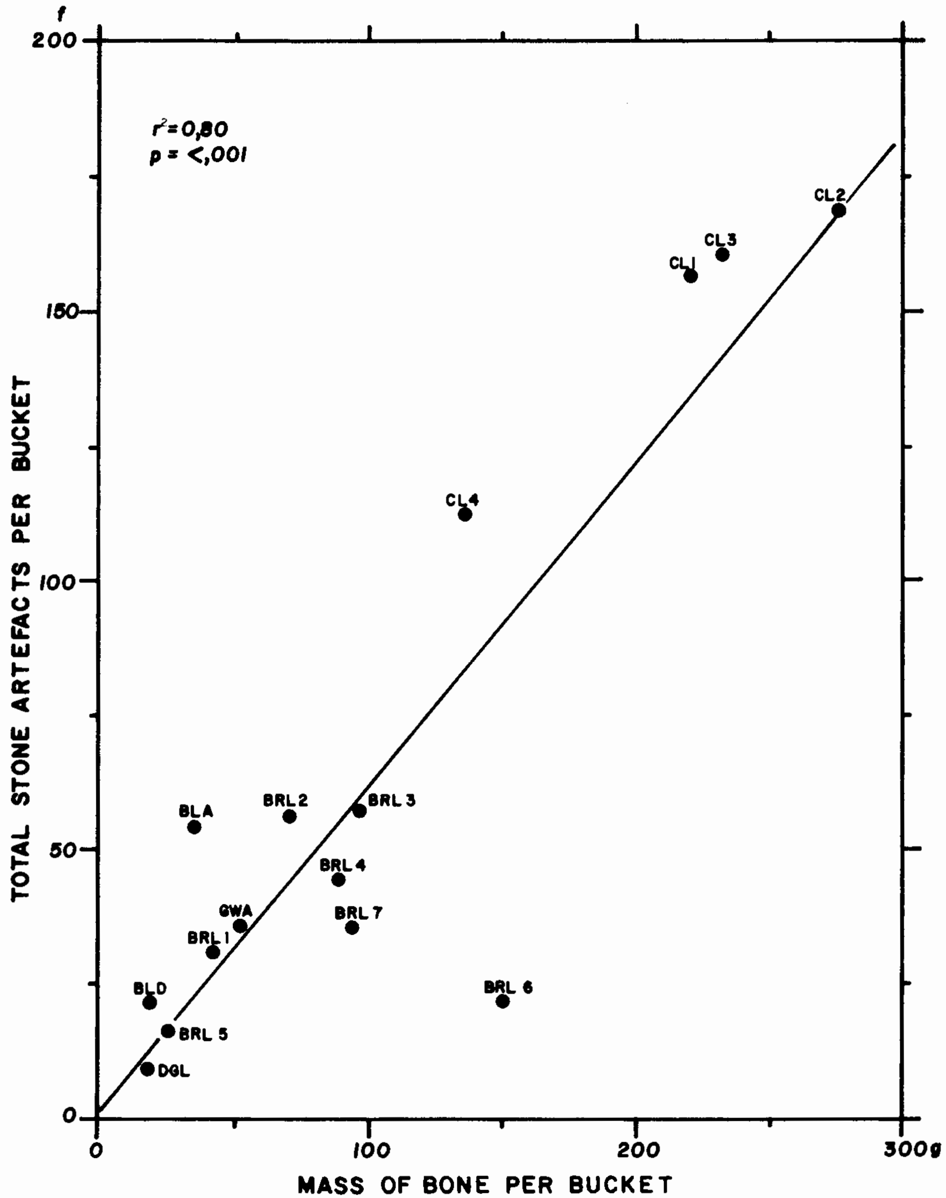
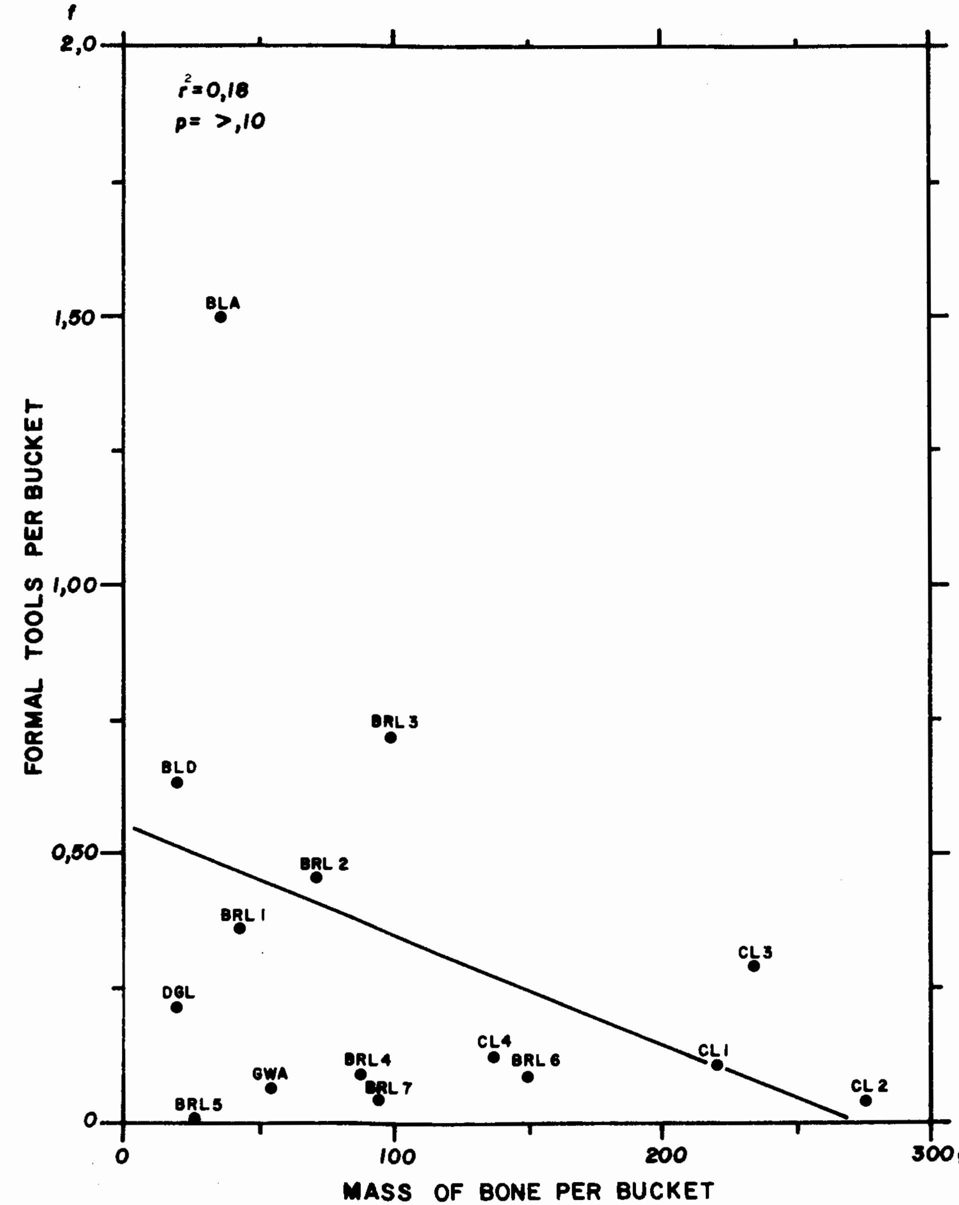


FIG. 147B

BPA: SCATTER DIAGRAM SHOWING NO LINEAR CORRELATION BETWEEN THE NUMBER OF FORMAL TOOLS/BUCKET AND THE MASS OF BONE/BUCKET



Thus the changes we see in the untrimmed flake and scraper lengths are considered to be stylistic ones where sociocultural change generated by environmental shifts and changes in the availability of larger mammals disrupted the prevailing style of artefact manufacture, but did not determine the scraper design per se. The data presented here are an indication of the scale of dislocation generated within a technological system at a time of economic and social adjustment and are thus comparable to the dress style data in documenting long-term secular trends that are generally not observable in the modern idiom.

In response to a suggestion by L R Binford that the increase in formal tool frequencies in the mid-Holocene may have been the result of an effort on the part of the toolmakers to increase production in the face of reduced hunting potential, the mass of bone in each unit at BPA was calculated (Fig. 146, Table 67) and plotted against the incidence of stone (Fig. 147) and formal tools (Fig. 148). While there is a good linear correlation between the incidence of bone and stone (r=0,08; p=less than .001), there is no relationship between the amount of bone and the incidence of formal tools indicating that the production of formal tools had no correlation with the quantity of bone brought back to the site. The member with the highest incidence of formal tools, however, also had one of the lowest amounts of bone (BLA) which may be construed as supporting the hypothesis, but the occurrence in BLA of charcoal-filled pits has been cited as evidence for specialized use of the site at that time. To resolve this point data from other sites of similar age are needed. Data on the mass of bone from NBC were not available, but the minimum number of individuals per unit was plotted in Fig. 148 and again shows a close correspondence between the incidence of bone and stone although it should be noted that the larger number of individuals in the Holocene is the result of hunting smaller bovids so the totals are not directly comparable with those of the late Pleistocene.

Changes through time in the bone and stone at NBC and BPA show that both decreased in frequency between 12 000 and 8000 B.P. relative to the preceding and succeeding periods and that the meat yield in a Holocene unit was well below that of a late Pleistocene one. There is little doubt that meat was not as important a source of food to Holocene peoples at BPA and NBC as it had been during the late Pleistocene and

Table 67. Boomplaas A : Mass of bone and number of artefacts per bucket of deposit excavated. ($^{+}$ DGL buckets calculated on occupation deposit only and does not include layers of burnt sheep dung. Buckets including dung = 3219,35)

	DGL	BLD	BLA	BRL 1	BRL 2	BRL 3	BRL 4	BRL 5	BRL 6	TOTAL BRL	BRL 7	CL 1	CL 2	CL 3	CL 4	GWA	TOTAL CL
Total mass of unidentifiable bone in grams	22206	16643	5392	3407	5844	2633	12264	2695	15317	42161	15941	35030	24724	57866	3305	5564	143430
Number of buckets of deposit excavated	1156^{+}	849,8	160,5	83,4	82,8	27,0	140,0	106,0	101,8	541,0	170,5	158,3	89,3	247,7	24,0	105,1	694,9
Mass of bone/bucket	19,2	19,6	33,6	40,9	70,6	97,5	87,6	25,4	150,5	77,9	93,5	221,3	276,8	233,6	137,7	52,9	
Total stone artefacts	10896	17901	8739	2505	4758	1546	6211	1749	2247	19016	6245	24970	15139	39762	2731	3790	92637
Number of artefacts/bucket	9,4	21,1	54,5	30,0	57,4	57,3	44,4	16,5	22,1	35,2	36,6	157,8	169,5	160,5	113,8	36,1	
Number of untrimmed flakes/bucket	2,3	5,4	15,9	7,0	14,9	18,2	12,1	3,5	9,6	9,9	12,6	30,7	26,6	27,7	30,9	10,5	
Number of formal tools/bucket	0,2	0,6	1,5	0,4	0,5	0,7	0,09	-	0,09	0,2	0,04	0,1	0,04	0,3	0,1	0,06	

FIG. 148

NBC: Changes through time in the density of artefacts and bone/bucket

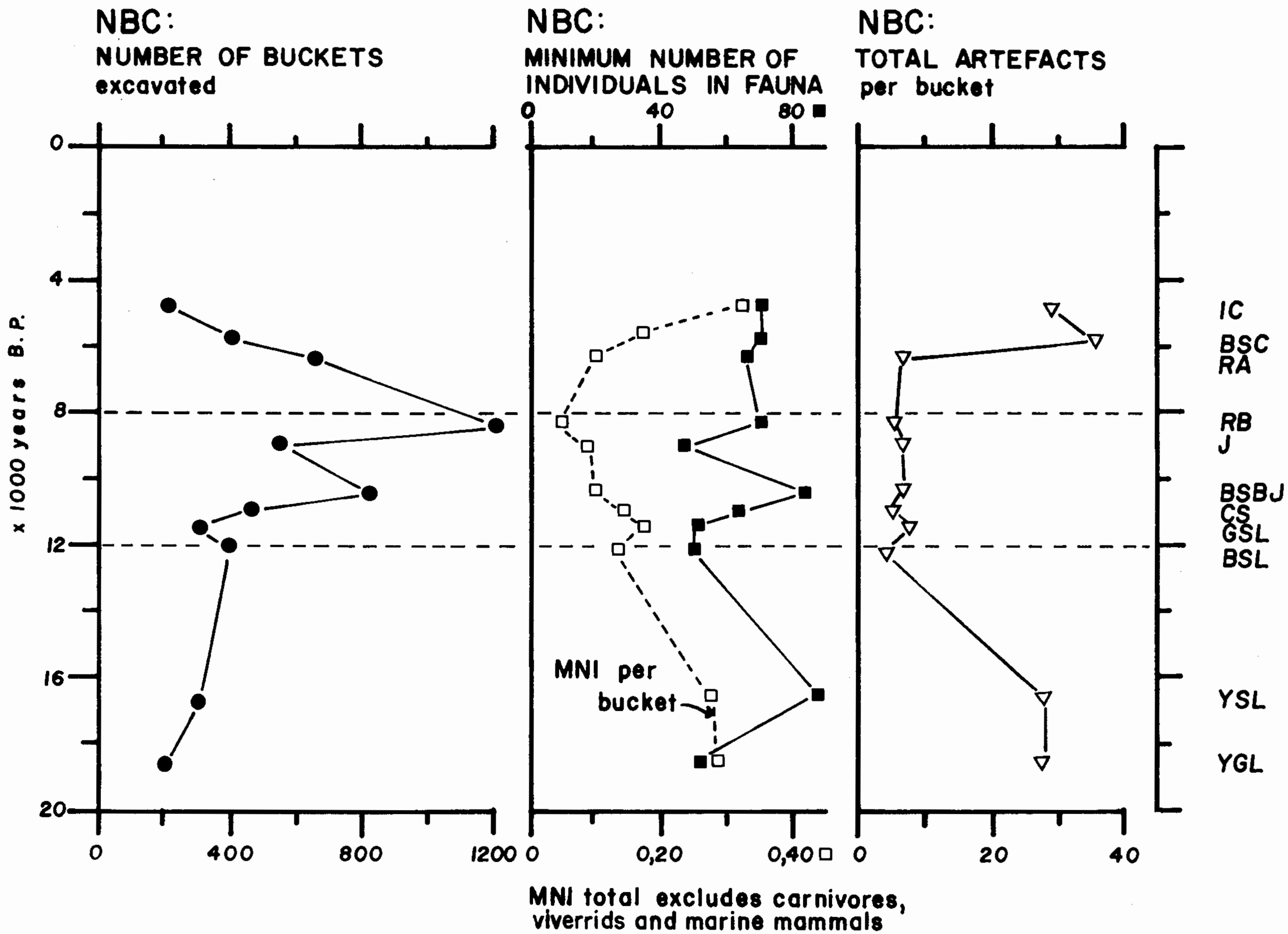
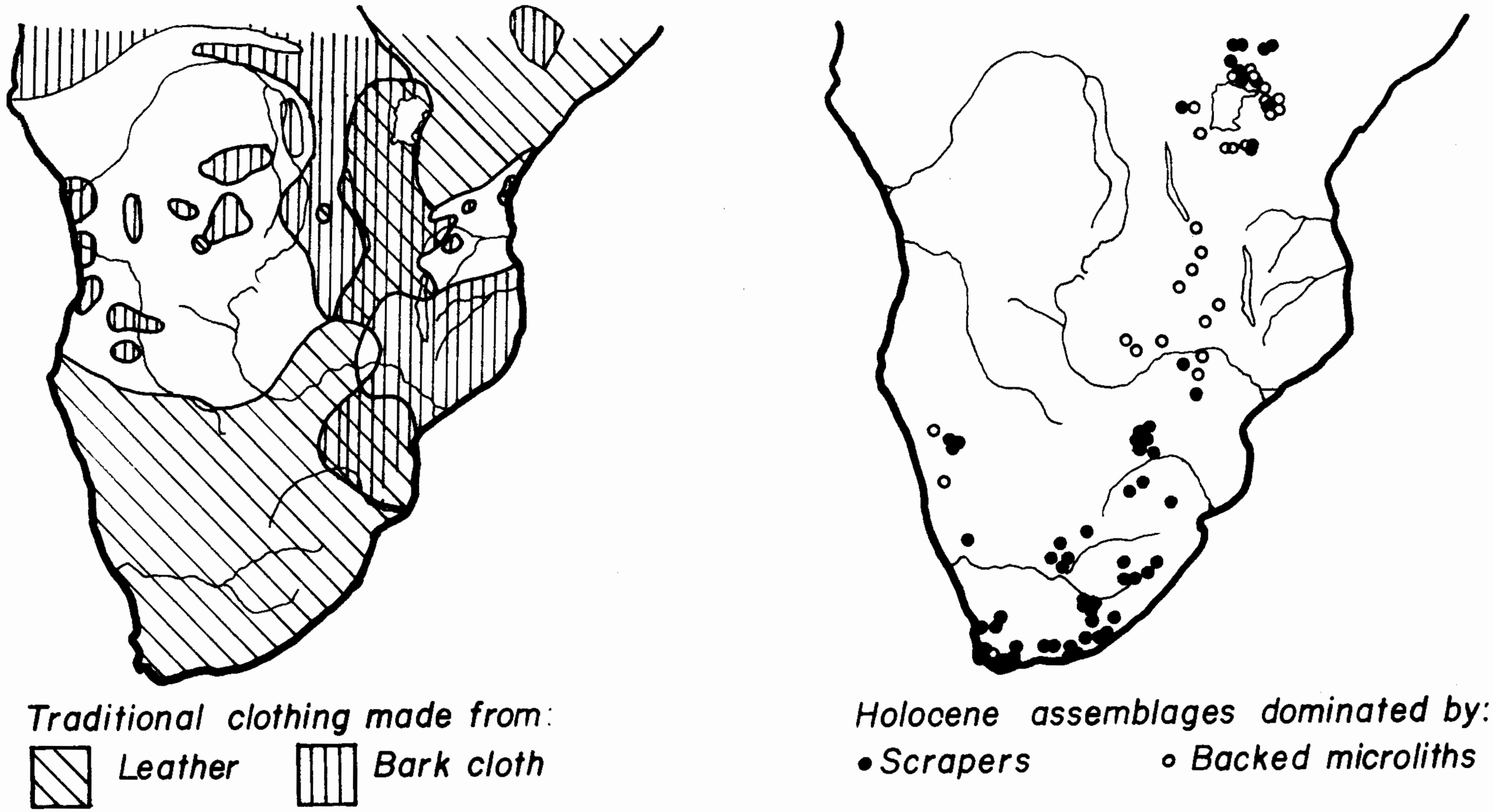


FIG. 149

Distribution of traditional clothing materials, either bark cloth or leather, in sub-Saharan Africa (A) after Von Boeckmann (1921) compared with the distribution of Holocene assemblages dominated by scrapers or backed microliths (B). Data are from sites plotted on Fig. 156, as well as from Inskeep (1959) for the Zambesi Valley, Clark (1974) for Kalambo Falls, Merrick (1975) for East Africa, Nelson (1976) for East Africa and Masao (1979) for Tanzania. Note: scraper counts exclude notched and hollow scrapers which are considered to relate more to the adze class than to scrapers used for skin working.



we may assume that gathered plant and marine foods played a more important role in the diet of Holocene populations than they had before. The period between 12 000 and 8000 B.P. was clearly crucial for establishing this new pattern.

In summary, innovative changes, i.e. those resulting from the dispersion of predictable advances in technological evolution, are less sensitive to environmental change than are post-innovative stylistic changes which appear to be triggered by sociocultural instability. Further variability may also be induced between contemporary assemblages, however, by geographic factors and some of these non-diachronic patterns are discussed below.

SOME NON-DIACHRONIC CHANGES THAT MAY CAUSE VARIABILITY

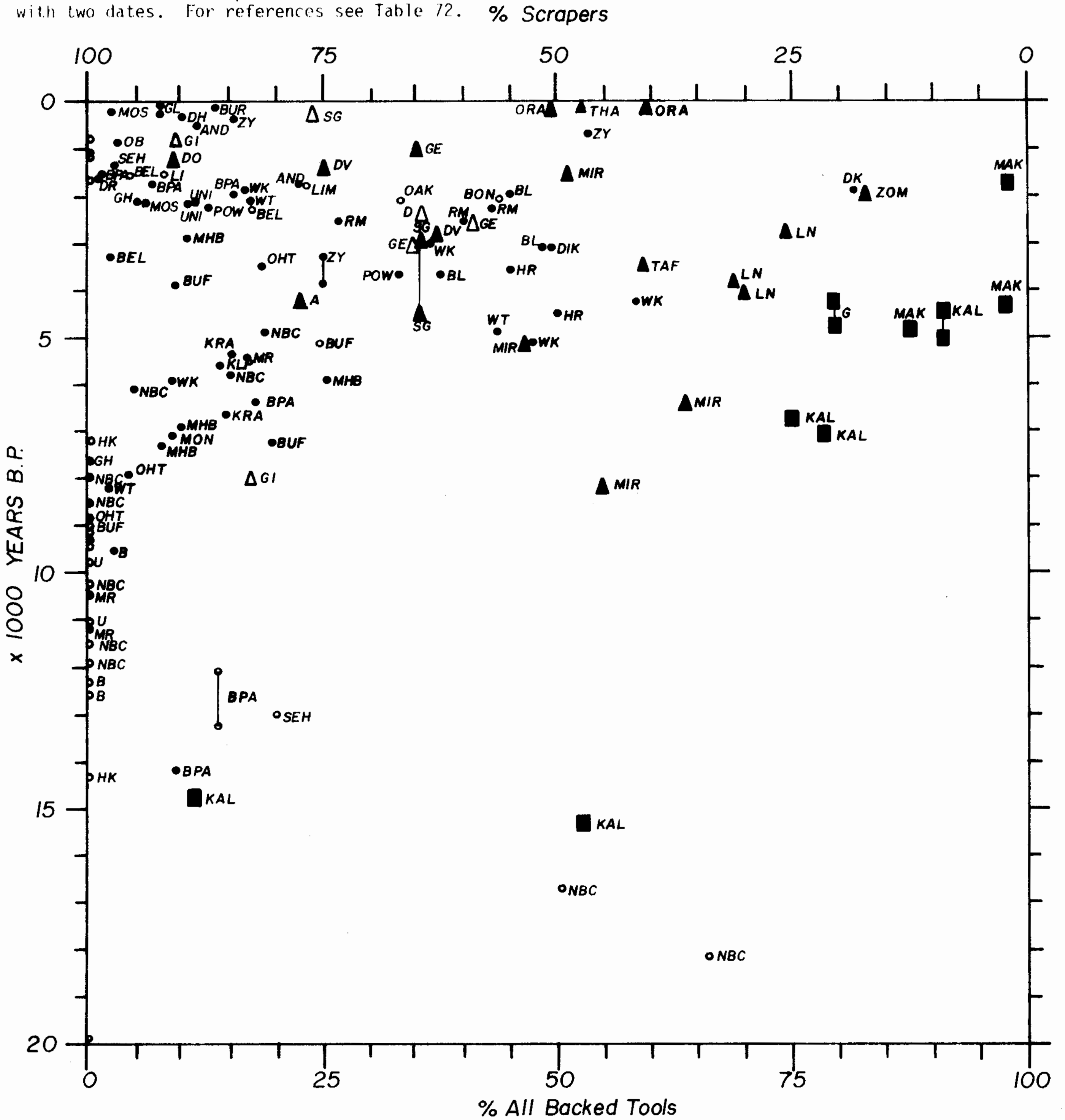
Although the focus of this study has fallen on diachronic change, there are some spatial patterns in the southern African LSA that are local or regional responses which have introduced variability amongst contemporary samples either in the frequency of artefact classes or in stylistic attributes.

Differences in relative frequency

Gross differences have been noted in the past between the relative frequencies of scrapers and backed tools in northern Zimbabwe, northern and central Namibia and Zambia on the one hand, and southern Namibia, southern Zimbabwe and South Africa on the other, the former having consistently higher frequencies of backed microliths (Deacon, H.J. 1972, 1976; Deacon, J. 1974; Nelson 1976; Phillipson 1976, 1977; Wadley 1979; Deacon & Deacon 1980). This requires some explanation beyond a stylistic one, although style may be involved, for example, in the ways in which the backed microliths were mounted. Phillipson (1976, 1977) has presented reconstructions of the mounting of backed microliths in Zambia based on finds of a few mounted specimens and others with mastic adhering to them which suggest their use as barbs, multiple component cutting tools and armatures. There is in addition ethnographic evidence for the more frequent use of barbs on iron arrows and spears made in Zambia than was common to the south (Frobenius & Von Wilm 1921) and if these designs were adapted from earlier LSA ones, it may in part explain the high incidence of discarded backed microliths in Zambia where many more were needed per artefact than to the south where barbing

FIG. 150

The relative frequency of scrapers vs all backed microliths plotted against time in radiocarbon-dated assemblages from southern Africa. A few examples from Zambia (solid squares) are included for comparison. Circles = sites in South Africa; triangles = sites in Namibia and Zimbabwe. Solid symbols = samples with more than 25 scrapers + backed microliths combined; open symbols = samples with less than 25 scrapers and backed microliths. Symbols joined by a vertical line indicate samples with two dates. For references see Table 72.



Samples on left-hand margin not labelled through lack of space are, from top to bottom: BEL, MG, DF, BPA, BPA, WK, BPA, HK.

was rare.

In contrast to the backed microliths, scraper frequencies in areas of northern and central Namibia, northern Zimbabwe and Zambia are low both in relative and absolute terms. To the south, however, they are much more abundant and are in addition more standardized in size and shape. Scrapers are known from historic records (Kannemeyer 1890) and from replication and microwear studies (Binneman 1982) to have been used mostly for skin working and similar tools are still in use today as skin scrapers in Ethiopia (Gallagher 1977). In maps prepared from ethnographic data gathered in the first two decades of this century under the direction of Leo Frobenius, it is shown (Fig. 149) that clothing was made exclusively from leather in most of South Africa, Namibia, Botswana and Zimbabwe, but in Mozambique, parts of northern and eastern Zimbabwe, Malawi, eastern Zambia and parts of western and eastern Africa, the preferred material for clothing was bark cloth. The distribution of higher frequencies of scrapers in Holocene assemblages corresponds closely to the distribution of leather clothing (Fig. 149) and is low in areas where bark cloth was made (Von Boeckmann 1921; Deacon & Deacon 1980). While there are problems with measuring these differences by comparing the frequencies of the one formal tool against the other, it is clear that even when the gross frequencies (rather than relative frequencies) are compared, the same pattern emerges (Deacon, H.J. 1972: fig. 3). Either way these comparisons demonstrate that functional correlates can be sought in ethnographic data to explain, at least in part, anomalies in the spatial patterning of LSA artefacts.

At a local level, the relative frequencies of scrapers, backed microliths and adzes in the western Cape have led Mazel & Parkington (1978, 1981) and Parkington (1980) to suggest that high adze frequencies at late Holocene mountain sites are the result of more intensive wood-working activity in that area partly because of the availability of wood there and partly because the stony ground increased the need to sharpen digging sticks. In the southern Cape the absence of adzes at the coastal site of NBC and their presence inland at Kangkara and BPA would support the expectation that adzes would be more common at mountain sites, and a similar case has been made for the occurrence of spoke-shaves (notched scrapers) in Natal (Cable et al 1980). Grosser southern African patterning of high adze/notched scraper frequencies has been remarked on by Clark (1959:215) who notes their higher frequency in wooded regions of Zambia, Zimbabwe and Natal than in the grassland regions of southern Africa.

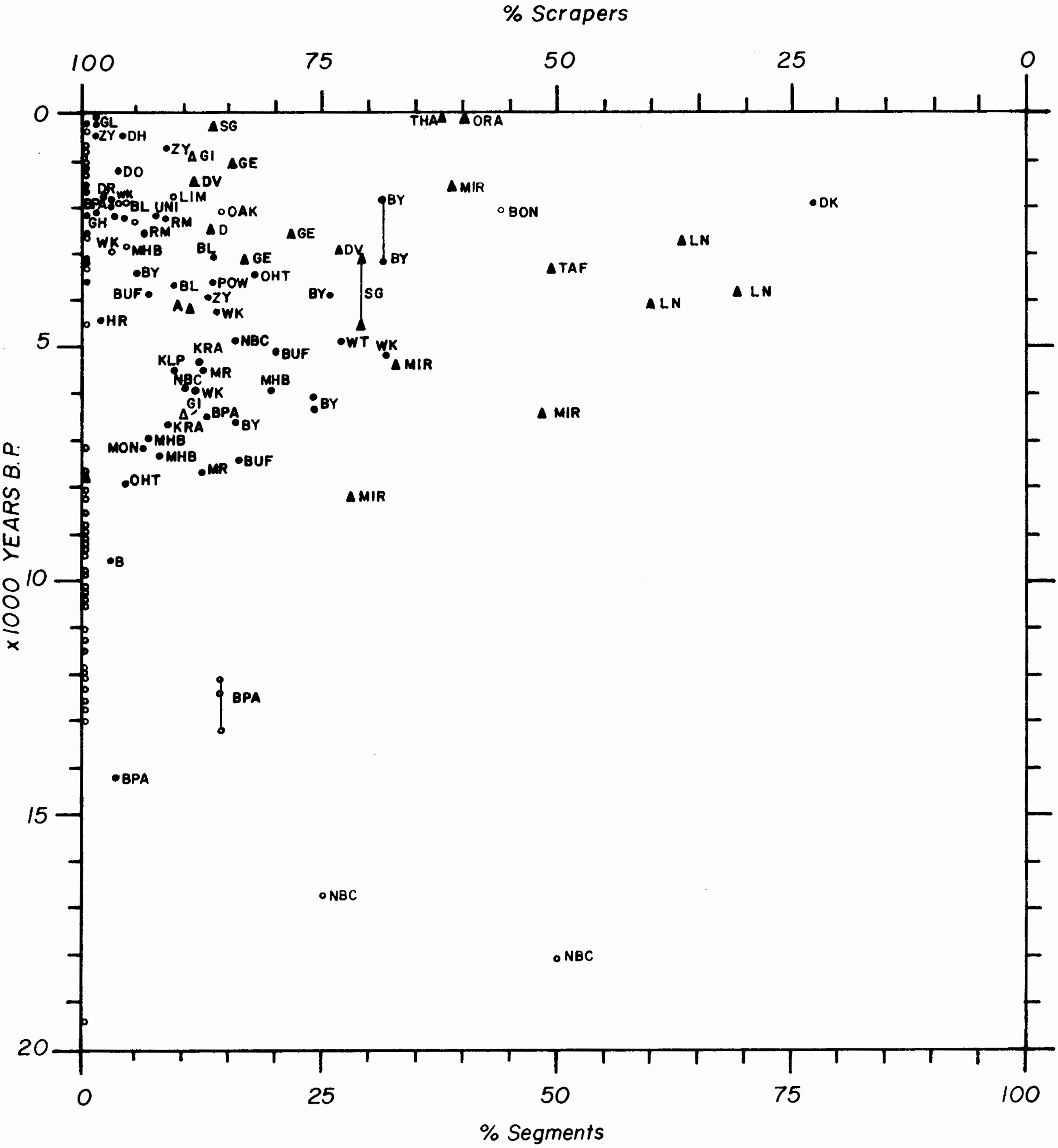
The patterning between contemporary sites in different settings has to be taken into account where artefact frequencies at different sites are being evaluated. It is clear that a knowledge of both the diachronic and synchronic (spatial) patterning in a region is essential for the understanding of inter-site variability, the extent of which is illustrated in Figs 150-152 which summarize the relative frequencies of scrapers, all backed microliths, segments and other backed tools at a large number of dated occurrences in southern Africa. They show that while there are generalized trends through time and space, it is only possible to predict the age of a sample from the relative frequency of scrapers and backed tools within very broad limits. The pattern shows that late Holocene samples from southern Africa are likely to have low numbers of both scrapers and backed microliths and may have either high or low numbers of segments. Samples dating between ca 12 000 and 8000 B.P. are unlikely to have backed microliths of any sort, while high segment frequencies are more likely to occur between ca 6000 and ca 3000 B.P. Samples with high backed bladelet frequencies are more common within the last 3000 years. Interwoven with this variability is that introduced by geographic positioning of sites. The Middle Orange River and some northern Cape sites, for example, do not include occupation deposits that date within the mid-Holocene timespan and Transvaal sites are either very early or late Holocene in age (Deacon, J. 1974).

Differences in size and shape

Interest in the measurement of stone artefacts as an aid to distinguishing between assemblages of different ages was started in the 1920s by Goodwin (1929) who measured changes in the size and shape of handaxes from Montagu Cave. He later applied this methodology to trace what he assumed to be migration routes of people who made bored stones of different designs by plotting the geographic distribution of size and shape categories (Goodwin 1947). Metric analyses are now standard practice for most stone artefact sequences, but relatively little work has been published comparing contemporary assemblages at an inter-regional level. While such comparisons may be complicated by variations in the availability of raw materials, it has nevertheless been mooted

FIG. 151

The relative frequency of scrapers vs segments plotted against time in radiocarbon-dated assemblages in southern Africa. Symbols and references as in Fig. 150.



Samples on left-hand margin not labelled through lack of space are from top to bottom: MOS, OAK, AS, BEL, PAT, MG, BEL, LIM, BPA, MOS, RM, GB, DIK, BEL, GB, HR, BON, HK, GH, P, NBC, WT, NBC, OHT, BUF, HK & B, BY, U, NBC, NBC, BPA, MR, NBC, MR, NBC, BUF, NBC, BPA, B, HK, BY, SEH, HK. Unmarked circles to right of 2000 B.P. refer to BPA, UNI, WT and BEL

FIG. 152

The relative frequency of segments vs other backed microliths plotted against time in radiocarbon-dated assemblages from southern Africa. Symbols and references as in Fig. 150

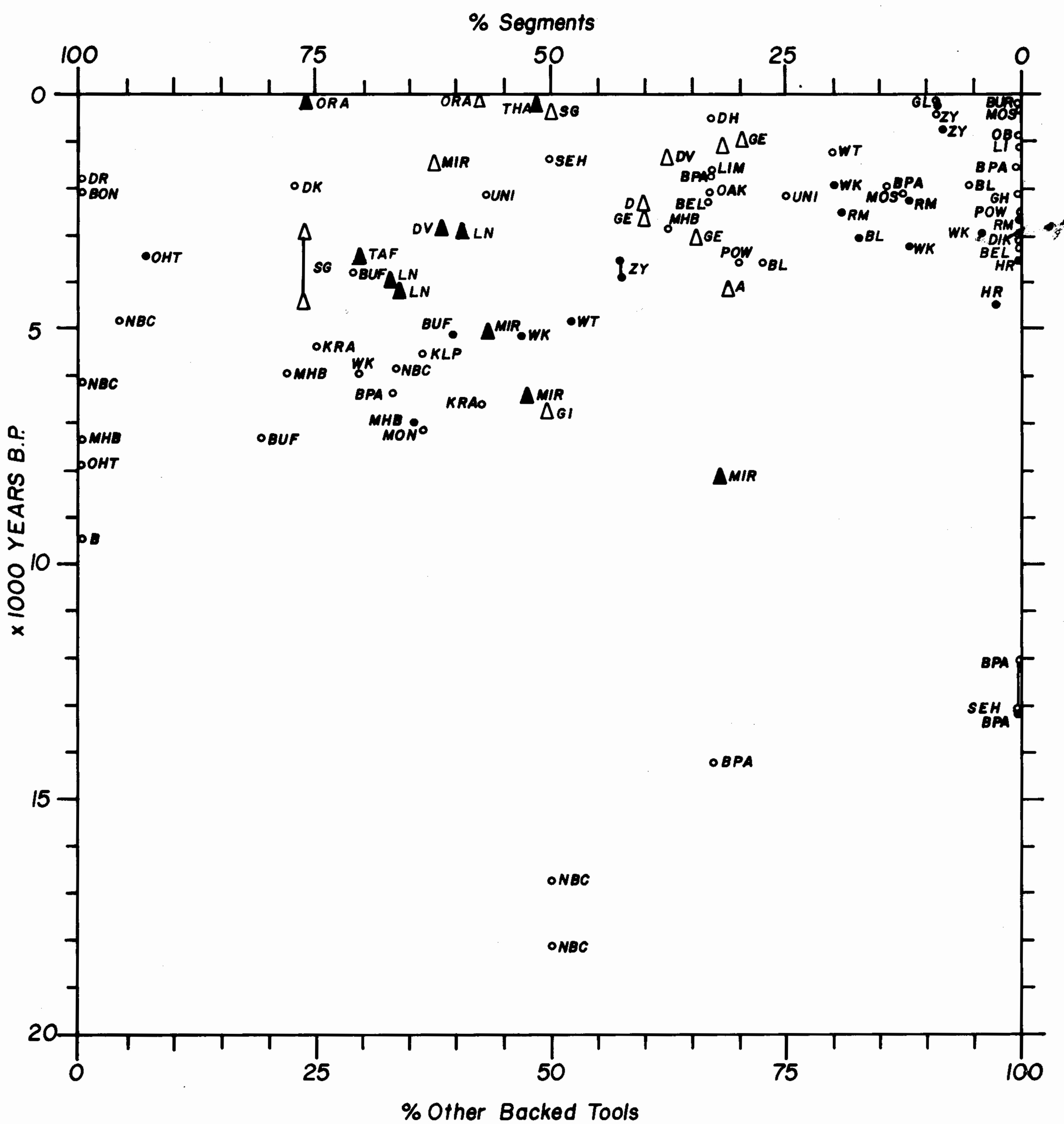
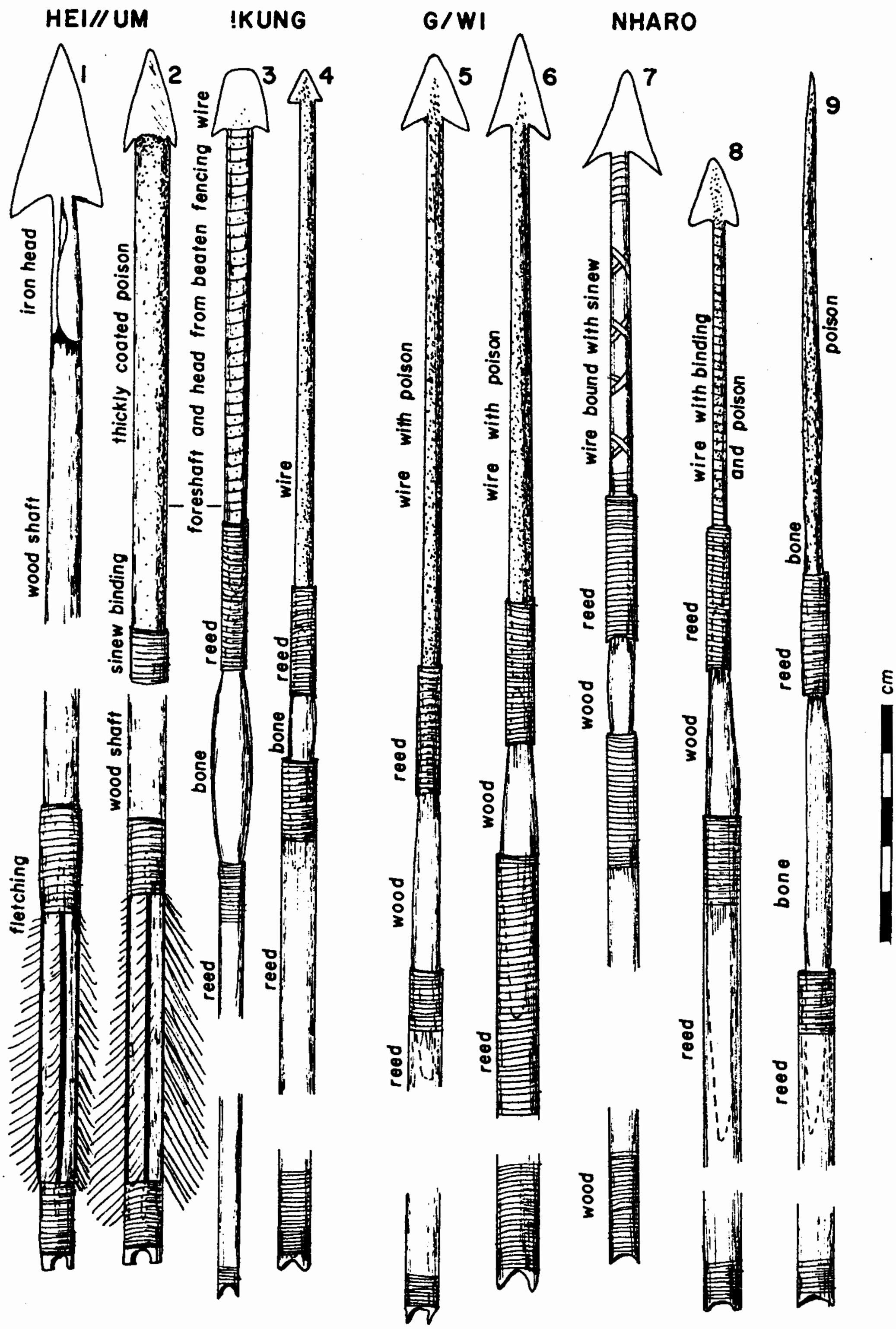


FIG. 153

San arrows from known sources collected after 1920. All are made from beaten fencing wire except 1 (beaten iron wrapped around a wood shaft) and 9 (reversible bone point).
1,2,3,5-7: National Cultural History Museum, Pretoria.
4,8,9: South African Museum, Cape Town.
All drawn from original specimens by J. Deacon.



that language (dialectal) differences between neighbouring LSA peoples may be reflected in stylistic differences in their artefacts (Deacon, H.J. 1976:170ff). This assumption has been tested on a limited scale with stone artefacts in New Guinea (White & Thomas 1972; Thomas 1974: 55) and on a variety of cultural items including spears in Kenya (Hodder 1977) where some correlation was noted between style and sociocultural groups. On a broader scale, Crosby (1977) has measured museum collections of percussive cutting implements and concludes that although there is some broad correlation between ethnic boundaries, language groups and economic practices, the measurements have little predictive value. We cannot assume that because artefacts are stylistically similar they must have derived from a common source, nor that communities with similar artefacts were in regular contact with each other. This lack of predictive value has also been noted by Hodder (1977, 1978b) not only in the measurement of individual items, but also in terms of which items showed significant inter-group variations.

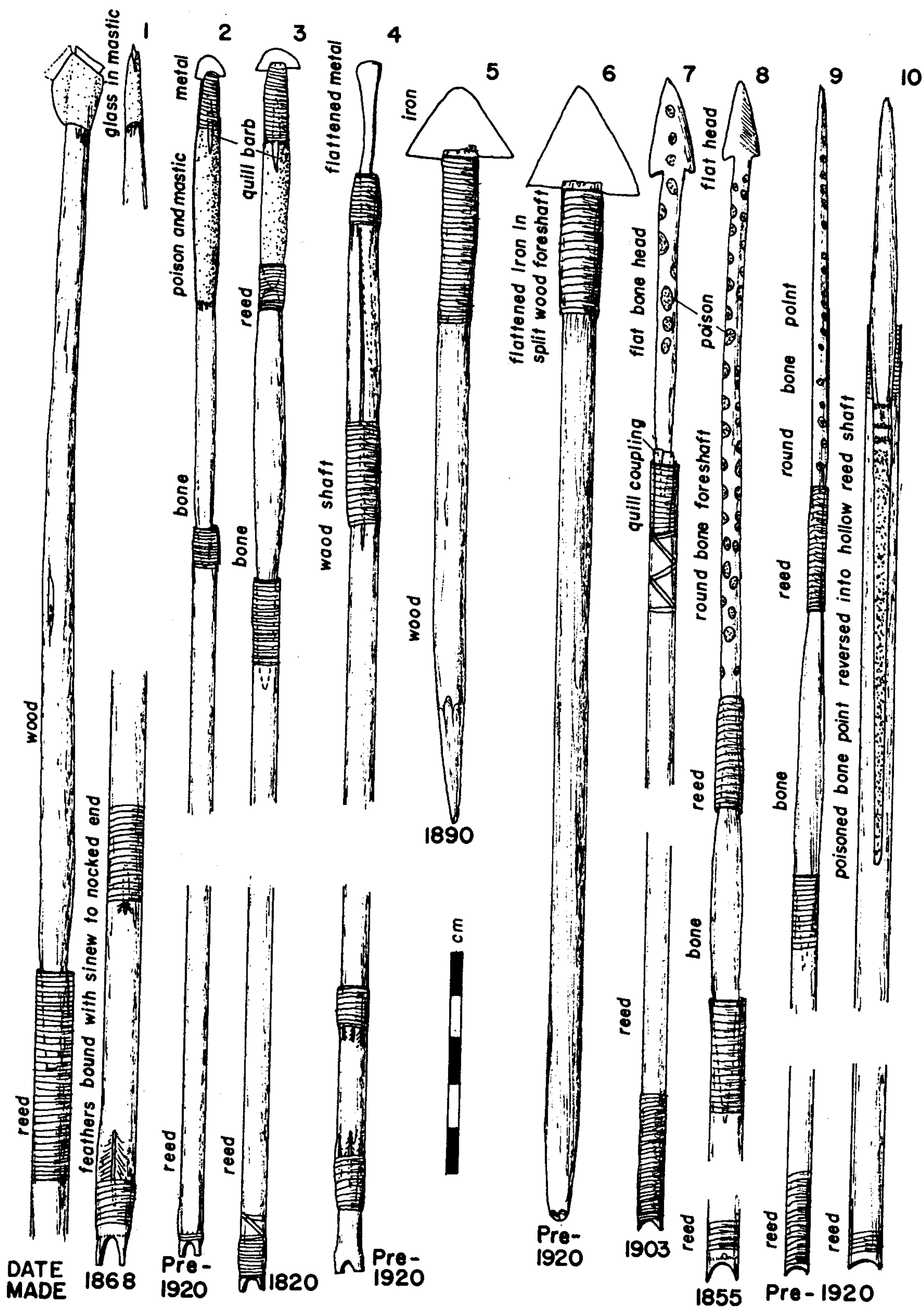
There are no detailed ethnographic data available on whether or how southern African hunter-gatherers sought to express their group identity in material culture, although there are observations by Wiessner (1982) who notes that while metal arrowheads made by San in the Kalahari are specific to language groups, their beadwork is not similarly restricted. The beaten wire arrowheads are recognizably group-specific so that !Kung arrows are distinctively different from those made by Hei//um, Nharo and G/wi (Fig. 153).

In an effort to quantify these differences, over 700 arrows from South African museum collections dating within the last 150 years have been measured (Deacon, J. in prep.). They were made both by extant groups in Namibia and Botswana and by extinct groups of San and Khoi in South Africa. Preliminary results confirm that group-specific styles of present-day San extend back at least 60 years, but older collections that date to the 19th century and first two decades of this century are unfortunately too small and lack sufficient contextual information to enable them to be used for the establishment of group-specific stylistic modes.

The main distinction between arrowheads post-dating 1920 from Namibia and Botswana and those pre-dating 1920 is that fencing wire was used for the more recent sample and bone, beaten tin and nails were used

FIG. 154

San and possibly Khoi arrows made in South Africa before 1920. 1: Griqualand West; 2: Natal Drakensberg (Vinnicombe 1971); 3: Graaff Reinet; 4: Bleek-Lloyd collection; 5: Kuruman, northern Cape; 6: Prieska, northern Cape; 7: 'Cape Bushman,' 8: Boshoff, Orange Free State; 9: Hei//um, northern Namibia; 10: Barkly West, northern Cape.



1,3,4,6,7: From South African Museum, Cape Town; 2: Natal Museum, Pietermaritzburg; 5,10: Duggan Cronin Gallery, Kimberley; 8: National Museum, Bloemfontein; 9: Cultural History Museum, Pretoria. All drawn from original specimens by J. Deacon.

for the earlier ones. A few examples from the last century in South Africa have also made use of small beaten metal inserts in split bone points and of glass and stone microliths set in mastic. The differences between the modern ethnographic specimens and those that can be described as 'historic' may therefore be as much attributable to change in the availability of raw materials, suitable metal in the form of fencing wire only becoming available after about 1910 in Namibia and Botswana; it was only with the use of fencing wire that the variety of known styles could have developed because of the ease with which this raw material could be worked.

Within South Africa larger metal arrowheads (Fig. 154:5,6) made from beaten nails tend to have come from the western half of the country around Kimberley and Prieska, while those with a small metal insert set with sinew, mastic and poison into a split bone point (Fig. 154:2,3) were found mostly in the Drakensberg and surrounding country to the east. Here again the size and shape would seem to be constrained by the form in which the metal was available.

An interesting contrast is provided by bone arrowheads (Fig. 154: 7-10) that are found in both ethnographic and archaeological samples from northern Namibia to the southern Cape. These show no significant differences in size or shape over a large geographic area, presumably in this instance because of the delicate balance of the arrow design and, again, because of the constraints of raw material and the fact that modern technology has not provided a substitute.

The implication of these results for archaeological interpretations is that where regional stylistic differences occur, these may coincide with language boundaries, but different artefacts are likely to have different distribution patterns and we cannot predict which will be the most accurate in plotting prehistoric dialectal boundaries, particularly if both the artefact designs and the dialectal boundaries change through time.

Apart from regional differences in bored stone measurements, the other artefact class which shows contemporary variability is that of scrapers. Although the data from the southern Cape lead to the expectation that cyclic changes in scraper size and shape would occur through the last 20 000 years regardless of raw material differences between sites, this is not the case where samples from a wider geographic area

Table 68

Matrix summarizing the number of times two samples were not significantly different at p.05 in Kolmogorov-Smirnov and Mann-Whitney U-tests for scraper length, width, height and w/l ratio using samples from sites detailed below.

	BOOMPLAAS					NELSON BAY					KANGKARA				WILTON							MELKHOUTBOOM				WONDERWERK							
	DGL 11	BLD 12	BLA 13	BRL 14	CL 15	1C 21	BSC 22	RA 23	RB-GSL 24	BSL-YGL 25	SUR 31	HBL-GBL 32	PBW-RBL 33	PBW-BBD 34	1 2A 41	2B-3A 42	3B -3C 43	3D -3E 44	3F 45	3G -31 46	4A 47	SUR-CAFL 51	M B 52	WED 53	M+ WBM 54	1A-C 61	2A 2B 62	3A 63	3B 64	4A 65	4B 66	4C 67	4D 5B 68
11																																	
12	8																																
13	8	8																															
14	0	0	0																														
15	0	0	0	2																													
21	2	0	0	0	1																												
22	6	7	8	1	0	1																											
23	7	7	7	1	2	3	8																										
24	0	0	0	2	4	0	0	0																									
25	6	6	7	4	5	4	8	8	0																								
31	5	6	6	2	0	4	4	6	0	4																							
32	6	7	8	1	0	0	8	8	0	8	5																						
33	0	0	0	8	1	0	0	0	2	3	2	0																					
34	2	2	2	6	5	0	2	5	2	6	2	2	8																				
41	2	0	0	6	2	2	0	1	2	1	3	0	6	6																			
42	0	0	0	0	4	1	2	6	0	5	4	0	2	4	2																		
43	0	0	1	0	2	0	2	6	0	6	3	2	0	1	2	4																	
44	2	2	2	0	2	1	2	6	0	6	4	2	0	0	1	3	6																
45	2	0	2	0	1	2	6	6	0	5	4	4	0	2	2	4	3	2															
46	2	2	2	0	0	0	3	3	0	3	8	2	0	2	1	4	2	4	4														
47	0	0	0	5	2	0	0	2	2	3	0	1	4	8	3	1	0	0	0	0													
51	2	3	4	2	0	0	8	6	0	6	3	4	0	2	0	2	2	0	0	2	0												
52	8	5	6	0	0	2	7	8	0	7	6	6	0	2	1	2	2	0	6	2	0	7											
53	4	0	2	2	1	2	2	3	1	2	6	2	2	2	4	1	0	1	0	2	2	2	3										
54	4	2	2	2	0	2	2	3	0	2	7	2	0	2	2	2	0	2	1	4	0	1	6	4									
61	0	0	0	5	2	0	0	0	2	3	2	0	4	7	3	2	0	0	0	0	5	0	0	0	1								
62	0	0	0	5	1	0	0	0	2	3	0	0	4	4	2	0	0	0	0	0	5	0	0	0	0	5							
63	0	0	0	5	0	0	0	0	2	4	0	0	4	4	2	0	0	0	0	0	4	0	0	0	0	5	6						
64	0	0	0	3	4	0	0	0	4	1	0	0	2	4	2	0	0	0	0	0	2	0	0	1	0	6	1	0					
65	0	0	0	3	2	0	0	0	2	2	0	0	3	6	2	0	0	0	0	0	6	0	0	0	0	7	8	8	4				
66	0	0	0	6	2	0	0	0	2	3	0	0	6	8	3	0	0	0	0	0	5	0	0	1	0	8	8	8	6	8			
67	0	0	0	4	2	0	1	0	2	2	1	0	2	3	0	2	0	0	2	1	1	2	2	0	2	7	3	2	6	4	2		
68	2	2	2	0	2	0	2	2	6	2	1	2	0	2	0	1	2	2	2	2	1	1	2	0	0	3	1	2	4	1	2	6	

are compared (Fig. 155). The geographic limits of the southern Cape pattern cannot be measured as yet for many sites in adjacent regions lack occupation deposits that pre-date 4500 B.P., but Wonderwerk in the north-western Cape and Diana's Vow in Zimbabwe do not appear to conform in that their mid-Holocene scrapers are not significantly shorter than those of preceding and succeeding samples. Whether this is a reflection of raw material differences or whether it has wider implications, we cannot judge at present and larger samples are needed. The pattern of similarities is summarized in Table 68.

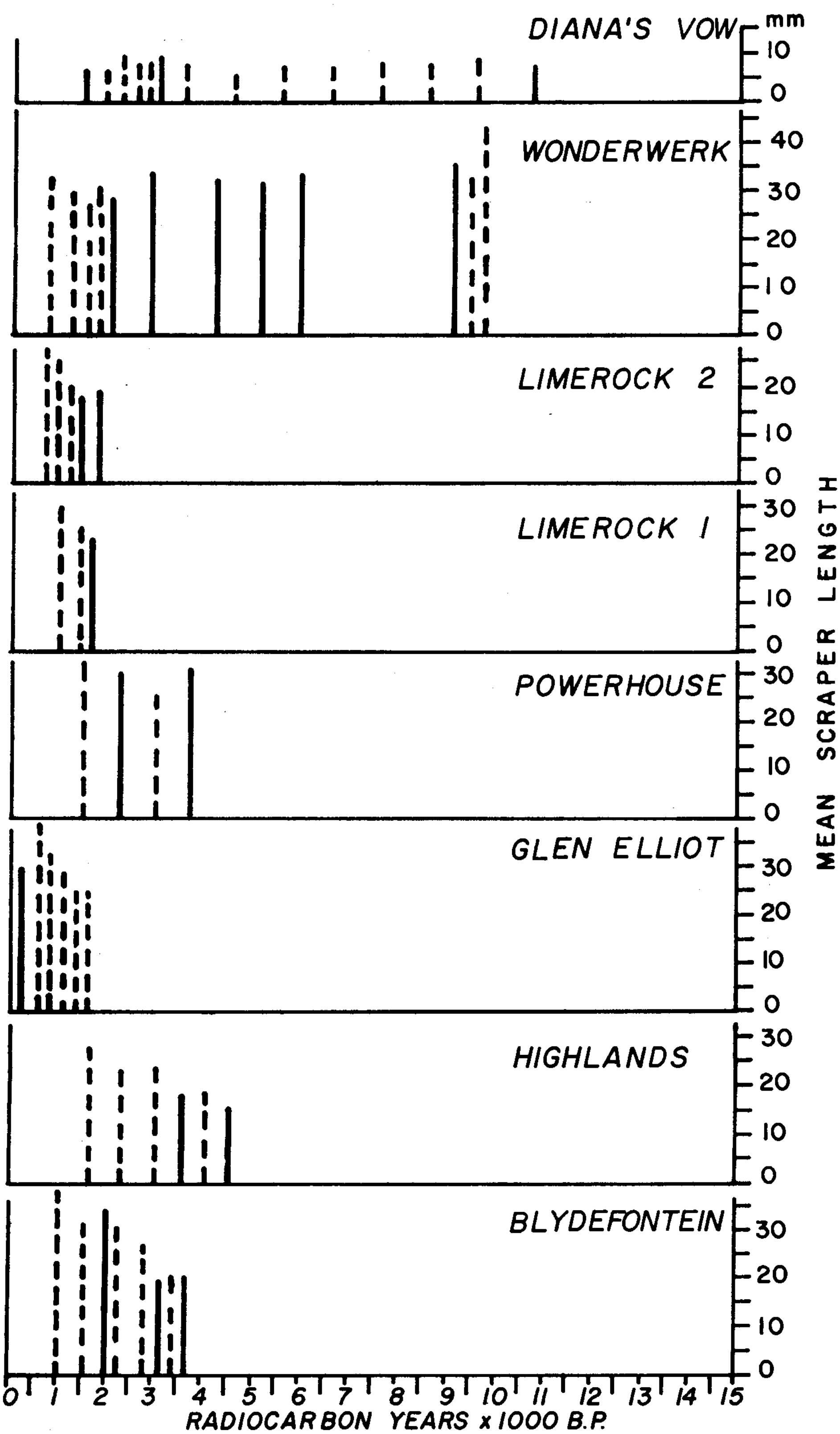
SUMMARY

Comparisons between the trends through time in modern technology and the stone and bone artefacts of the Later Stone Age suggest that some patterns are common to both. The increasing complexity, greater standardization and miniaturization of the Holocene formal tools are features that would be expected had the momentum of technological change and the diffusion of new techniques moved at an even rate. The data from the southern Cape show, however, that the rate of change was not even and that the developmental sequence was disrupted at ca 12 000 B.P. by a change in flaking technique, an increase in the size of untrimmed flakes and scrapers and a change in raw material preferences at a time when a major shift occurred in the hunting pattern. This was made necessary by changing environmental conditions initiated some 2-4000 years earlier which reduced the availability of the animals commonly hunted during the late Pleistocene and obliged the LSA hunters to change to smaller, non-gregarious browsing antelope rather than the large grazers they had previously relied on. As suggested in Fig. 138, this change in hunting pattern probably had repercussions in terms of social and demographic factors such as group size and distribution as well as in seasonal movements. The lack of correlation between particular climatic regimes and particular artefact types suggests that while adjustments to environmental changes stimulated change in the artefact system through sociocultural instability, the direction these changes took was within the range of secular variability and was not therefore a functional adjustment in the accepted sense.

The fact that almost all the stone and bone artefact types of the Later Stone Age are known virtually throughout Africa and elsewhere

FIG. 155

Changes in scraper length through time in LSA assemblages from the northern Cape and Zimbabwe



Solid lines represent samples associated with radiocarbon dates; dashed lines are interpolated samples between dated ones.

Sources: Diana's Vow from Cooke (1979); Wonderwerk from A.I. Thackeray (1981); Highlands from Deacon, H.J. (1976); all the rest from Humphreys (1979).

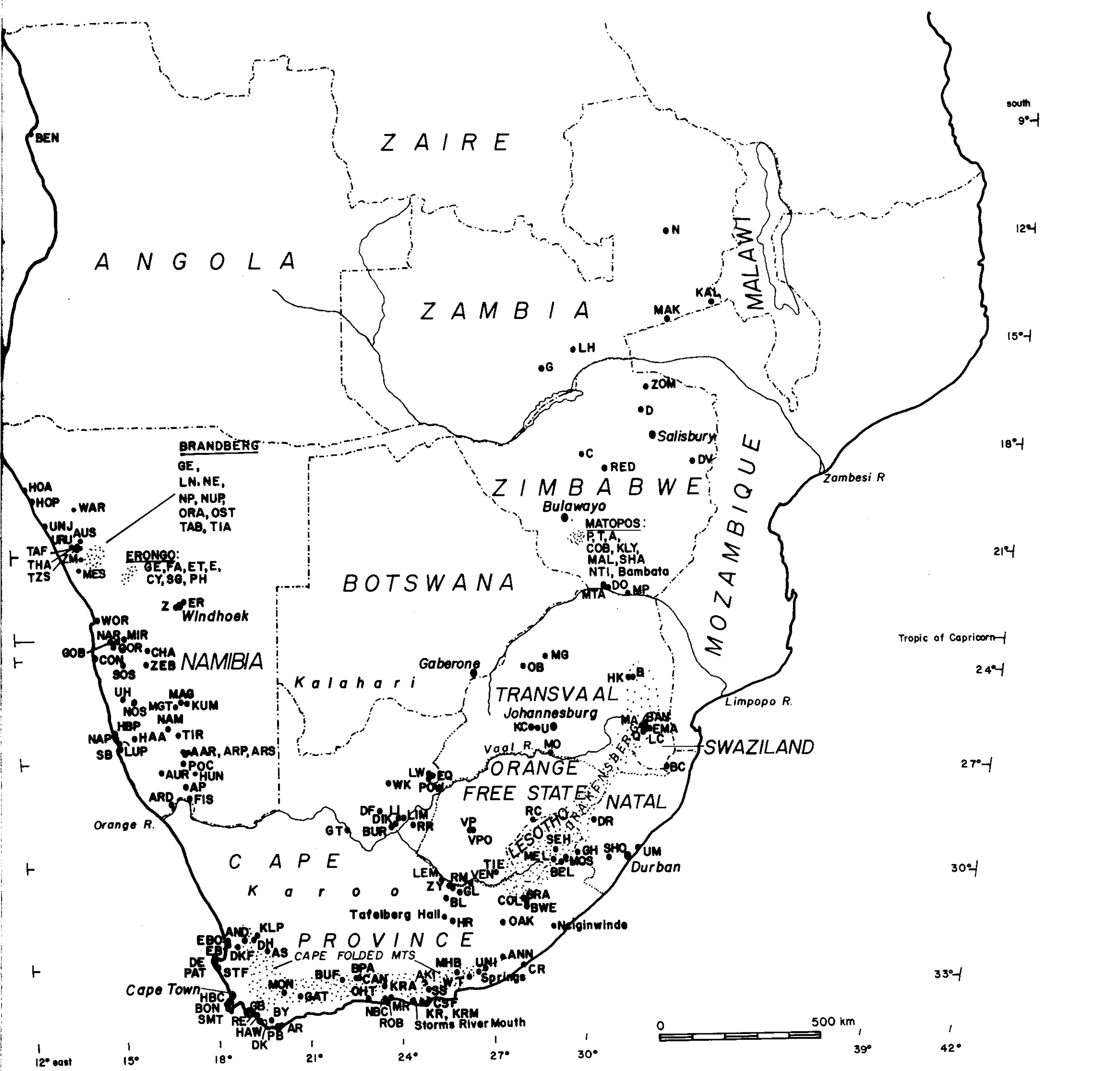
in the Old World argues for the existence of established lines of communication along which ideas and people moved to diffuse the evolutionary developments of Stone Age technology. In cases where we can plot the speed of movement of individual items as, for example, with pottery, we can suggest whether the innovation was spread by immigrant people or by the gradual borrowing of ideas, but a great deal more information is needed before we can hope to identify identity-conscious Later Stone Age groups by their stone artefacts, or to predict the age of a sample of artefacts from the relative frequency, size and shape of its tools.

7

THE SOUTHERN AFRICAN SEQUENCE

FIG. 156

Map of southern Africa showing the position of sites mentioned in Tables, Figs and text. A key to the abbreviations and references is given in Table 72.



THE SOUTHERN AFRICAN SEQUENCE

The patterns of diachronic change described in Chapter 6 have shown that while innovative changes follow the directions expected from the technological evolution of LSA artefacts and are largely independent of environmental changes, changes in style initiated at ca 12 000 B.P. have a broad temporal correlation with changes in hunting pattern. After 8000 B.P., with the introduction of hafting, there was widespread adoption of microlithic tools and a marked increase in formal tool frequencies in a tradition that persisted through to historic times. Within the last 2000 years, however, with the advent of herding and pottery, the stylistic mode of scrapers was disrupted again in some areas but not in others. At the next level of abstraction, it is useful to group these observations into units with some temporal and spatial limits. There should be no misunderstanding about the nature of these culture-stratigraphic units, however. They do not denote exclusive sets of dependent variables, but merely group together in a loose temporal framework those assemblages in which there is a similar range of stone flaking techniques, a similar range of formal tools and in which secular shifts in style are broadly coincident. Variability is expected within each unit both in terms of the relative frequencies of raw materials, artefacts, formal tools and the size and shape of the formal and unretouched flakes, and some of this variability is great enough between contemporary assemblages to distinguish regionally-specific industries. Major changes are identified through time where a series of innovative items has been introduced over a relatively short space of time and is correlated with a change in the method of flaking stone as identified in the core sub-classes. Within these major units, as within the Later Stone Age for example, temporal subdivisions are based on changes in the choice of raw materials and the correlated shift in core sub-classes and the size and shape of the flakes and formal tools; regional subdivisions tend to be based more on the relative frequencies of formal tools, although the size and shape of scrapers and flakes

Table 69

The dating, characteristics and equivalent terms of Later Stone Age culture-stratigraphic units used in this review

CULTURE-STRATIGRAPHIC UNIT	DATING	CHARACTERISTICS	TERMS INCLUDED
Late Pleistocene microlithic assemblages	40 000 - 12 000 B.P.	Clear evidence for the use of a microlithic flaking technique with single platform bladelet cores and bi-polar cores yielding numerous bladelets less than 25 mm long. Few formal tools, but including unstandardized scrapers, and a few backed microliths. Includes bored stones, polished bone points, ostrich eggshell beads, tortoiseshell bowls. Middle Stone Age formal tools absent.	Robberg Industry of the southern Cape (Klein 1974; Deacon, H.J. 1976; Deacon, J. 1978) and the late Pleistocene industry from Sehonghong (Carter 1978). Broadly equivalent to the Nachikufan I in Zambia (Miller 1969), the early microlithic from Matupi in Zaire (Van Noten 1977) and the Second Intermediate from Kisese in Tanzania (Inskeep 1962). Also includes the Early LSA from Border Cave, Heuningneskrans and Rose Cottage (Beaumont 1978). Excludes proto-LSA of Leopard's Hill in Zambia and the Tshangula in Zimbabwe because both have MSA-type formal tools.
Terminal Pleistocene/early Holocene non-microlithic assemblages	12 000 - 8000 B.P. Two sites in Namibia date between 20 000 and 12 000 B.P.	Microlithic flaking techniques absent or very rare. Cores generally large and irregular, flakes quadrilateral and larger than preceding and succeeding assemblages. Few formal tools, but scrapers predominate with large circular and end scraper forms. Bone tools numerous.	Smithfield A (Goodwin & Van Riet Lowe 1929), Early and Middle Smithfield of the Transvaal (Mason 1962), Albany Industry of the southern Cape (Klein 1974; Deacon, H.J. 1976; Deacon, J. 1978), the Oakhurst Complex encompassing the Oakhurst, Lockshoek and Pomongwe Industries (Sampson 1974), the Pomongwe Industry of Zimbabwe (Cooke et al 1966), the Early LSA at Apollo 11 and Pockenbank (Wendt 1972, 1976), the Bushman Rock phase of the Transvaal LSA (Plug 1978) and the early Holocene assemblage at Good Hope shelter in Natal (Cable et al 1980).
Holocene microlithic assemblages	8000 - a few hundred years B.P. One site over 10 000 B.P. in Zimbabwe and one in Namibia in 10th millennium B.P.	Fully developed microlithic tradition with numerous formal tools; backed microliths and small convex scrapers highly standardized; bone, shell and wooden artefacts; rock art clearly associated	Wilton & Smithfield C (Goodwin & Van Riet Lowe 1929). Wilton Industry of the southern and eastern Cape (Deacon, J. 1972, 1974; Deacon H.J. 1976), Wilton Complex of Sampson (1974) incorporating the Coastal and Interior Wilton, the Khami and Matopo Industries (Cooke et al 1966; Cooke 1971, 1979); the Inland Wilton of Humphreys (1979) and the LSA II of Lesotho (Carter 1978).
Late Holocene assemblages associated with pottery	Within the last 2500 years, with most sites more recent than 2000 B.P.	In some areas the pottery is associated with microlithic assemblages, but in the northern Cape, the Transvaal and Natal pottery is associated with assemblages dominated by long end scrapers and few backed microliths. Metal (copper), glass beads and glass artefacts also occur. Another facies is expressed in coastal midden assemblages in which formal tools are either absent or very rare, but pottery is present.	With microlithic tools: Post-Climax Wilton (Deacon, J. 1972; Inskeep 1978a), Ceramic Wilton (Sampson 1974), LSA I in Lesotho (Carter 1978), late microlithic in Namibia (Wendt 1972; Wadley 1979), Sandy Bay industry of the south-western Cape (Rudner & Rudner 1954; Sampson 1974; Mazel & Parkington 1978) and the final expression of the Khami/Wilton/Matopo sequence in Zimbabwe (Cooke 1971, 1979; Walker 1980). With long end scrapers: Smithfield B of Goodwin & Van Riet Lowe (1929), Smithfield Complex (Sampson 1974), Smithfield P and N (Goodwin 1930; Van Riet Lowe 1936), the Later Smithfield of the Transvaal (Mason 1962). Coastal: Coastal Complex of Sampson (1974), Strandloper of Rudner (1968). Macrolithic with pottery: Brandberg Culture (Rudner 1957) and late macrolithic in Namibia (Wendt 1972; Wadley 1979).

may also be taken into account.

With the number of names at large in southern African Stone Age terminology, and few of these based on well excavated, well dated sequences, the culture stratigraphic record for the Later Stone Age will be described in this chapter under generalized descriptive headings that group together broadly contemporary assemblages in which a similar toolmaking technique has been used and a similar range of formal tools made. This should not be seen as a new classification scheme, but rather as a device for the characterization of major changes in the southern African Later Stone Age sequence over the last 20 000 years or more. Because these stages coincide, again very broadly, with periods of somewhat different environmental character than the present, the evidence for subsistence will be reviewed at the same time to indicate the scale of habitat changes involved.

The headings under which the Later Stone Age sequence is summarized are listed in Table 69 together with their synonyms. The assemblages on which the scheme is based are several hundred radiocarbon-dated stratigraphic units from over 160 sites in southern Africa (Tables 70, 71, 72; Fig. 156).

LATE PLEISTOCENE MICROLITHIC ASSEMBLAGES

Late Pleistocene microlithic assemblages have been reported from deposits dating between about 40 000 and 12 000 B.P. (Table 70). The oldest dated samples are from Border Cave in KwaZulu (Beaumont 1978; Beaumont et al 1978) where they date to ca 38 000 B.P. and thereafter, in order of antiquity, they have been reported from Rose Cottage in the eastern Orange Free State, Heuningneskrans in the eastern Transvaal (Beaumont 1981), Boomplaas, NBC, Kangkara and Melkhoutboom in the southern and eastern Cape (Deacon, H.J. 1976; Deacon, J. 1978), Elands Bay in the western Cape (Parkington pers. comm.) and Byneskranskop in the south-western Cape (Schweitzer & Wilson 1982). In Lesotho a similar assemblage has been described from Sehonghong (Carter 1978) and Beaumont (1978) has suggested that the Lower Occupation at Shongweni in Natal (Davies 1975) may relate to these assemblages as well. In Zimbabwe assemblages assigned to the Tshangula Industry (Cooke 1963, 1971) date to between 25 000 and 12 000 B.P. but retain a number of formal tools that are typologically Middle Stone Age as well as backed microliths

Table 70

DATED LATE PLEISTOCENE ASSEMBLAGES FROM SOUTHERN AFRICA WITH LATER STONE AGE AFFINITIES, INCLUDING THE 'EARLY LSA', THE TSHANGULA AND NON-MICROLITHIC INDUSTRIES

45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13
BC	-	-	-	-	RC+ HAA°	-	BC	BC	BC BC	POC° BC	BC	BC	BC	POC* (HK) BC	-	POC°	RC -	BC	-	RED* RC	(HK) HK	SHO HK	NOS° (HK)	ZOM* P* HK BPA° BPA°	ZOM* HK EB°	-	D*	-	-	P*	P*	ZOM* ZOM*

--------- Radiocarbon dates x 1000 years B.P. ---------

- * Tshangula associations
- ° Non-microlithic associations
- \+ Non-finite date
- ( ) Amino acid calibration

Note: Border Cave (BC) dates from 45 000 to 32 000 B.P. are almost all from the 1WA layer. The best estimate of its age is 38 000 B.P. (Beaumont et al 1978)

Note: Assemblages other than Tshangula ones dating between 19 000 and 12 000 are listed in Table 71

Key to site names and references for dates may be found in Table 72 (p.458)

and ostrich eggshell beads typical of the Later Stone Age; their precise relationship to contemporary assemblages to the south and north is not yet fully understood. Also contemporary with the late Pleistocene microlithic industries are non-microlithic ones from Namibia (Wendt 1976 and pers. comm.) that date between 40 000 and 10 000 B.P. and from BPA that date between 32 000 and 20 000 B.P.

Late Pleistocene microlithic assemblages (with the exception of those from Border Cave and Heuningneskrans where the bladelet element is not well represented) are characterized by the systematic production of small bladelets from standardized single-platform bladelet cores and by the occurrence in some quantity of bi-polar cores that have sometimes been so reduced by flaking that they are classed as pièces esquillées, outils écaillés, scaled pieces or core reduced pieces. Quartz and quartz crystal are preferred raw materials, but where these were not available, other fine-grained rocks have been substituted.

Very few of the bladelets were retouched into formal tools, but where backed microliths are present they take the form of blunt or round-ended segments and casually backed bladelets. Scrapers tend to be short (less than 25 mm long) and relatively high (thick), and there are also rare and well-made large scrapers reminiscent of the concavo-convex scrapers described by Goodwin and Van Riet Lowe (1929) for the Smithfield A. At BPA and NBC a few of the single platform bladelet cores show polish on the striking platform indicating their use as scrapers as well as cores (Binneman 1982). In all cases the percentage frequency of formal tools is less than 1% of the total assemblages. Adzes, borers, one serrated backed bladelet and small bored stones are also known from assemblages of this type at BPA.

Although the frequency of formal tools is low, the LSA character of these late Pleistocene microlithic assemblages is shown in associated lithic and non-lithic artefacts that are directly comparable with items in Holocene assemblages and in the ethnographic present. These include a small bored stone (too small for a digging stick weight), ostrich eggshell beads and a polished bone point from Border Cave at 38 000 B.P. (Beaumont 1978) and ostrich eggshell water containers decorated with incised lines, tortoiseshell bowls, ostrich eggshell and marine shell beads, and polished bone points/linkshafts from 18 000 B.P. at NBC and from 15 000 B.P. at BPA (see Deacon, H.J. 1980 for discussion).

Dating

The transition from clearly MSA to clearly LSA assemblages is not easy to pinpoint in time on the basis of the small number of occurrences known at present, but in the rare instances where late Pleistocene microlithic assemblages are found stratified between MSA and fully developed LSA horizons, the shift is dated between 40 000 and 20 000 B.P. (Beaumont et al 1978; Deacon, H.J. 1979, 1980). In Zimbabwe the situation may have been more complex in the Tshangula industry with MSA characteristics persisting through to ca 12 000 B.P., while in Namibia MSA-type artefacts are dated as recent as 26 000 B.P. at Apollo 11 where they are associated with painted slabs (Wendt 1976). The overall picture is therefore of considerable variability in the dates for the first appearance of late Pleistocene microlithic assemblages (Table 70).

At the other end of the time scale, however, the shift to non-microlithic assemblages at the end of the late Pleistocene seems to have occurred over a wide geographic area within about 1000 years at ca 12 - 11 000 B.P. There are no assemblages of late Pleistocene microlithic character dated more recent than 12 000 B.P. in the southern Cape, but at Heuningneskrans there is one assemblage dated within the 12th millennium (Beaumont 1981).

Evidence for subsistence

The effect of lower temperatures and different rainfall regimes from those of the present varied from one ecozone to another in southern Africa during the late Pleistocene and is most clearly reflected in the faunal remains from occupation sites. Assemblages in the western, southern and eastern Cape, for example, show more differences between late Pleistocene and Holocene faunas than do assemblages elsewhere in South Africa because the combination of lower temperatures and the exposure of the continental shelf led to the grass element in the vegetation becoming more dominant and to the occurrence of springbok, ostrich, wildebeest, quagga, bontebok and warthog at NBC where they were not known in historic times. A feature of late Pleistocene faunal assemblages in the Cape ecozone is the presence of a number of large mammals that became extinct at the end of the Pleistocene or early in the Holocene, partly as a result of climatic and habitat changes, and partly because of the role of man (Klein 1980:272). These included the giant buffalo, Pelorovis antiquus, the giant Cape horse, Equus capensis, the giant alcelaphine Megalotragus priscus, a large warthog Metridiochoerus sp. and two springbok, Antidorcas bondi and A. australis. Klein (op.cit.) suggests that Stone Age people in the Cape intensified their hunting of the large plains game at the end of the Pleistocene when habitat changes made these species less numerous and, together with the technological innovation of the bow and arrow (?), some species were driven below a critical threshold and could not maintain their reproductive capacity.

Outside the Cape ecozone, late Pleistocene faunal assemblages are less common. Two older samples, from Border Cave (ca 38 000 B.P.) and from the Tshangula levels at Redcliff in Zimbabwe (30 - 20 000 B.P.), however, indicate that cooler conditions allowed some species to increase their geographical range (Klein 1977, 1978a; Beaumont et al 1978).

No significant differences have been noted in the range of animals hunted by MSA and late Pleistocene LSA people, but when late Pleistocene faunal assemblages, regardless of cultural association, are compared with Holocene ones, there are differences both in the range of animals (due partly to changes in availability) and in the relative frequency of gregarious and non-gregarious species which broadly equates with grazers and browsers (Klein 1980, 1981a). There are no striking differences apparent between MSA and early LSA hunting methods and capabilities judging from mortality profiles of small bovids (Klein 1981a), but LSA people showed greater competence in the Holocene and were able to kill more dangerous animals, for example bushpig, than were their MSA counterparts, enabling them to increase the range of animals hunted. Klein (1976, 1979) has also argued that Holocene people were more efficient in fishing and fowling than their MSA counterparts, but the lack of coastal sites with evidence for fishing and fowling as well as shellfish collecting between ca 90 000 and 12 000 years ago makes it impossible to test whether this efficiency was coincident with the advent of the LSA or whether it developed gradually during the late Pleistocene.

Poor preservation is probably responsible for the lack of identifiable plant food remains at most late Pleistocene sites with microlithic assemblages. An exception is Border Cave where grass bedding material, leaves, twigs and seeds are present in the units dating to ca 38 000 B.P. (Beaumont 1978, 1980). There are 95 leaves from 15 species of which 14 leaves from 5 species are known to be edible, and two others are of known medicinal value. Of the 55 seeds from 13 species, 26 from 5 species are edible and seven seeds from two species are medicinal. Carbonized plant materials have also been found beneath stones in late Pleistocene levels at BPA and Elands Bay Cave, but they have not been analyzed and may or may not include edible species.

The limited data base suggests that the hunting of larger migratory plains game was common in the Cape and Transvaalian ecozones during the late Pleistocene and that some plant foods were contributing to the diet. Ethnographic analogy suggests that hunting of large migratory grazers is often associated with relatively large groups of people to facilitate hunting in game drives and in the sharing of meat. This could have meant larger territories per group and therefore a lower archaeological visibility of sites as a population was more dispersed (Deacon, H.J. 1976), and it may in part account for the small number of known sites associated with microlithic assemblages in the late Pleistocene.

TERMINAL PLEISTOCENE/EARLY HOLOCENE NON-MICROLITHIC ASSEMBLAGES

South of the Zambesi a group of assemblages occurs post-dating the Tshangula in Zimbabwe and the late Pleistocene microlithic assemblages south of the Limpopo, and pre-dating the Holocene microlithic assemblages in Namibia. They are characterized by the absence or extreme rarity of bladelet cores and backed and unretouched microliths, and the presence of a variety of medium and large scrapers with a mean length of greater than 20 mm. Other formal tools are rare. Cores tend to be casual multi-platformed types and untrimmed flakes are quadrilateral or irregular in shape and somewhat longer than those in preceding and succeeding assemblages. A feature of some assemblages is the sophisticated range of associated bone tools, particularly those at the coast at NBC and Elands Bay which include bone beads and fish gorges. Artefacts known in the ethnographic present and associated with stone artefact assemblages for the first time include bored stone digging stick weights at Tshangula (N J Walker, pers. comm.) and Matjes River (Louw 1960), an eyed matting needle from Pomongwe (N J Walker, pers. comm.) and engraved stones from Wonderwerk in the northern Cape (Thackeray et al 1981) and from Bambata (N J Walker, pers. comm.). A deliberate burial in a rock shelter at Nswatugi in Zimbabwe (Walker 1980) is dated to this period, while others at Matjes River (Louw 1960) may be equally early.

As has been demonstrated in the southern Cape data, the scrapers (often the only formal tools in these assemblages) are consistently larger than those of the Holocene and the late Pleistocene and there are also changes in size and shape within the 12 000 - 8000 B.P. time period. In earlier assemblages (12 - 10 000 B.P.) the classic Smithfield A forms and large side scrapers that are also occasionally found in the late Pleistocene, are relatively common, but in the more recent levels (10 - 8000 B.P.) elongated end-scraper forms reminiscent of Goodwin & Van Riet Lowe's Smithfield B are more numerous. They are made on relatively thick flakes with scraper retouch on the convex working edge and steep, sometimes almost adze-like, retouch down one or both sides (Fig.157). Some specimens from undated Lockshoek surface sites in the northern Cape (Sampson 1972:184, 1974) are steep-sided but have natural facets rather than retouch to shape the blank. Sampson has called this class 'frontal scrapers' (1972:186) to distinguish them from the flatter, more regular 'end scrapers' that date to the end of the Holocene in the northern Cape (Fig. 158).

Dating and distribution

The distribution and dating of terminal Pleistocene/early Holocene non-microlithic assemblages is summarized in Table 71 where it can be seen that the majority of the occurrences date between about 12 000 and 7500 B.P. The general absence of dated assemblages in the northern Cape is the result of the lack of deep stratified sites, but the occurrence of numerous open-air assemblages assigned to the Lockshoek industry (Sampson 1972) demonstrates that the same range of non-microlithic assemblages occurs there and it is likely that they all date within the same time period.

Non-microlithic assemblages of this type have not been reported north of the Zambesi nor are they known north of the Matopos in Zimbabwe, endorsing the conclusions of Goodwin and Van Riet Lowe (1929) who saw the Smithfield as an essentially local development in South Africa. The recognition of the Pomongwe industry in the Matopos and the Albany or Oakhurst industry in the southern Cape, however, has extended its distribution beyond the hornfels region to which they thought it was restricted.

FIG. 157

STONE ARTEFACTS FRON NON-MICROLITHIC ASSEMBLAGES OF THE TERMINAL PLEISTOCENE/EARLY HOLOCENE IN SOUTHERN AFRICA

1-3: Nelson Bay Cave

4-6,9: Boomplaas Cave

7,8,10: Pomongwe (after Cooke 1963:fig. 16)

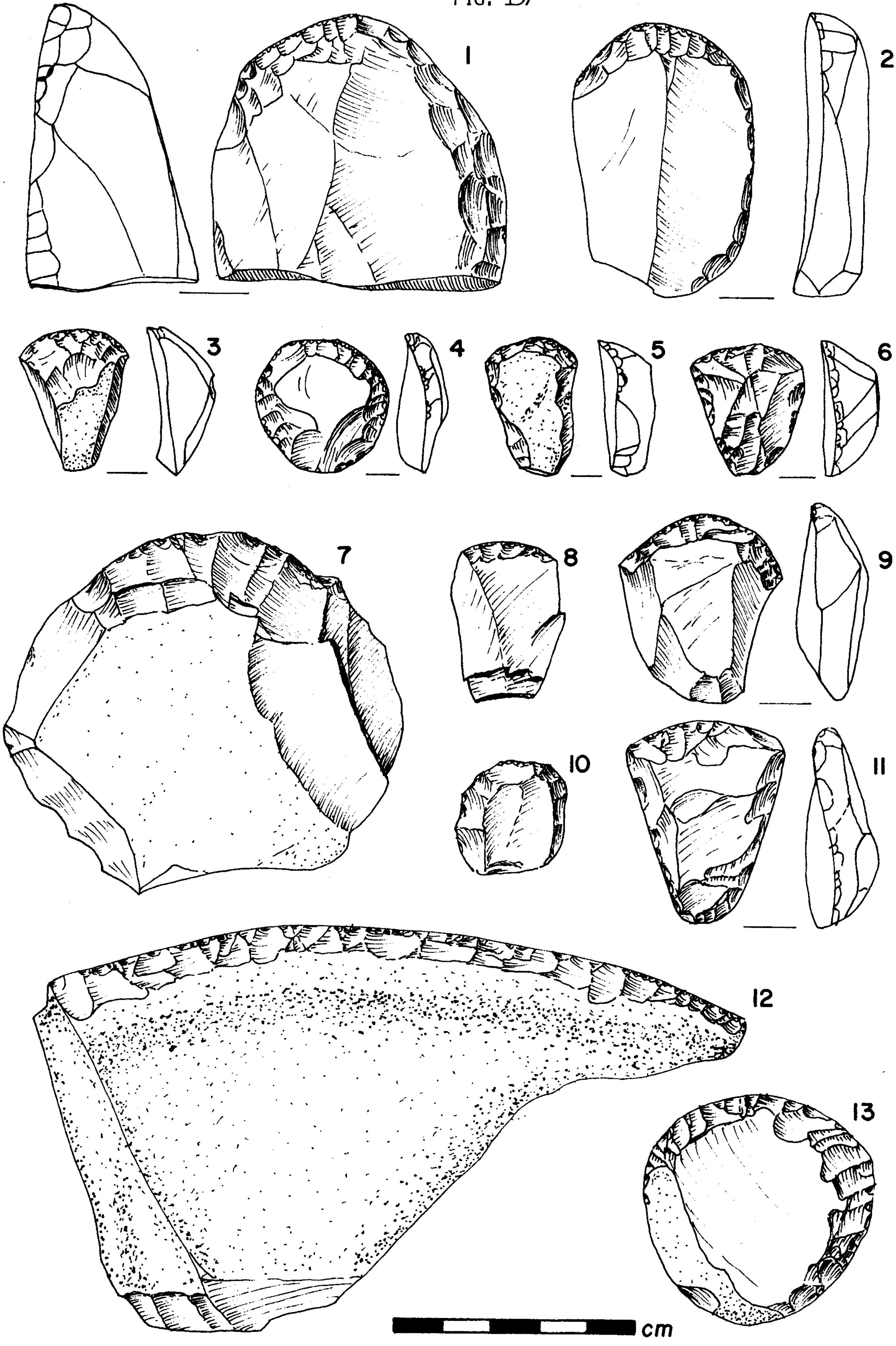
11: Lemoenfontein 10-11 (after Sampson 1970:fig. 3)

12: Kopje 18, middle Orange River Valley (after Sampson 1970:fig. 23)

13: Zeekoegat 13, lower level (after Sampson 1967c:fig. 12)

All these artefacts are classified as scrapers

FIG. 157



The relationship of these industries to the early non-microlithic assemblages from Pockenbank and Apollo 11 in Namibia (Wendt 1972, 1976; Freundlich et al 1980) is not easy to assess because detailed descriptions of the assemblages are still in preparation (see Table 70 for dates).

The appearance of non-microlithic assemblages at the end of the Pleistocene occurs within the 12th millennium at most sites in southern Africa, but their replacement by Holocene microlithic assemblages is spread over a wider period between about 10 000 and 7000 B.P., the earlier occurrences being to the north at Diana's Vow (Cooke 1979), Apollo 11 (Wendt pers. comm.) and Wonderwerk (Thackeray, A. 1981) and the most recent to the south at Buffelskloof (Opperman 1978) and Byneskranskop (Schweitzer & Wilson 1982) as well as NBC, KRA and BPA.

Evidence for subsistence

The majority of the occurrences grouped together here are associated with food remains different from those of earlier assemblages at the same sites. On the coast this is particularly noticeable in the appearance of quantities of marine shell, fish bones and the bones of marine birds and mammals as these sites were now on the coast with the rise in sea level at the end of the Pleistocene. Away from the coast it is evident in a smaller range of large gregarious grazers than is present in older samples, but a larger percentage than in the Holocene samples making the terminal Pleistocene/early Holocene ones essentially intermediate.

Marine shells at early Holocene sites show evidence for cooler water and changes in coastal morphology as well as providing information on exploitation patterns. As noted in Chapter 4, the black mussel is present at NBC between 12 000 and 8000 B.P. but is absent thereafter and is not found in the area today (Klein 1972a). At Elands Bay on the west coast, however, the black mussel is common on the coast today, but is absent before 10 000 B.P. (Parkington 1981). The early presence and later absence of the black mussel at NBC is likely to reflect warmer waters of the Agulhas current returning in the early Holocene for this species prefers cooler waters, but its presence at Elands Bay only after 10 000 B.P. may rather reflect a changing coastal configuration or summer occupation of the site when black mussels have an increased risk of toxicity.

The exploitation of marine resources from the terminal Pleistocene through the Holocene was noticeably more efficient than it was during the MSA (Voigt 1973; Klein 1976). Mussels and limpets are best represented at most sites, but whelks and rock lobster also occur. Flying birds such as gannets and cormorants are common, as are seals, dolphins and fish. Analyses of the age at death of seals from early Holocene levels at Elands Bay Cave indicate that the site was occupied during winter and spring (Parkington 1976), but a wider seasonal pattern is evident at NBC (Parkington, pers. comm.). Two Patella tabularis shells from NBC dating to ca 9000 B.P. were analysed for their oxygen isotope content and the results indicate that both were collected in the winter or early spring (Shackleton 1973:138-9).

Mammalian faunas dating to the terminal Pleistocene/early Holocene at NBC and Elands Bay include the most recent occurrences of extinct forms of the Cape horse, giant buffalo and springbok (Klein 1980). Inland these do not occur later than 12 000 B.P. at BPA and are absent from terminal Pleistocene deposits at Bushman Rock Shelter and Heuningneskrans in the Transvaal (Plug 1978; Beaumont 1981), Apollo 11 in Namibia (Thackeray, J.F. 1979) and Pomongwe in Zimbabwe (Brain 1981). While these latter samples include only species present in their respective ecozones during historic times, there is an emphasis towards larger rather than smaller bovids when compared with mid- and late Holocene samples from the same sites. A higher incidence of larger bovids when compared with later samples is also present in terminal Pleistocene/early Holocene assemblages in the southern and eastern Cape (Hewitt 1931a; Deacon, H.J. 1972, 1976; Klein 1974, 1980) and the former assemblages can therefore be seen as intermediate in character.

As in the late Pleistocene occurrences, plant food remains are rarely preserved. Notable exceptions are sites where wood and hardier seeds rather than the softer residues of plant foods have accumulated, as at sites in the Matopos (Cooke 1963; Walker 1980), at Zebrarivier in Namibia (Wendt, pers. comm.), Bushman Rock Shelter (Plug 1978, 1981), Heuningneskrans (Beaumont 1981:142) and Kruger Cave (Friede & Pienaar 1974; Mason & Vogel 1974) in the Transvaal. Marula seeds (Sclerocarya caffra) are the most common in the Matopos and Transvaal samples and are still widely eaten today both for their fruits and their kernels. In Namibia the most common seed is that of the nara melon. Modern hunter-gatherers use the melon and the seeds which can be dried and stored for long periods.

HOLOCENE MICROLITHIC ASSEMBLAGES

Holocene microlithic assemblages are characterized by a wider range of formal tools than appear at any other time during the LSA and by a return to a microlithic flaking technique for the production of bladelets. Formal tool components in southern Zimbabwe, southern Namibia and throughout South Africa and the adjoining countries are all dominated by scrapers, with backed microliths seldom accounting for more than 30% of the total formal tools. In northern Zimbabwe and at some sites in central and northern Namibia, as well as in Zambia, backed microliths are more numerous.

The most common scraper form in southern Africa during the mid-Holocene is the small convex type and samples generally have a mean length of less than 20 mm and a mean width/length ratio of about 1:1. Other formal tools found in Holocene microlithic assemblages include adzes, segments, backed bladelets, backed points, large segments, petits tranchets, borers, microliths with serrated edges ('saws'), tanged arrowheads or points (rare), grooved stones, sinkers, bored stones and reamers. Amongst the bone tools are rare eyed needles, fish hooks, arrow points and foreshafts, spatulas, spoons,beads and pendants. Being younger, preservation of organic materials at some sites is good and perishable items of wood, plant fibre and leather have been found including fragments of bows, arrows, netting, fire sticks, leather clothing and bags, digging sticks, wooden pegs and points. There is a wide variety of shell, bone and stone beads, pendants and other ornaments, and tortoiseshell bowls and scoops, decorated ostrich eggshell fragments and portions of water containers or flasks. There is also, for the first time, clear evidence in the form of mastic traces and a few mounted artefacts that microlithic and other tools were hafted. The range of tools with mastic includes small convex scrapers, adzes, all the backed microliths, borers and untrimmed flakes, but significantly excludes pièces esquillées.

The toolmaking debris associated with the Holocene microlithic tradition usually, but not invariably, shows a reduction in the mean length of untrimmed flakes when compared with samples from the terminal

Pleistocene/early Holocene as has been demonstrated at NBC and BPA. The cores include single and double platform bladelet types, small disc cores and less standardized forms.

There is a definite increase in the incidence of burials and human skeletal remains in living sites during the Holocene and in some cases burials are covered with ochre and, more occasionally, painted gravestones. This pattern is much more common in the western, southern and eastern Cape than elsewhere. Rock paintings and engravings are clearly associated with mid- and late Holocene microlithic assemblages in the form of painted stones dated from the seventh millennium at BPA and Matjes River (Louw 1960), and with engraved stones throughout the Holocene sequence at Wonderwerk (Thackeray et al 1981).

Dating

As has been noted, the first occurrence of Holocene microlithic assemblages is spread over three millennia in southern Africa from about 10 000 to about 7000 B.P. and by 6000 B.P. it was widespread in the subcontinent. The dating of the 'end' of this tradition is equally difficult to pinpoint for while assemblages of this type persist at some sites through to the Christian era in Lesotho (Carter 1978) and are associated with pottery at BPA and De Hangen (Parkington & Poggenpoel 1971), at other sites the microlithic tools are replaced by longer scrapers and fewer backed microliths during the last 2000 years. This change appears to be independent of the association of pottery. The diversity of late Holocene assemblages has led to the naming of a number of contemporary industries (Sampson 1974) and to the suggestion that all these occurrences belong to the same complex, the Wilton (Humphreys 1979). For the moment it would be prudent to acknowledge that despite a high-level similarity amongst all Holocene assemblages, there was greater variability in assemblages dating within the last 2000 years than occurred earlier in the mid-Holocene.

The dated assemblages in various ecozones of southern Africa are summarized in Table 71. In contrast to the distribution of dates in the terminal Pleistocene/early Holocene and the late Holocene time ranges, there is a general dearth of mid-Holocene assemblages from the South African interior (with the exception of the Drakensberg region and foothills and the Wonderwerk area) and it is not until after 4500

Table 71a

REGIONAL DISTRIBUTION OF RADIOCARBON DATED LATER STONE AGE ASSEMBLAGES IN SOUTHERN AFRICA

(a) Northern Cape, Middle Orange River Valley, Western Orange Free State and Western Transvaal

20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	x 1000 years B.P.
-	-	-	-	-	-	-	DIK DIK DIK	WK* DIK	U*	KC*	WK° U* KC*	-	EQ°	VP	WK°	WK° LW° HR°	ZY° ZY° RR POW° HR° DIK° BL° BL°	WK° RM° RM° RM° POW° EQ°	WK* VP+ MO MG+ LW° LIM° LIM° LI° DF+ DF+ BL°	ZY° ZY° TIE° TIE° TIE° TIE° OB+ MO MO GT GL° DIK2+ BUR°	

(b) Natal, Eastern Transvaal, Swaziland, Lesotho, North-eastern Cape, Eastern Orange Free State

20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	x 1000 years B.P.
HK	HK	-	-	-	-	<u>SHO</u>	<u>SEH</u> HK BC	HK B*	HK*	HK*	MA* MA* LC* HK* B* B* B*	HK* BWE* BEL	HK* GH*	RC° GRA* GRA* COL°	BAN	SHO	SHO Q EMA BEL°	Q MOS° GH° BWE BEL°	SHO SHO SEH° RC° MEL° DR° COL° BEL° BEL°	UM° SHO RC° MOS° COL° COL° BEL°	

° Holocene microlithic assemblages
* Terminal Pleistocene/early Holocene non-microlithic assemblages
\+ Late Holocene non-microlithic
Underlined : Late Pleistocene microlithic assemblages
No notation: Associations not given by excavator

<u>KEY to abbreviations in Table 72 (at end of Chapter 7)</u>

Table 71b

(c) Southern and Eastern Cape

x 1000 years B.P.	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	NBC NBC	-	NBC	MHB	BPA	BPA	KRA BPA BPA	NBC* NBC* NBC* MR* BUF*	NBC* NBC* NBC* NBC* NBC* MR* MR* MHB* BPA*	NBC* MR* MR* MR* KRA* BPA*	WT OHT* OHT* NBC* NBC* NBC* BUF*	OHT° MON° MHB° MHB* MR° MR° KRA* BUF* BUF°	NBC° NBC° NBC° MHB° KRA° CAN BPA°	NBC° NBC° NBC° NBC° MR° MHB° KRA° CSF° BUF° ANN°	WT° ROB° NBC° NBC° KRM° KRM° KR°	ROB° ROB° ROB° ROB° OHT° NBC° NBC° NBC+ MR° CAN BUF°	WT° UNI° UNI° OAK° NBC+ NBC+ NBC+ NBC+ NBC+ NBC+ NBC+ MHB° KRM° KRM° KR° CR+ ANN+	SS+ ROB° OAK° OAK° NBC+ NBC+ BPA° BPA° BPA° BPA°	SS+ OAK+ NBC+ GAT+ CR+ CR+ ANN+ ANN+

(d) Zimbabwe

x 1000 years B.P.	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	T* COL*	P	NTI* DV° COB* COB*	T* P* P* NTI*	T° SHA° P°	SHA° P° P° NTI°	NTI°	KLY°	MAL° COB° A°	-	ZOM T° DV° D°	T° DV° DO° C°	MTA° MTA° MTA° MP° MP°

Symbols and key as for Table 71a

Table 71c

(e) Western and South-western Cape

x 1000 years B.P.	
20	-
19	-
18	-
17	-
16	-
15	-
14	-
13	-
12	EB, BY
11	EB*
10	EB*, EB*, EB*, EB*
9	EB*, EB*, BY*, AS
8	EB*, EB*
7	EB*
6	RE°, BY*, BY°, BY°, AS
5	KLP°, AS
4	BON°
3	PAT°, GB+, EB°, EB°, EB°, BY°, BY°, BY°
2	PB+, GB+, GB+, EB+, DK°, DK°, DE, BON°
1	STF+, SMT+, SMT+, PB+, PB+, PAT+, HBC+, HBC+, HAW+, HAW+, EBO+, EB°, EB°, DKF°, DKF°, DK+, DK+, DK+, DK+, DK°, DH°, DE+, DE°, DE, BY°, AR, AND°
0	PAT+, PAT+, EBO+, EBO+, EB°, DKF°, DKF°, DH°, DH°, DH°, DH°, DH°, BY°, BY°, AS+, AND°

Symbols and key as for Table 71a

Table 71d

(f) South West Africa/Namibia

Key and symbols as for Table 71a

x 1000 years B.P.	Entries (top to bottom)
19	POC*, POC*, AP*
18	AP*, AP*
17	-
16	-
15	-
14	AP*
13	AP*, AP*, AP*, AP*
12	GOB, AP*
11	ZEB
10	AP
9	AP°
8	NAM°, MIR°, MIR°
7	NAM°, NAM°, AP°, AP°
6	POC°, MIR°, MIR°, MIR°, GI°, CHA°, AP°, AP°, AAR°
5	Z°, TZS°, NAM°, MIR°, MIR°, MAG°, CY°, CHA°
4	SG°, LN°
3	TAF°, SG°, PH°, MGT°, LN°, GE°
2	WAR, UNJ, TIA°, SB°, SB°, SB°, OST°, OST°, MES°, MES°, MES°, LNU°, LN°, HAA°, HAA°, GI°, GE°, GE°, FA°, FA°, FA°, FA°, FA°
1	URU+, NAR, MIR°, MES°, GOR+, GE°, GE°, ER°, E°, AUR, ARD+, ARD+, ARD+, ARD+, ARD+, AP°, AP°
0	ZM+, ZM+, ZM+, ZM, WOR+, WOR+, UH°, TIR°, TIR°, THA°, THA°, TAB+, TAB+, TAB+, TAB+, SOS+, SG°, POC°, POC°, PH°, ORA°, ORA°, NUP, NP°, NOS+, NOS+, NE°, NAP, MES°, MAG°, MAG°, LUP, KUM°, KUM°, HUN, HOP, HOA+, HBP, GOR, GI°, GI°, FIS+, FIS+, FA°, ET°, ES°, CON, CON, CHA°, AUS°, ARA°, ARP, AP+, AP+, AAR°, AAR°

----- x 1000 years B.P. -----

B.P. that dated sites become anything like as numerous as they are in the adjacent ecozones in the southern and eastern Cape, Zimbabwe and parts of Namibia. It has been suggested that this distribution may reflect a lower population density in the interior during the mid-Holocene possibly because of drier and warmer conditions (Deacon, J. 1974). The distribution pattern would support an hypothesis that population fluxes occurred during the last 10 000 years in some areas where rainfall or other environmental factors played a critical role in maintaining population levels, but the details of timing and distribution can only be worked out once a larger sample is available, particularly from regions such as Natal and the north-eastern Cape where archaeological research has not been active until very recently.

Environmental changes have also been responsible for some variability in site distribution in the western, southern and eastern Cape. The mid-Holocene marine transgression (Martin 1968; Flemming 1977) was probably responsible for the absence of some early and mid-Holocene coastal shell middens (Robertshaw 1978a), while the break in occupation deposits during the mid-Holocene at Elands Bay Cave and other sites in the western Cape may be an indication of drier conditions leading to a lower population density there at that time (Parkington 1980).

Ethnographic evidence for subsistence

As with the cultural record, there are two sources of information on the subsistence ecology of the Holocene peoples of southern Africa - the historic and ethnographic accounts of hunter-gatherers on the one hand, and the analysis of archaeological materials on the other. The former supply a useful corpus of information on adaptations to particular plants and animals and provide the sort of detailed basis for understanding how the indigenous food resources were used that would be impossible to reconstruct from the archaeological record alone. The archaeological record, on the other hand, can give us some idea of the time depth of these practices and of their geographic spread. The evidence for subsistence throughout the Holocene will be discussed here to explore the time depth of the ethnographic tradition. It is realised, however, that subtle shifts in emphasis have occurred within the last 8000 years that would be difficult to detect archaeologically and that it is only for the last 2000 years or so that the historic and ethnographic record is really pertinent (see Ebert 1978). It is also realized that many of the ethnographic records relate to the Kalaharian ecozone and may not be applicable to the rest of southern Africa; the focus is therefore on general patterns of subsistence rather than on particularistic detail.

Schapera (1930) has provided a useful synthesis from the early literature of the ethnography of the Khoi and San in parts of the Cape Province, Namibia and Botswana, but it is only recently that in-depth studies have been undertaken in which subsistence has been considered in detail. An impetus to a more ecological approach was provided by Story (1958, 1964) who showed that not only were there regional differences in the availability of particular plant foods, and thus differences in the importance of specific plants to specific groups of people, but that there was a high dependence on plant foods relative to animal foods in the Kalahari hunter-gatherer diet (Story 1964:99).

Ethnographers have built on the initial observations of Story and there are several studies of individual communities such as the !Kung (Lee 1965, 1968, 1969, 1972, 1979), the G/wi (Silberbauer 1965, 1972; Tanaka 1969, 1976, 1978) and the Nharo (Bleek 1928; Steyn 1971, 1981). What emerges from these studies in an admittedly restricted range of habitats that are more arid than the regions for which we have Holocene archaeological observations, is that the modern hunter-gatherers have an extensive knowledge of economic botany and animal behaviour and that this is a prerequisite for survival. Their daily, seasonal and annual movements are geared to the availability of water, plant and animal foods that are not uniformly distributed through the landscape nor through the year. Successive years of drought or good rainfall can have a marked effect on availability of foods. The schedule of movements from one resource nexus to the next is not fixed in that there are year-to-year changes in productivity, but they are constrained by the general character of the habitat (Silberbauer 1972:300). For example, in the drier areas where surface water may be available at only a few localities in a given season, the choice of possible camp sites is limited.

As is traditional in most other hunting and gathering societies, there is a sexual division of labour with men concerned mostly with hunting and women responsible for the bulk of the plant food collecting. The high reliance of all the present-day San in southern Africa on plant

TABLE 73

ANNUAL AND SEASONAL MEAT YIELD ESTIMATED FROM DATA GIVEN FOR ANIMALS KILLED BY ONE ≠XADE BAND IN ONE YEAR (AFTER SILBERBAUER 1972)

SPECIES	MEAT YIELD PER INDIVIDUAL ANIMAL (kg)	TOTAL MEAT YIELD PER			NUMBER OF INDIVIDUALS KILLED											
		annum	summer	winter	SUMMER						WINTER					
					Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Giraffe	136	136	136	-	-	1	-	-	-	-	-	-	-	-	-	-
Eland	86	774	688	86	1	2	1		1	3	1	-	-	-	-	-
Kudu	45	135	135	-	-	-	1	-	1	1	-	-	-	-	-	-
Gemsbok	68	1 360	816	544	3	2	4	2	1	-	3	3	2	-	-	-
Hartebeest	36	396	216	180	1	-	-	2	1	2	2	2	1	-	-	-
Wildebeest	36	432	252	180	1	1	-	3	2	-	2	2	1	-	-	-
Springbok	11	352	253	99	1	4	2	6	6	4	6	2	1	-	-	-
Duiker	4,5	293	112	181	4	5	4	3	7	2	3	1	2	12	10	12
Steenbok	3,6	245	98	147	3	3	4	3	6	8	2	4	2	8	10	15
Springhare	0,7	155	119	36	32	30	24	28	30	26	22	15	4	3	-	8
Porcupine	4,5	9	9	-	-	-	-	1	-	1	-	-	-	-	-	-
Warthog	16	16	16	-	-	-	-	-	1	-	-	-	-	-	-	-
Fox	1,8	33	8	25	-	-	-	-	4	-	3	1	3	2	1	4
Jackal	2,3	32	6	26	-	-	-	2	-	1	2	2	3	4	-	-
Rodents	0,06	18	5	13	30	20	30	30	30	40	20	20	15	15	15	30
Birds	0,23	37	18	19	8	18	22	13	14	6	12	4	12	16	16	20
Tortoises	0,12	53	47	6	90	90	90	80	40	-	-	-	-	-	-	50
Snakes	0,23	11	8	3	4	8	4	-	8	10	8	2	-	-	-	6
TOTAL		4 487	2 942	1 545												
% TOTAL		100	65,57	34,43												
Ants (litres)		2,5	2	0,5	0,5	0,5	0,5	0,5	-	-	-	-	-	-	-	0,5
Termites (litres)		8	8	-	2	4	2	-	-	-	-	-	-	-	-	-
Caterpillars		no figures given			-	-	-	x	x	x	-	-	-	-	-	-

foods is explicable in that plants are a more easily guaranteed source of food than is meat, but the fact that most of the underground plant foods, which provide the bulk of the plant foods eaten, are generally high in carbohydrates and low in protein makes it necessary that they be supplemented by foods with higher protein values, of which meat is the obvious choice. Historical observations of hunter-gatherers consuming seemingly incredible quantities of meat at a single sitting are related to a pattern of periodic rather than regular meat eating which is reflected also in ethnographic records of hunting successes (Table 73).

All ethnographic studies show that while the present-day hunter-gatherers may know of a wide variety of edible and medicinal plants (several hundred species in many cases), only a few of these are used as staples. Amongst the !Kung for example, 14 out of 105 species used regularly constitute almost 75% of the calories in the plant food diet (Lee 1979:159), while amongst the G/wi only 13 species are of major dietary significance (Silberbauer 1972:183). It is the natural storage organs of plants, such as bulbs, corms, roots, rhizomes, seeds and nuts, that are mostly used for staple foods (Table 74) because they keep well and are available over long periods during the year. Fruits and leaves are more seasonal and do not generally last as long unless they are dried.

Table 73 summarizes the estimated meat yield from animals caught and hunted by a ≠Xade band during a year (Silberbauer 1972: table 7-2) and reflects several factors. Firstly, although fewer large animals were successfully killed, they provided the main source of meat by weight; the smaller game provided less meat, but kills were spread throughout the year. The smaller animals must therefore be seen as providing a more regular, if less spectacular, source of protein. Secondly, there is a clear difference between the amount of meat consumed during the months of summer and the amount consumed in the leaner winter months. In this summer rainfall area 65,5% of the annual meat intake is eaten in the six months from December through May.

The seasonal rainfall and hunting pattern affects other parts of the system too. During the summer, for example, the G/wi mostly hunt with poisoned arrows because this is restricted to times of the year when poison grubs are available and for 4-6 months thereafter. Beyond

Table 74. Relative abundance of various types of plant foods from Holocene archaeological sites and ethnographic sources

SITES AND REGIONAL SURVEYS WITH REFERENCES	MELONS AND CUCURBITS	TUBERS, ROOTS, CORMS AND BULBS	SEEDS AND FRUITS	LEAVES
CAPE ECOZONE				
Buffelskloof (Opperman 1978)		xx	x	
Boomplaas (Moffett & Deacon 1977)		x	xx	
Paardeberg (H.J. Deacon, pers. comm.)		xx	x	
Scott's Cave (Wells 1965)		xxx	x	x
De Hangen (Parkington & Poggenpoel 1971)		xxx	x	
Andriesgrond (Parkington, unpublished)		xxx		
Melkhoutboom (Deacon, H.J. 1976)		xxx	x	
Springs (Deacon, H.J. 1976)		xx	xx	
Diepkloof (Parkington 1977a)		xx	xx	
BASUTOLIAN ECOZONE				
Highlands (Deacon, H.J. 1976)		xx		
Tafelberg Hall (Hewitt 1931b)		xx		
Tienfontein 2 & 7 (Brooker 1980)		xx	x	
TRANSVAALIAN ECOZONE				
Bushman Rock Shelter (Plug 1981)			xxx	
Nswatugi (Walker 1980)			xxx	
Kruger Cave (Friede & Pienaar 1974)			xxx	
KAROO-NAMAQUALIAN ECOZONE				
Mirabib (Sandelowsky 1977)	xxx		xx	
Big Elephant Shelter (Wadley 1979)		xxx	x	
MODERN SAN IN KALAHARIAN ECOZONE				
!Kung at Dobe (Yellen & Lee 1976:38-41)	xx	xx	xxx	x
Nharo (Steyn 1971, 1981)	xx	xx	x	x
G/wi (Silberbauer 1965:44-6)	xx	xx	xx	x
≠Kade (Tanaka 1976:117-8)	xx	xx	xx	x
Korana (Engelbrecht 1936)	x	xxx	x	x

this time the poison is either weakened by age, or supplies have run out (Silberbauer 1972:292). In the winter months, on the other hand, trapping or snaring are more suitable than they are in the wet summer months when rain interferes with the strength of the twine (Lee 1979:208). Lee notes also that snaring is not as efficient as bow and arrow hunting in the region in which his observations were made; an additional factor in modern times that may affect the success of hunting expeditions is whether or not dogs were used. Only one small animal was caught per hunter per week from July through August in 1964, although each person regularly set 20 - 25 snares. Furthermore, animals caught in snares accounted for 61% of the kills, but only 20% of the meat during the four weeks that observations were made (Lee 1979:209). While snaring proficiency may have been better in different regions and at other times in the past, this observation nevertheless suggests that the introduction of the bow and arrow must have changed the hunting methods of LSA peoples considerably.

Another aspect of the Kalahari hunter-gatherer system affected by the differences in availability of food and water in summer and winter is the settlement pattern. Amongst the G/wi, for example, the people tend to live in larger groups during the summer when there is standing water available, melons are in season and larger animals are hunted, but in the leaner winter months when surface water is scarce, the groups fragment and disperse. The !Kung, on the other hand, fragment into smaller groups during the summer when mongongo nuts and fruits are plentiful and aggregate during the dry winter season. There seems to be a correlation between the availability of water, which can vary quite considerably from one part of the Kalahari to another, and the fluidity of groups in socio-territorial organization (Barnard 1979:140-1). Barnard points to a ranking of San groups from !Ko through G/wi to !Kung and Nharo in terms of most nucleated to least nucleated that corresponds with the ranking of least water to most water available in each territory. Thus, although the Kalahari may seem to be a 'uniform' environment to the outsider, it is the local variations in topography and substrate that control the amount and seasonal availability of surface water and, ultimately, the socio-territorial structure and seasonal movements of the people living in that vicinity. For this reason it is unwise to assume that a particular seasonal pattern of aggregation and dispersal correlates with a particular rainfall regime. The reality is a complex interplay of a number of factors, not all of which are predictable from the standpoint of the non-hunter-gatherer in the 20th century.

A strong pattern that emerges from the ethnographic studies is the regional adaptation to a preferred set of staples, despite the fact that the plant lore includes knowledge of a much wider range of plants. The essential element here is security. Hunter-gatherers need to know which plants can provide the most assured yield throughout the year and it is these which become the staples. The growth regimes of individual taxa determine when they are usable, which in turn imposes a seasonal rhythm on exploitation making it necessary to know what is available, in what quantity and at what location. Together with a knowledge of where secure water supplies are to be found through the year, the collecting of plant foods requires continual evaluation of information on availability that could affect and indeed structure the residential pattern and the size of groups.

Archaeological evidence for subsistence

Studies of the archaeological evidence for Holocene subsistence were begun in the 1930s (Hewitt 1931a; Goodwin 1938), but have become common only since the early 1960s (Deacon & Deacon 1963; Hendey & Singer 1965; Wells 1965). There is now considerable emphasis given in archaeological research in southern Africa to the recovery of food waste, its quantitative and qualitative analysis and the interpretation of aspects of subsistence ecology. While floral and faunal studies are limited by preservation factors at open sites, the majority of caves and rock shelters as well as some open middens have bone preserved, while dry cave deposits generally preserve some plant food remains. The synthesis of Holocene food waste analyses will be discussed below under the headings of faunal evidence, plant remains and marine resources, with a final section on the evidence for seasonal transhumance.

Faunal evidence. The fauna from all sites that post-date ca 8000 B.P. includes only those animals that were present in southern Africa in historic times and the 'mix' of larger mammals is usually what might be expected from analogies with present-day hunter-gatherers and our knowledge of animals present in the vicinity of the sites in historic times. In line with the functioning of Holocene subsistence economies within territorial ranges of limited size, migratory herd animals such as springbok, zebra, wildebeest and buffalo are not prominently represented, but there is good evidence for the regular hunting of small and small-medium bovids such as grysbok/steenbok, bushbuck, duiker, vaalribbok, mountain reedbuck and southern reedbuck on a regular basis. This gives the Holocene faunas a smaller mean body weight per individual animal than those of the late Pleistocene (Deacon, H.J. 1972, 1976; Klein 1972b, 1974, 1977, 1980; Thackeray, J.F. 1980), particularly in the western, southern and eastern Cape where habitat changes were apparently more drastic than in the grassland regions to the north. Table 75 summarizes the frequencies of particular species at a number of Holocene sites to illustrate the regional differences and general reliance on small bovids. It should be noted, however, that the absence or low frequencies of small animals such as rodents, lizards, frogs and birds is due to the fact that faunal analysts have not always included these in their lists partly because they may accumulate naturally in cave and rock shelter deposits, and partly because of difficulties involved in identifying them to species level.

The generally smaller size of the animals hunted during the Holocene (accompanied by a corresponding increase in the minimum number of individuals (Table 76)) has received comment because of the implications of this change in terms of hunting methods and weapons, seasonal movements and a stable meat supply. The habits of the bovids are of particular interest in this regard. The grassland herd animals such as springbok, impala, wildebeest, zebra, buffalo and hartebeest tend to move seasonally with the grass growing regime, congregating in large herds at the end of the dry season and dispersing to better grazing in the summer, but still in fairly large herds. Their constant mobility would necessitate an equally mobile hunting strategy. By contrast, the smaller non-gregarious browsers such as grysbok, steenbok, bushbuck, duiker and klipspringer and the solitary grazers such as the oribi, mountain reedbuck, southern reedbuck and vaalribbok, live in fixed territories that do not change seasonally. They live in small groups, in pairs or singly, and tend to hide during the day and feed in the early morning, evening or at night (Dorst & Dandelot 1970). Their predictable daily movements and life-style make it easier for them to be caught through trapping and snaring than by projectile hunting. Non-gregarious animals can be hunted with equal success throughout the year and are more successfully hunted by

COMPOSITION OF FAUNAL SAMPLES FROM HOLOCENE LATER STONE AGE SITES IN SOUTHERN AFRICA COMPARED WITH ANNUAL KILLS OF MODERN G/WI

	Western Cape coast		Southern Cape coast		Cape Folded mountains		Northern Cape-Orange Free State a. Bushveld		b. Grassveld		Namibia		Natal		Modern G/wi	
	f	% Total bovids	f	% Total bovids	f	% Total bovids	f	% Total bovids	f	% Total bovids	f	% Total bovids	f	% Total bovids	f	% Total bovids
Bovids																
small	333	86,0	162	47,5	278	52,6	35	42,2	63	30,1	33	56,9	18	36,7	133	60,5
small-medium	16	4,1	85	24,9	158	29,9	19	22,9	107	51,2	19	32,8	18	36,7	32	14,5
large-medium	19	4,9	27	7,9	68	12,9	25	30,1	35	16,7	6	10,3	9	18,4	46	20,9
large	19	4,9	67	19,7	25	4,7	4	4,8	4	1,9	-	-	4	8,2	9	4,1
TOTAL	387	99,9	341	100,0	529	100,0	83	100,0	209	99,9	58	100,0	49	100,0	220	100,0
	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids	f	ratio to bovids
Equids	-	-	-	-	20	1:26	23	1:25	20	1:10	9	1:6	1	1:49	-	-
Hippopotamus	2	1:194	10	1:34	1	1:529	1	1:83	-	-	-	-	1	1:49	-	-
Rhinoceros	2	1:194	-	-	2	1:265	6	1:14	1	1:209	1	1:58	-	-	-	-
Elephant	1	1:387	-	-	3	1:176	-	-	-	-	-	-	-	-	-	-
Giraffe	-	-	-	-	-	-	1	1:83	-	-	-	-	-	-	-	-
Bushpig/warthog	1	1:387	29	1:12	49	1:11	8	1:10	23	1:9	1	1:58	5	1:10	1	1:220
Aardvark	-	-	-	-	1	1:529	-	-	10	1:20	-	-	2	1:25	-	-
Clawless otter	-	-	12	1:28	-	-	-	-	3	1:70	-	-	-	-	-	-
Pangolin	-	-	-	-	1	1:529	-	-	1	1:209	-	-	-	-	-	-
Porcupine	7	1:55	23	1:15	14	1:38	6	1:14	16	1:13	-	-	2	1:25	2	1:110
Honey badger	4	1:97	-	-	2	1:265	2	1:42	-	-	-	-	-	-	-	-
Hyrax (dassie)	45	1:9	162	1:2	193	1:3	18	1:5	80	1:3	79	1:0,7	16	1:3	-	-
Hare	10	1:39	-	-	46	1:12	32	1:2,5	70	1:3	35	1:1,7	11	1:4	222	1:1
Tortoise	+58	----------	----------	----------	data incomplete or absent					----------	52	1:1	+3	-	390	1:0,6
Lion	-	-	-	-	-	-	1	1:83	-	-	-	-	-	-	-	-
Leopard	2	1:194	8	1:43	5	1:106	-	-	3	1:70	-	-	-	-	-	-
Caracal	3	1:129	8	1:43	14	1:38	4	1:21	5	1:42	1	1:58	1	1:49	-	-
Wildcat/genet	15	1:26	5	1:68	21	1:25	3	1:28	7	1:30	5	1:12	1	1:49	-	-
Jackal/fox/aardwolf	11	1:35	9	1:38	7	1:75	10	1:8	18	1:12	2	1:29	3	1:16	32	1:7
Mongooses	10	1:39	23	1:15	43	1:12	7	1:8	19	1:12	3	1:19	3	1:16	-	-
Rodents	1449	1:0,3	----------	----------	data incomplete or absent										295	1:0,7
Sheep	35	-	8	-	20	-	3	-	-	-	?1	-	-	-	-	-
Cattle & ?cattle	?2	-	-	-	6	-	5	-	9	-	-	-	2	-	-	-
? Domestic dog	?2	-	?1	-	-	-	-	-	-	-	-	-	-	-	-	-
Seal	146	1:3	235	1:1,5	-	-	-	-	-	-	-	-	-	-	-	-
Cetaceans	+9	-	22	1:16	-	-	-	-	-	-	-	-	-	-	-	-
Marine fish	numerous		numerous		-	-	-	-	-	-	-	-	-	-	-	-
Freshwater fish	-	-	-	-	present		-	-	-	-	-	-	133	-	-	-
Birds	+106	----------	----------	----------	data incomplete or absent					----------	15	1:1,4	no data		161	1:1,4
Sites represented (for references see Table 12)	EBC, PAT, DK, GB, BY		NBC, KR, KRM		WT, MHB, BUF, BPA, AKI, SS		DF, POW, LW, LI, LIM, DIK, DIK2, BUR		BL, ZY, RM, GL, TIE, LEM, VEN		AP, FA, TIR, NAM, NOS, AAR, HA, POC		DR, GH			

Bovid size categories: small (0-23 kg live weight): duiker, grysbok, klipspringer, oribi, steenbok

small-medium (23-84 kg): bushbuck, mountain reedbuck, southern reedbuck, vaalribbok, blesbok, bontebok, impala, springbok

large-medium (84-296 kg): kudu, blue antelope, hartebeest, wildebeest, gemsbok

large (more than 296 kg): eland, buffalo people working on their own or in small groups. Larger browsers and mixed feeders such as the eland, Cape buffalo, kudu and blue antelope are intermediate in habit between the gregarious grazers and non-gregarious browsers as they move in small herds with some seasonal movement to take advantage of the best grazing.

The expectation of Story (1958) was that hunting would have played a more prominent role in the economy of grassland systems which supported large herds of gregarious grazers in historic times. Where archaeological samples are available to test this in the northern Cape they show plains game at some localities but unfortunately the vast majority of the known sites in this region are in the open and bone is not preserved. Analysis of the faunal remains from thirteen late Holocene sites in the Middle Orange River valley showed that there is a contrast in the range of taxa at sites in or near bushveld vegetation and those near grassveld, with the obvious corollary that animals common in the grassveld occur more frequently in the grassveld sites (Klein 1979). This can be seen in Table 75 which shows an increase in small-medium bovids from 22,9% in the bushveld sites to 51,2% in the grassland ones due to a higher proportion of springbok in the latter. In other regions equids are relatively more common in the Cape Folded Mountain sites, in the northern Cape, Orange Free State and Namibia than they are in the southern Cape coastal localities, while the Cape buffalo accounts for the high percentage of large bovids in the southern Cape coastal sample. Seen in broad overview, the emphasis on smaller bovids that is observed ethnographically is also clear in the archaeological samples.

Plant remains. As in the case of faunal remains, archaeological sites cannot provide complete information on the range and quantity of plant foods eaten by Holocene people because only the inedible residues of plants collected and processed at the home base are preserved there. Many plants have little or no inedible residue, others are eaten away from the home base, and those that do have inedible residues have different quantities per unit consumed and different preservation properties. These factors combined make it difficult, if not impossible, to estimate accurately the minimum numbers of any plant that may have been eaten. What plant remains can show, however, are inter-regional differences in the range of plant foods and medicinal plants and at least a partial view of the taxa of economic importance; here ethnographic and historical

Table 76

Changes in the size and habits of bovids hunted at Boomplaas Cave over the last 20 000 years (after Klein 1978b). The figures show a shift from larger equids and alcelaphines to smaller antelope from the late Pleistocene to the late Holocene that is statistically significant.

		STRATIGRAPHIC UNITS			
		DGL, BLD, BLA	BRL	CL	LP/LPC
Mountain reedbuck, vaalribbok, klipspringer, grysbok/steenbok	f	38	62	17	6
	%	(81)	(65)	(22)	(14)
Equids and alcelaphines	f	9	33	59	38
	%	(19)	(35)	(78)	(86)

Selected chi-square values:

			Chi-square	p (two-tailed)	
DGL-BLA	vs	BRL	3,65	.10 - .05	
DGL-BLA	vs	CL	40,14	.001	
DGL-BLA	vs	LP/LPC	41,04	.001	
BRL	vs	CL	31,22	.001	
BRL	vs	LP/LPC	32,01	.001	
CL	vs	LP/LPC	1,33	.30 - .20	(not significant)

records of the uses and methods of preparation of plants is invaluable (Quin 1959; Smith, C.A. 1966; Heinz & Maguire 1974; Steyn 1981).

One of the largest and most intensively studied assemblages of plant remains has come from horizons dating within the last 7500 years at Melkhoutboom Cave in the eastern zone of the Cape Folded Mountain Belt (Deacon, H.J. 1976). It shows that the most common plant residues preserved are from monocotyledenous geophytes of the iris family (Iridaceae) represented by corm bases and tunics of the underground storage organs. Melkhoutboom is some 40 km inland and 800 m above sea level, yet the plant remains include all the taxa found at a comparably well preserved but much younger occurrence at Scott's Cave situated less than 100 m above sea level in the Gamtoos Valley close to the southern Cape coast (Deacon & Deacon 1963: Wells 1965). This is evidence for a stable adaptation to a particular set of plants with wide geographical and seasonal availability in this habitat, an adaptation essentially similar to that observed amongst present-day San in the Kalahari. The southern Cape pattern shows that most of the collecting activity was directed at the open heathland and grassland areas in the vegetation mosaic, a contrast to the more closed shrubland-woodland habitats exploited by the hunters living at the same sites.

Correlation of the data on plant food remains from a number of western, southern and eastern Cape sites (Table 74) shows that geophytes are most commonly represented, and of these Watsonia sp. corms are ubiquitous. The dominance of this genus is related to its high visibility through much of the year as the leaves above the ground are generally longer and heavier than those of other genera and do not blow away at the end of summer. In addition the individual corms are somewhat larger than those of other species such as Cyperus usitatus, Moraea sp., Freezia/Tritonia spp. and Hypoxis sp., all of which have a shorter seasonal visibility. Regional differences can be seen in the western Cape where plant remains from the sandveld site of Diepkloof show Gladiolus sp. corms to replace those of Watsonia in numerical importance and seeds are better represented, in particular those of the tortoise berry, Nylandtia spinosa (Parkington 1976, 1977a). In the summer rainfall region of central Namibia, however, Wadley (1979) notes the occurrence of Cyperus fulgens corm tunics at Big (Great) Elephant Shelter which flourish after the summer rains have fallen. Corm-dominated samples have also been recorded from Highlands and Tafelberg Hall in the Cape Midlands with Cyperus usitatus and Freezia corymbosa predominating (Hewitt 1931b; Deacon, H.J. 1976).

As noted in Chapter 4, pits containing seeds of Pappea capensis were found at Boomplaas and similar pits with Calodendron and Pappea seeds are known from the same time range (ca 2000 B.P.) at Melkhoutboom in the eastern Cape (Deacon, H.J. 1976). Seeds of the nara melon are found in southern Namibia at Apollo 11 where they date to between 8000 and 7000 B.P. (Wendt 1976 and pers. comm.) and at Mirabib in central Namibia where they date to ca 6500 B.P. (Sandelowsky 1977). The lack of suitable mid-Holocene sites in the Transvaal makes it impossible to test whether the emphasis on fruits and nuts in that region persisted through the Holocene, but it seems likely to have done from the ethnographic record (Quin 1959) which shows them to be important even today. The importance of nuts in the diet of the !Kung in Botswana has been widely discussed (Lee 1968, 1969, 1972, 1979) and emphasises the pattern evident in Table 74 which shows that while underground plants were of greatest importance to the south, nuts and melons replaced them to the north of southern Africa.

Other gathered foods. Other foods for which we have limited archaeological evidence but which are regularly mentioned by early travellers and ethnographers as providing important but seasonally abundant sources of food include honey, locusts, termites, caterpillars, tortoises, birds' eggs, land snails, lizards and snakes. Honey leaves no archaeological trace but rock paintings illustrate the raiding of hives (Vinnicombe 1976). Portions of termitaria have been found at Melkhoutboom and Springs Rock Shelter (Deacon, H.J. 1976) and at De Hangen (Parkington 1977a:62) where two complete and several fragmentary ovoid 'cakes' packed with the bodies of termites were found. While these may have been the result of the collection of clay from termitaria for making pottery rather than for food, the Melkhoutboom examples pre-date pottery and thus suggest that they may well represent food residues.

Marine resources and freshwater fish and shellfish. The third important element of the Holocene subsistence strategy was fish and shellfish. Substantial numbers of shell middens dating to the terminal Pleistocene and Holocene are known along the southern African coast from Angola in the north-west to Mozambique in the north-east. Open midden sites post-dating ca 3000 B.P. are more numerous than those in caves and rock shelters, but mid-Holocene marine transgressions along stretches of the coast have eroded away some of the early Holocene open sites making these less numerous. Inland, particularly in Natal, Lesotho and the north-eastern Cape, middens of freshwater mussels are known and a few rock shelter sites include the remains of freshwater fish. Sea-shells have been transported as much as 100 km or more inland for use in making ornaments.

It was the expectation of Lee (1965) that hunter-gatherers with access to coastal resources would have relied on these in the same way as the !Kung San rely on mongongo nuts for their staple foodstuff. All archaeological evidence, however, suggests more seasonal use of coastal resources (Deacon, H.J. 1969, 1970, 1972, 1976; Parkington 1972, 1976, 1977a,b, 1981), complementing hunting and gathering activities in the annual round. Their importance seems to lie in offering alternative food resources in the stress period for gathering which in most of the Cape coastal areas is in the winter months, but may have varied from time to time and from place to place.

Following on Goodwin's pioneer studies at Oakhurst (1938) and elsewhere (1946), interest was revived in the study of midden occurrences in the 1960s (Maggs & Speed 1967) and the numbers of observations on midden deposits have grown significantly (Deacon, H.J. 1970; Parkington 1972, 1976, 1981; Klein 1972a; Voigt 1973; Avery, G. 1974, 1975, 1976, Schweitzer 1974, 1975, 1979; Robertshaw 1977, 1978a, 1979; Buchanan et al 1978; Poggenpoel & Robertshaw 1981). Research has centred on the range of species represented, their relative quantities, the relationship of these to local availability and the food values of individual species and communities.

In general it is the intertidal zone along the sea shore that is most heavily exploited with larger shellfish caught below the low water mark being rarer overall and possibly needing spring low tides to allow exploitation. As with hunting and gathering, the mix of species present in an archaeological deposit is a reasonably good reflection of what was available in the immediate vicinity of the site. This has been confirmed by several studies (Deacon, H.J. 1970; Avery, G. 1974; Parkington 1976; Robertshaw 1977, 1979; Buchanan et al 1978; Schweitzer 1979). Thus middens along sandy shores will contain sand-burrowing mussels such as Donax serra, while those near rocky promontories will contain limpets and mussels which prefer a rock substrate. Middens with larger shells, such as Haliotis, tend to be located closer to the sea as the shells were probably shucked there (Avery, G. 1974:111). The frequency of middens along a shore may be influenced by the nature of the shoreline. Where rocky promontories are more isolated, as around Elands Bay, the middens are larger, deeper and more localized adjacent to rocky intertidal shores, and they have remarkably similar contents. By contrast, middens around Paternoster along a coast where short stretches of rocky shore are separated by short sandy beaches have more variable contents (Buchanan et al 1978).

Along the south-western Cape coast, Parkington (1976) and others have attempted to estimate how long prehistoric shellfish collectors may have remained at the coast and whether the resources could have sustained long-term predation. They have assumed that the mean length of limpet shells is a reasonably good reflection of the upper size range of limpets available on the rocks at the time of collection. Data collected along the coast between the mouths of the Berg and Olifants Rivers suggest that predation as reflected in shell middens dating within the last 3000 years was of the order of 40% of the live population at any point in time. Depending on the size of the LSA groups, this implies that intense exploitation could not have been sustained for much longer than 3-4 months a year (Parkington 1976:135-7). A similar pattern is reported from the coast south of the Berg River mouth at Paternoster (Robertshaw 1977) and Duiker Eiland (Robertshaw 1979:10).

Fish were caught by lines, by spearing and in tidal fish traps and cold water upwelling may also have provided people with an unpredictable quantity of fish from time to time. There is no physical evidence for the use of nets, but the large number of small fishes caught at some sites suggests they may have been used (Poggenpoel, in prep.). For deposits dating within the last 3000 years at NBC, for example, 95,8% of a sample of over 10 000 individual fishes are estimated to have weighed less than 117 g each. Line fishing is evident from finds of sinkers at NBC and Storms River Mouth (Deacon, H.J. 1970) and Schweitzer (1979:197) notes that the large numbers of hottentot fishes (Pachymetopon blochii) at Die Kelders must have been caught by lines as other methods would have been unsuccessful.

As with shellfish, it is clear that the range of fish species in an occupation deposit is a fairly accurate reflection of the habitats for fishes in the immediate vicinity of the site and that people brought back to the home base those fishes that were most abundant (Deacon, H.J. 1970). Changes in the size range and in the species of fish through time at a site probably reflect the changing morphology of natural pools in the vicinity as much as changes in cultural preferences.

In addition to fish, shellfish and crustaceans, marine mammals such as seals and occasional cetaceans are also represented in the coastal occupation deposits. From the analysis of bird remains, Avery (G. 1977, 1981) has been able to estimate the season of occupation at some sites and from modern surveys of beached birds has suggested that many of the birds and marine mammals were probably scavenged from the beaches rather than actively hunted by LSA people.

Remains of terrestrial mammals at coastal sites attest to the fact that the inhabitants still derived an important part of their diet from hunting and trapping (Table 75). Plant food remains, on the other hand, are rare at coastal sites (Deacon, H.J. 1972), even where other plant remains are preserved and it has been suggested that shellfish gathering probably replaced plant food gathering to a large extent at times when coastal sites were occupied (Deacon, H.J. 1969, 1970, 1972; Parkington 1972, 1976). Because plant food gathering was largely the preserve of women and hunting of men, it is therefore highly likely that the shellfish were gathered by women.

Inland, spawning runs are known on some rivers and were exploited in historic times by the indigenous people living along the Orange River and its tributaries. Rock paintings of inland fishing scenes are also known in the Drakensberg region (Vinnicombe 1965). Fish hooks and bones of freshwater fish have been found at LSA sites in Lesotho (Carter 1978) and Natal (Maggs & Ward 1980) and fish and freshwater mussels, crabs and frogs have been identified from sites in the middle Orange Rive area (Sampson 1967a:147) and at sites in the Cape Folded Mountains (Deacon & Deacon 1963; Deacon, J. 1972; Deacon, H.J. 1976; Parkington 1977b:154). Stone fish traps are also known inland (Willcox 1965). There is, however, no archaeological evidence that the inland riverine resources of southern Africa were exploited on a large scale during the LSA. This is perhaps understandable in that many southern African rivers are highly seasonal in their flow, are subject to long periods of drought in many areas, and do not have a rich fish fauna. The freshwater fish and molluscs have therefore not apparently been more than a supplement to hunting and gathering inland, in contrast to the far more substantial coastal exploitation pattern. What is of interest is that the dating of inland middens and assemblages which include fish bones and fish hooks tends to be late in the Holocene, within the last 2000 years. It has been suggested that this exploitation of an additional resource may have been stimulated by local readjustments in group territories and annual movements as a result of the influx of herders and Iron Age people and the consequent demographic changes (Deacon, J. 1969, 1972) and it has also been seen by Parkington (1980:83) as part of a general trend in the later Holocene towards broad spectrum gathering.

Evidence for seasonal transhumance during the Holocene. Assessment of the season of occupation of sites from the floral and faunal remains has been a subject of interest since Bowker (1884), Goodwin (1953:152) and others pointed out the implications of seasonal movement. But while it has long been realised that LSA people moved to take advantage of seasonal abundances (Clark 1959:217), it is only recently that good data have been produced to demonstrate it. The plant remains from Scott's Cave (Wells 1965), Melkhoutboom, Springs and Highlands in the eastern Cape (Deacon, H.J. 1976) and from De Hangen and Diepkloof in the western Cape (Parkington 1972, 1976, 1977a,b) provided the first clear evidence for spring and summer occupation inland in the Cape Folded Mountains and nearer the coast. A local record from the Langkloof in the southern Cape describes seasonal movements of the last bands of San in the 19th century and reports that they moved to the coast in summer and to the mountains in winter (Deacon, H.J. 1969, 1970, 1976), but a careful analysis of the historic records and archaeological data in the western Cape shows that the mountain zone was favoured there in the summer and the coast in winter (Parkington 1972, 1977a,b; Avery, G. 1975). This apparent contradiction between the southern and western Cape data is explicable, however, in terms of the different rainfall regimes of the two areas, the western Cape having predominantly winter rain and the southern and eastern Cape having rain at all seasons of the year, but predominantly in spring and autumn. The rainfall regime has a strong influence on the seasonal abundance of underground plant foods, particularly the Iridaceae, and as these appear to have been the staple plant foods of LSA people it is logical that their movements would have been governed by the timing of the season of maximum abundance, as is also the case amongst the present-day San in the Kalahari.

The southern and eastern Cape with a relatively high rainfall and no marked seasonal peak shows no clear contrast in the seasonality of archaeological remains between mountain and coastal plain sites. There are instances of spring and summer occupation both inland at Melkhoutboom (Deacon, H.J. 1976) and near the coast at Scott's Cave (Wells 1965). Few data are so far available on the season of occupation at coastal sites in this region, but what is available suggests that occupation of the sites could have taken place at several times during the year. Analysis of the $^{16}O/^{18}O$ ratio in a small sample of two shells from ca 6000 year-old levels at NBC indicates that both were collected in the winter or early spring (Shackleton 1973). The age at death of seals from the Holocene levels, on the other hand, shows a less seasonal pattern and individuals could have been caught or collected at several different times of the year (Parkington 1976: 138-9 and pers. comm.) while historical records indicate that herders were met in that area during both spring (Sparrman 1785) and summer (Storrar 1978:16).

Assessment of a regular pattern of transhumance in the southern and eastern Cape may be further hampered by the possibility that changes occurred through time and that radical adjustments were necessitated after the introduction of domestic stock. The data on seals from NBC have not yet been subdivided according to level, but the samples are small and even if shifts are noted through time, these may not prove to be significant. That a change in the seasonal pattern may have occurred was first suggested after a shift was observed after 2500 B.P. in the relative frequency of marine and freshwater shells at the Wilton name site in the Cape Folded Mountains, the latter becoming more common. This intimated that either the coast was not being frequented as often as before, or that there had been a change in the season of occupation of the site (Deacon, J. 1969, 1972). The latter possibility was considered more likely with the identification of the late summer/autumn flowering Cyperus usitatus in the surface levels at the nearby site of Melkhoutboom where it was not found in the pre-pottery levels despite excellent preservation of plant remains (Deacon, H.J. 1976).

Independent evidence on dietary changes was sought in the analysis of the $^{13}C/^{12}C$ ratio in human bones from 67 burials in the eastern Cape (Silberbauer, F. 1979), but the results have proven to be complicated by the fact that the isotopic composition of milk from sheep and cattle enriches the ^{13}C content of bones in the same way as marine foods and the consumption of meat from mixed feeders (as opposed to purely browsers) in that region. Nevertheless, from the very small number of dated individuals (2) it seems that those from ca 8000 to ca 5000 B.P. had a lower intake of marine foods/mixed feeders/milk than those of the later Holocene and that, although there was some overlap, individuals judged from burial style and other factors to have been hunter-gatherers differed from those judged to have been herders in the mean ^{13}C content of their bones. Thus, while we have some intimation that changes occurred in the seasonal pattern and the relative importance of marine foods through the Holocene, more intensive work is needed to resolve the details.

In the western Cape the seasonal contrasts between mountain, coastal plain and coast are apparently greater than in the southern and eastern Cape and this is reflected in the archaeological data. The relative paucity of staple plant foods on the coast and adjacent sandveld of the coastal plain, and the high risk of toxicity amongst marine mussels and other filter feeders during the summer combine to suggest that people would have been better off inland amongst the mountains and intermontane valleys during the summer, while the relative lack of plant food staples everywhere during the winter encouraged people to move to the coast to exploit marine resources at that time (Parkington 1972, 1976, 1977a,b). That people were present in the mountains during summer is confirmed by analysis of the age at death of dassie (rock hyrax) remains at De Hangen, by the occurrence of corm remains indicating summer collection and by the relatively high incidence of tortoise bones (tortoises tend to hibernate in winter and are therefore more easily collected in spring and summer (Parkington 1977b:154)). Along the coast, on the other hand, Parkington (op. cit.) has shown that seals from the Elands Bay terminal Pleistocene and early and late Holocene sequence were killed or collected over a very short time span between July and October. This highly restricted time period seems to be confirmed by the assessment of growth rings on seal teeth (Fletemeyer 1977). In addition, tortoise remains are relatively rare and the large quantities of mussels here and at other sites in the vicinity also suggest winter occupation. Combined with observations on limpet shell sizes which indicate a short-term annual exploitation pattern, there is good evidence for the hypothesis of seasonal mobility with regular transhumance involving summer occupation on the mountains and winter occupation along the coast. A functional interpretation of formal tool frequencies by Mazel & Parkington (1978, 1981) and Parkington (1980) gives some support for mobility in that the relative frequencies of formal tools differ at mountain, sandveld and coastal sites.

The pattern of seasonal mobility documented from the archaeological evidence in the western Cape may not have applied everywhere in the western and south-western Cape, however. Analysis of the shellfish and marine bird remains at Paternoster to the south of Elands Bay indicates summer occupation at the coast from about 3500 B.P. to about the time that pottery was introduced, while the uppermost level, dated just after 900 B.P., shows autumn occupation (Avery, G. 1977; Robertshaw 1977: 71-2). Robertshaw (op. cit.) suggests that the alternative strategy adopted by people who occupied the Paternoster site is the result of a narrower coastal plain in the vicinity bringing a more varied set of habitats closer to the coast and reducing the necessity for a clear-cut division between summer and winter habitation sites. This type of variability both through time and through space needs to be documented further before any firm patterns can be established.

The seasonal patterns would have been different also inland of the Cape Folded Mountains where rainfall is generally low and falls more often in summer than in winter, resources are more evenly distributed and coastal resources were not available as a release from stress in seasons of low plant food abundance. Humphreys (1979:378), in writing about the northern Cape, has stressed the uniformity of resources and the general similarity of faunal remains and formal tool frequencies at these sites and suggests that this reflects a diversified hunting strategy that was not geared to a seasonal pattern because the habitats of the animals did not warrant it. This assumption, however, does not take plant foods into account because no plant food remains have been preserved at the sites investigated. That seasonal abundance and scarcity did affect the plant food collecting pattern in this region is clearly evident from the ethnographic study of the Korana by Engelbrecht (1936). The uniformity in the sites studied by Humphreys (which include those from the Gaap Plateau as well as the middle Orange River) may thus be present in the fauna only. Modelling of seasonal movements in the middle Orange River catchment area is currently being investigated by Sampson (1980) and the role of plant foods and their seasonal pattern is to be given due weight.

Data on seasonal occupation at Namibian sites are not yet published in full (Wendt 1976), but analysis of the plant materials, birds' eggs and fauna from the Big Elephant Shelter in central Namibia has established that this site at least was utilized for short periods at all times of the year (Wadley 1979). Data are not yet available for the analysis of seasonal movements in Zimbabwe and Botswana either, but would be particularly interesting for the latter because modern collecting patterns are well documented and can be used for comparison (Yellen 1977). Some summer occupation at sites in the Matopos in Zimbabwe is indicated by the finding of marula endocarps (Walker 1980).

Inland, and some distance from the coast, a highly seasonal pattern of transhumance has been hypothesized for the Lesotho and Natal Drakensberg region and the adjacent Natal Midlands that is based more on game movements than on plant food cycles. Carter (1970, 1978; Cable et al 1980) notes that the historically documented movement of game into the higher mountain pastures in summer would have encouraged the movement of hunter-gatherers into the mountains to make use of this resource, while the severe winters in the higher mountains would have discouraged hunter-gatherer occupation at that time of year. Support for the hypothesis is given in the occurrence of bones of the freshwater fish Barbus natalensis in the late Holocene levels at Sehonghong which could only have been collected during summer (Carter 1978:225). Winter occupation of Melikane and Belleview situated lower down the mountain slopes, on the other hand, is assumed on climatic data that show no extremes of winter cold thus allowing the growth of winter grazing and ensuring the availability of wood for fuel. Circumstantial evidence for summer occupation of Good Hope shelter in the Highland Sourveld of Natal is proposed on the occurrence of a higher frequency of convex scrapers there. The assumption is that these indicate a lesser emphasis on plant food collecting than is apparent at sites in the Thornveld/ Mixed Podocarpus forest regions of the Natal Midlands where notched scrapers are more numerous. The notched scrapers are thought to reflect woodworking and in particular the manufacture and maintenance of digging sticks used for collecting plant foods (Cable et al 1980).

Evaluation of the evidence for seasonal transhumance during the Holocene needs to take a number of variables into account. Barnard (1979) has pointed out that the availability of water, both its abundance seasonally and its location, has an important influence on the movements of modern hunter-gatherers in the Kalahari and it undoubtedly affected prehistoric people even in better-watered areas. The important point he makes, however, is that local differences in water availability cross-cut other seasonal regularities such as the abundance of plant foods and movements of game, making it difficult to predict a prehistoric seasonal pattern with knowledge only of the rainfall regime and staple plant foods. What the archaeological data show is that changes also occurred through time with shifts in the subsistence economy probably coincident with the introduction of domestic stock. While gross variability may be introduced with changes from one rainfall regime to another and with inter-regional differences in staple plant foods, the viability of hypotheses and archaeological data also depends on estimates of the size of the territory over which people may have moved during a year. Some of the models offered are unrealistic in this regard. A final point is that several independent lines of evidence need to be sought in order to test a seasonal hypothesis fully. Evidence from plant food remains that a site was occupied in a particular season is not necessarily evidence that the site was not occupied at other seasons. The archaeological data that have been amassed so far bear ample witness to the complexity of both the prehistoric patterns of seasonal movement and the evaluation of the remains, but the general conclusion is that it was plant foods and their natural seasonal rhythm that controlled in turn the seasonal movements of the people exploiting them.

LATE HOLOCENE ASSEMBLAGES WITH POTTERY

Southern African stone artefact assemblages which include pottery and, in many cases, the bones of domesticated sheep/goat and/or cattle, have been grouped together here because the advent of these new elements within the last 2000 years or more is evidence of the spread of a new technological development in the manufacture and use of baked clay pots, and a modification of the traditional hunter-gatherer-fisher economy with the introduction of domesticated stock exotic to the sub-continent. However, here as in eastern Africa (Phillipson 1977:81), the new additions were not generally accompanied by a change in the stone artefact manufacturing system although there are gradual changes within the sequences involving the relative frequency of some formal tools and the size and shape of scrapers. The overall impression is that pottery and domestic stock were added to the pre-existing Stone Age tradition and that there is continuity in the range of stone tools made in each region. Within southern Africa as a whole there is regional differentiation in the styles of pottery made and in the size of scrapers (Deacon, H.J. 1972; Sampson 1972, 1974) that post-dates ca 2000 B.P.

This regional differentiation is expressed in the recognition of a Smithfield Complex, a Ceramic Wilton and a Strandloper Complex that are broadly contemporary (Sampson 1974). As defined by Sampson, the Smithfield is found in the northern Cape, the Transvaal and Natal, with some sites in the Brandberg in Namibia; the Wilton is found in Zimbabwe, parts of Namibia and the western, southern and eastern Cape as well as the Drakensberg region; and the Strandloper Complex is found along the coast. Humphreys (1979), on the other hand, considers the Smithfield to be an integral part of the Wilton Complex and the characteristic long end scrapers of the Smithfield to be merely the result of the use of hornfels in some areas, while Beaumont (pers. comm.) recognizes three industries in the northern Cape: the Ceramic Wilton, the Smithfield and a Ceramic LSA with no microliths and uncommon informal scrapers which could be an inland equivalent of Sampson's Strandloper Complex. This variability in archaeological nomenclature merely serves to stress the variability observed in this time range, particularly inland of the Cape Folded Mountains.

Sampson's Smithfield Complex (formerly Smithfield B of Goodwin and Van Riet Lowe (1929)) is characterized by late assemblages in which pottery is associated with stone artefact assemblages that include long end scrapers made in hornfels in the northern Cape and Natal (Fig. 158) and somewhat smaller scrapers in other raw materials in the Transvaal and Namibia. Backed microliths are rare or absent. Added to this tool-kit in Natal are numbers of spokeshaves (=notched, hollow or strangulated scrapers), the type tool of the original Smithfield N and thought to be functionally equivalent to the adzes of the western Cape. At the top of the northern Cape and other sequences glass, glass beads, metal (usually copper or brass) and other European trade items may be found. In 1974 Sampson reported that all the Smithfield assemblages post-dated A.D. 1000, but more recent research indicates that this dating may be changed to post-date A.D. 100 (Maggs & Ward 1980), at least in Natal.

The Ceramic Wilton as seen by Sampson (1974) is at a different hierarchical level from the Smithfield Complex to stress the continuity in stone artefacts in pre- and post-pottery Wilton Complex assemblages. The reason is that assemblages grouped into the Ceramic Wilton do not show an increase in scraper length within the last 2000 years and retain more backed microliths than contemporary assemblages in the Smithfield Complex. A good example of this continuity can be seen in the assemblages from Boomplaas. Ceramic Wilton assemblages may show a reduction in the frequency of formal tools, a reduction in the relative frequency and variety of backed microliths and in some sites an increase in the range and number of bone tools (Schweitzer 1979). Copper and brass are associated with stone artefacts in the upper levels at some sites (e.g. Boomplaas and Andriesgrond (Parkington, pers. comm.) as are glass beads in some areas (Wendt 1972; Wadley 1979). In the southern and western Cape there is some evidence for an increase in the frequency of adzes (Mazel & Parkington 1978, 1981; Schweitzer & Wilson 1982).

The third set of assemblages associated with pottery are linked together by Sampson (1974) as 'Strandloper' sites. At most coastal sites there is an element of large unretouched flakes and flaked cobbles associated with shell middens and a generally low frequency of formal tools. This pattern is sometimes exaggerated and assemblages may then contain no formal tools at all as at Scott's Cave (Deacon & Deacon 1963) and a number of shell middens (Avery, G. 1974; Robertshaw 1977, 1978a,

FIG. 158

ARTEFACTS FROM LATE HOLOCENE ASSEMBLAGES IN WHICH LONG END SCRAPERS PREDOMINATE AND IN WHICH POTTERY CAN OCCUR

1-7: Burchell's Shelter, northern Cape (after Humphreys 1979:fig. 34)

8: Glen Elliott level II (after Sampson 1970: fig. 32)

9-12, 16: Glen Elliott level II (after Sampson 1967a)

13-15, 17, 18: Glen Elliott level III (after Sampson 1967a)

19-28: Zaayfontein Level V (after Sampson 1967b:87-90, 1970:165)

29: Tafelberg Hall (after Deacon, H.J. 1976: fig. 60)

30: Highlands (after Deacon, H.J. 1976: fig. 63)

31-33: Wilton large rock shelter layer 1 (after Deacon, J. 1969: plate 2)

Scrapers: 1-5, 9-14, 17, 19-23, 26, 27, 29-33

Backed microliths: 6, 7, 15, 18, 23

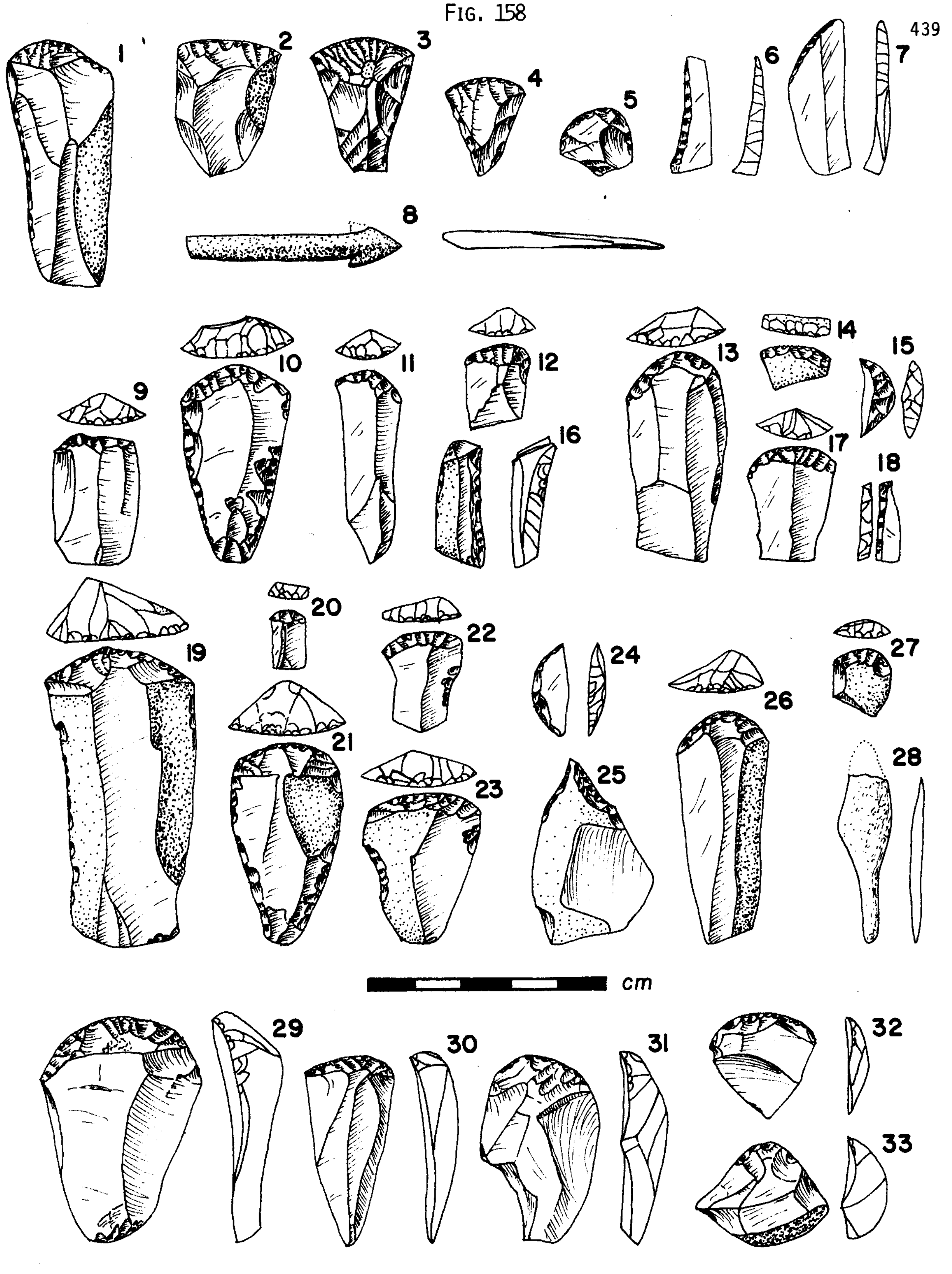
Adze: 16

Borer: 25

Tanged bone arrowhead: 8

Iron arrowhead: 28

FIG. 158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1979). While many researchers consider that such assemblages represent activity variants of those containing formal tools as well, Sampson (1974:436 ff) considers that they may represent the occupation sites of the so-called Strandlopers or Fishermen described by early European settlers (Thom 1952:80) who regarded them as ethnically and economically distinct from other local herders and hunter-gatherers. While this may be the case, there seems little way in which this hypothesis could be tested,but it is of interest that assemblages without microliths and with only a few informal scrapers are associated with pottery as far inland as Doornfontein in the northern Cape (Beaumont & Boshier 1974) and in Namibia (Jacobson 1980). These would presumably not be relatable to the Strandlopers.

In comparing pre- and post-pottery assemblages in general, the change most commonly observed is a reduction in the frequency of backed microliths and segments in particular. It is possible that this may relate to the introduction of metal at least after A.D. 300 when Iron Age people were already settled south of the Limpopo, and the replacement of stone inserts by metal ones. Alternative explanations have been offered by Humphreys (1979:366) and Sampson (1974:376). Other new items which appear in this time range are smoking pipes of stone and bone at Highlands (Deacon, H.J. 1976) and in Gordonia (Rudner, J. 1971:139) in the northern Cape and in the Brandberg in Namibia (Rudner, J. 1957), bone hooks assumed to have been used for fishing in the Drakensberg region (Carter 1978; Maggs & Ward 1980; H. Opperman pers. comm.), and stone-walled fish traps along the southern Cape coast (Goodwin 1946; Avery, G. 1975) and inland (Willcox 1965). Matting, presumed to be linked to the manufacture of mat-covered huts by herders, is preserved at sites where other items such as wooden artefacts, cordage, netting and leather have also been preserved (Grobbelaar & Goodwin 1952; Deacon, H.J. 1969; Parkington & Poggenpoel 1971; Humphreys 1974a; Wadley 1979). However, with the exception of matting for huts and pottery for cooking and for storing milk and milk products, there do not seem to be any artefacts linked to a herding economy.

As mentioned above, there is some regional differentiation of pottery styles. Rudner (1968) has recognized a Cape coastal ware that is similar to pottery from Namibia (Sydow 1967) and is found along the coast from southern Namibia to the eastern Cape and inland along the lower reaches of the Orange River and to the inland margin of the Cape Folded Mountains. It is characterized by a range of pointed based pots with internally reinforced lugs and incised decoration on the neck and rim (Fig. 159). Rarer forms, including spouts and bowls, are also known. The temper is usually quartz grains. The larger pots can be as high as 400 - 500 mm and the smaller pots and bowls are about 80 - 150 mm high.

Inland, in the northern Cape, smaller bowls with thicker walls and heavily impressed decoration (Sampson 1972, 1974; Fig. 159) are commonly made with grass rather than quartz temper and are regarded by Rudner (1979) as having been made by San hunter-gatherers rather than herders or Iron Age farmers. In Zimbabwe (Cooke 1979), the Transvaal (Mason 1974) and Natal (Maggs & Ward 1980) the pottery recovered from LSA contexts has been limited in sample size, but the affinities in decoration and pot shapes are considered to lie with the Iron Age tradition rather than with the Cape coastal or the northern Cape wares.

There has been much speculation about the ethnic affinities of the people who made the pottery and artefacts dated within the last 2000 years. While some researchers maintain that there is a close correspondence between the historically known Khoi herders and the Ceramic Wilton on the one hand, and the historically known San hunter-gatherers and the Smithfield Complex on the other (Rudner, J. 1968, 1979; Rudner & Rudner 1970; Sampson 1974), others are less convinced (Deacon, H.J. 1976; Deacon et al 1978; Inskeep 1978a; Schrire 1980), if only because we have no factual basis for assuming a one-to-one correlation between stone artefact traditions, pottery styles, subsistence and ethnic and language groups. In a recent review of Khoi settlement at the Cape, Elphick (1977) has used linguistic data collated by Westphal (1963) to suggest that herders met by early Europeans in the southern Cape from the early 16th century onwards were linguistically more similar to Tshu-Khwe speakers in present-day Botswana (a group that includes the G/wi and Nharo hunter-gatherers) than they were to the hunter-gatherers who lived alongside them at the Cape. The implication drawn from this observation is that the southern Cape herders were descendants of people who had moved with their stock from Botswana at some time in the past, introducing pottery, sheep and cattle to

FIG. 159

ARTEFACTS FROM LATE HOLOCENE ASSEMBLAGES WITH SMALL SCRAPERS, ADZES/SPOKESHAVES AND POTTERY

1-11: Driel, Natal (after Maggs & Ward 1980)

12-14: Sandy Bay, south-western Cape (after Rudner, I. & Rudner, J. 1954)

15-21: Boomplaas Cave (after Deacon et al 1978)

22: Robberg Peninsula (after Rudner, J. 1968:634)

23: Jeffreys Bay, southern Cape (Rudner, J. 1968:651)

24, 25: Kleinsee, north-western Cape (Rudner, J. 1968:654)

26: Avalon, Orange Free State (Sampson 1970:166)

27: Joubert's Gif, middle Orange River valley (Sampson 1970:167)

Scrapers: 1, 2, 7, 8, 17, 20, 21

Tanged points: 3, 4

Backed microliths: 5, 6, 15, 16

Spokeshaves: 9, 10, 11, 13, 18

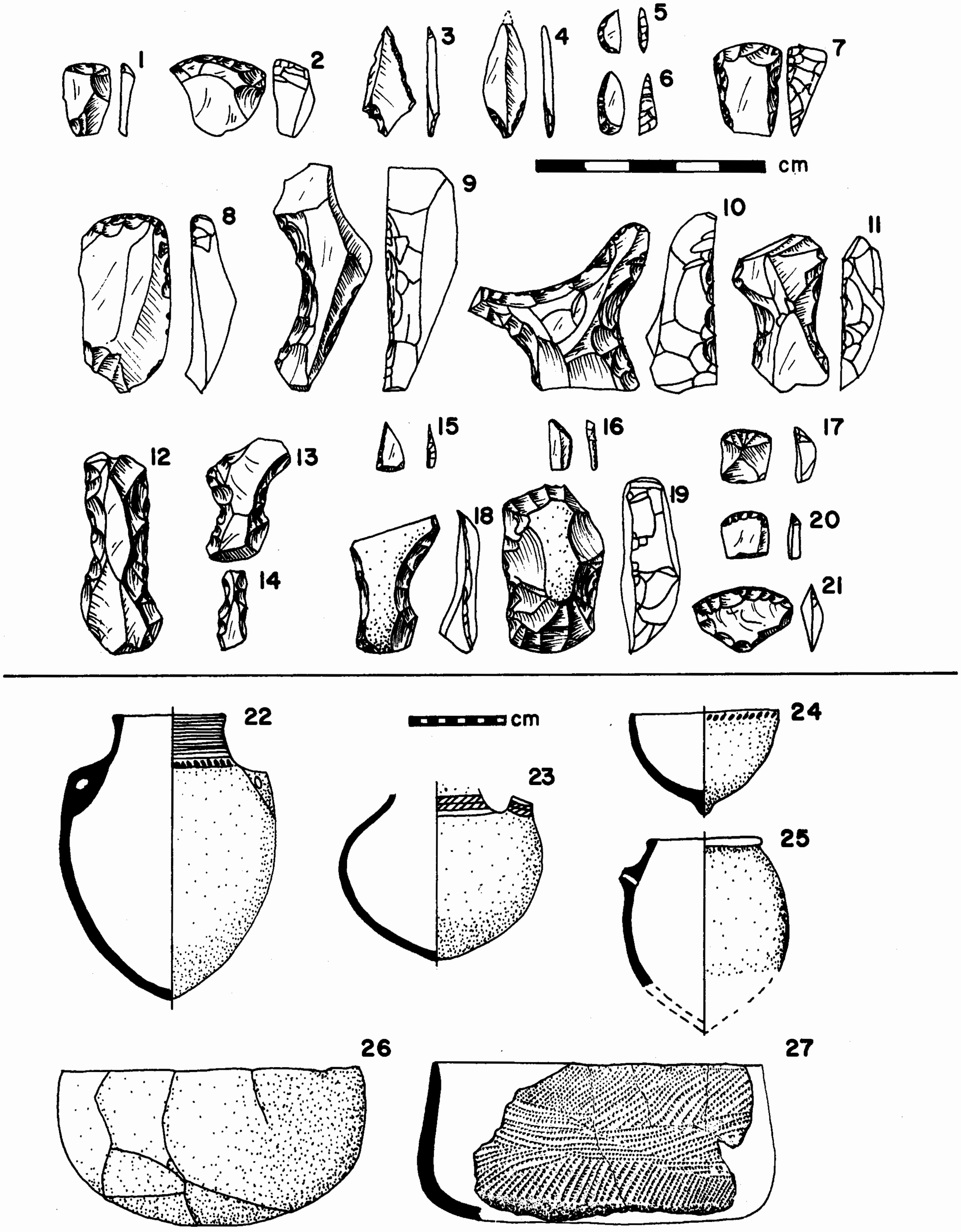
Adzes: 12, 14, 19

22-25: Cape coastal pottery

26, 27: Inland Later Stone Age pottery

FIG. 159

Fig. 8



South Africa and Namibia. However, as pointed out by Inskeep (1978b:35) we have no basis for assuming that all pastoralists belonged to the same language group, particularly since it has been established that hunter-gatherers themselves are known in both the Bush and Hottentot language families. Furthermore, all four Bush language families and all but one of the Hottentot languages that Westphal has studied were recorded north of the Orange River. The one exception is Griqua which was spoken in the northern Cape and Transkei in the last century, but for which there is no adequate documentation (Westphal 1963:248). Westphal considers that the small number of differences between Hottentot languages recorded between Angola and the northern Cape argues for a remarkably homogeneous language family with no important variants between the Natal-Transkei border and the borders of Angola (1963:249). While this would not necessarily allow us to assume that the herders along the Cape coast after A.D. 1496 spoke the same language as the herders who spoke Griqua in the northern Cape in the 19th century, it does give some support for a relatively rapid and recent movement by Hottentot-speakers southwards. Whether this was the same population movement which introduced domestic stock and pottery further south to the southern and south-western Cape, however, remains a matter for speculation.

Several archaeologists (Deacon et al 1978; Inskeep 1978a; Robertshaw 1978b) have recently attempted to use archaeological data, particularly radiocarbon dated assemblages with pottery and sheep, to test Elphick's (1977) hypothesis based on historical data. The latter suggests that the route followed by immigrant Tshu-Khwe-speaking herders southwards from Botswana was initially directly southwards to the northern Cape in the vicinity of the confluence of the Orange and Vaal rivers. From this centre, groups moved south and east to the eastern Cape and thence westwards along the coast to the south-western Cape. A second major movement from the northern Cape centre was westwards along the Orange River to the west coast and thence northwards into Namibia and southwards along the coast where they met the other branch from the east between the Olifants and Berg rivers. The long period of separation implied by the independent movements of the two branches from the northern Cape centre would account for the differences noted in historical times between the Nama of the west coast and the Khoi groups in the southern and south-western Cape (Elphick 1977:21). In testing this hypothesis archaeologically, we would expect to find the earliest pottery and domestic stock in the northern Cape and Botswana, but as the data discussed here will show, the pottery in Namibia is as early as that from the southern Cape coast, no dates are as yet available for early pottery or sheep in Botswana, and those from the northern Cape are ambiguous.

A second difficulty exists in distinguishing early herder sites from those of hunter-gatherers. There is little to differentiate the stone toolkits in pre- and post-pottery assemblages, skeletal remains are both rare and ambiguous, where the bones of domesticated animals are not present there is nothing to differentiate between the hunting and gathering patterns, and it is very difficult to date and indeed to locate open sites where herders preferred to camp. All these factors account for the low visibility of herder sites and it is clear that the chances of tracing the route/s taken by the hypothetical first herders are extremely slim.

The high mobility of individuals in herder and hunter-gatherer communities in historic times (Marks 1972; Schrire 1980) may be a recent result of disruption by Europeans, but the spread of domestic stock and pottery making was undoubtedly assisted as much by the acculturation of indigenous hunter-gatherers as by the migration of people from one part of the sub-continent to another. This would account for the lack of distinction between the stone toolkits of hunter-gatherers and herders and makes one cautious about accepting a correlation between Ceramic Wilton and herders and between Smithfield and hunter-gatherers.

On present evidence, a hypothesis involving the fairly rapid southward migration of people with pottery and sheep from Botswana to the northern Cape is tenable, but needs to be tested against new archaeological data. Acceptance of this hypothesis would not rule out the possibility, however, that the acculturation of local hunter-gatherers also took place and may have been the mechanism by which pottery and domestic stock was introduced to the eastern, southern and south-western Cape. In this instance, the source of the domestic stock and pottery-making techniques need not have been the same as that of the Botswana/northern Cape herders. A third route southwards along the

Table 77

Radiocarbon dates associated with Later Stone Age pottery in southern Africa

NB: Includes Angola but not Zambia and Malawi

* Date associated with sheep remains

\+ Date associated with cattle remains, or cf. cattle

Key to site names is in Table 72 (p.458)

Sites listed in italics indicate that the association between the date and the pottery is not certain

Radiocarbon years B.P.	3000-3499	2500-2999	2000-2499	1500-1999	1000-1499	500-999	0-499
							ZM
							ZM
							ZM
							ZY*
							WOR
							WOR
							TIR
							TIR
							TIE*
							TIE*
							TIE
							THA
							SS*+
							SOS
							SG+
							POC
							POC
							ORA
							ORA
							OAK*+
							NUP
							NP
							NOS
							NOS
							NBC+
							NAP
					VP		MO
					URU		MTA
				WK	T		MTA
				STF	SS*+		MOS
				SHO	SMT		MAG
				PB	SMT		LUP
				NBC+	SHO		HUN
				MIR+	SEH	ZY	HOA
				MEL+	RC	SHO	HOP
				LIM	MO	RC	HBP
				LI*+	MRS	PAT	GT
				HAW+	LW	PAT	GL
				ER	LIM	OB	GL
				EB	HBC	NE	FA
				DR	GOR	MTA	ET
				DKF	GE*+	MO	ES
				DK+	EBO	MRS	EB+
				DK+	EB+	GI	DKF+
				DK+	DV	EBO	DH*+
				DK	DKF+	EBO	DH*+
				DE	DK*+	DKF+	DH*+
				COL	DF*	DIK2*+	DH*+
				C	DF*	CR	DH*+
				BY	BEN	CR	CON
				BPA+	BEL	CON	COL
				BPA+	ARD	COL	BY+
				BPA+	ARD	BY+	BUR
			ZOM	BEN	ARD	BEL	ARS
		RM	*WAR*	BEN	ARD	AUS	ARP
		GE	*UNI*	*AP*	ARD	AS	AP
		GE	*UNI*	AP	AR	ANN	AP
	DIK	*FA*	*MOS*	AND	AP	AND+	ANN*+

west coast from northern Namibia to the south-western Cape may have been followed by ancestors of the Nama.

Dating

The speed with which pottery was introduced into southern Africa has been discussed in detail in Chapter 6 and it is noted that, on present evidence, it appeared virtually simultaneously at a number of sites from Namibia to the southern-most tip of Africa about 2000 years ago. Table 77 summarizes the geographic spread of radiocarbon dates associated with pottery, sheep and cattle in southern Africa. The earliest date considered to be reliably related to pottery is from Zombepata in Zimbabwe at 2110 $\pm$ 50 B.P. (SR-185; Cooke 1971, 1979). There are earlier dates in the 3499-2500 B.P. time range from Big Elephant Shelter (GE) in Namibia (Wadley 1979) and from Dikbosch and Riversmead in the northern Cape (Humphreys 1974a and Sampson & Sampson 1967:18 respectively), but the excavators consider the dates may be anomalously early. A similar degree of caution has been expressed about dates between 2499 and 2000 B.P. from Uniondale in the eastern Cape by Mary Leslie Brooker (pers. comm.), Warmquelle in Namibia (Vogel & Visser 1981) and Moshebi's Shelter in Lesotho (Carter 1978), but future research may yet prove them to be acceptable. Within the first 500 years after 2000 B.P., on the other hand, there are 23 sites with 30 dates, all of which are clearly associated with pottery and at least nine of which are associated with sheep remains as well. As it is unlikely that all these represent the 'first' appearance of sheep and pottery in southern Africa, there is a good chance that earlier well-dated occurrences will be found.

Stone Age pottery making in southern Africa shows some changes through time at sites as far afield as the northern Cape (Sampson 1972), East London and Matjes River (Rudner, J. 1968:598), the Wilton name site in the eastern Cape, Boomplaas in the southern Cape (Deacon, J. 1972; Deacon et al 1978) and at Die Kelders in the south-western Cape (Schweitzer 1979). In each case relatively thick-walled pottery was preceded by thinner and more finely made ware suggesting that pottery was initially made by people who were experienced in the art and was then adapted locally with regional styles developing. Apart from the thickness of the sherds, the earliest pottery at Die Kelders and BPA does not include the typical reinforced lugs and pointed bases of Cape coastal ware which appears at both sites after about 1600 B.P. The wide geographic spread of the earliest dates for pottery and the apparently later development of the distinctive Cape coastal ware makes the suggestion (Inskeep 1978a:116) that pottery could have been independently invented in the southern Cape no longer tenable.

Subsistence

As the hunting-gathering-fishing part of the economy of late Holocene people has been discussed in the previous section together with the evidence for mid-Holocene subsistence, only information relating to the herding aspect of the late Holocene economy will be dealt with here, but it must be remembered that this formed only a part of the total subsistence pattern. Exotic livestock species were introduced to the sub-continent within the last 2000 years or more and were adopted by many of the Later Stone Age people before the time of European contact. Cattle and sheep (goats were probably introduced to the southern Cape somewhat later, possibly as late as the 17th century (Elphick 1977:57-8)) were accumulated as a form of wealth, however, and apart from providing their owners with milk and its by-products, did not usually provide the bulk of their meat. Khoi herders practised no agriculture although some contemporary reports claim that dagga, which was used as an important trade item, was cultivated both in the western Cape (Moodie 1841:215) and along the Orange River (Elphick 1977:63). The result of a reluctance to slaughter livestock made it vital for the herders to maintain their hunting, gathering and fishing skills and these were relied on even during times of plenty.

Our knowledge of Khoi animal husbandry as it was practised at the time of European contact in the 15th, 16th and 17th centuries at the Cape is limited by the lack of detailed contemporary descriptions. Those we have may be found in official Dutch documents such as the Journal of Jan van Riebeeck (Moodie 1841; Thom 1952, 1954, 1958) or in travelogues such as those of Sparrman (1785) and Paterson (1790). Other shorter reports have been translated and collated by Moodie (1841) and Raven-Hart (1967, 1971). More recent accounts of Nama herders in the north-western Cape and Namibia have been published by Schultze (1907) and Hoernlé (1925). Other sources frequently quoted, such as Theal (1896), Stow (1905), Schapera (1930), Maingard (1931), Engelbrecht (1936), Epstein (1937, 1971), Wilson (1969) and Elphick (1977) have drawn on the older literature, while Kolben (1731) compiled much of his account from hearsay because he never in fact visited the Cape personally. Details of interest to archaeologists include the daily and annual cycle which would have controlled movements, the size and composition of the herds, the products associated with herding, items of material culture that were exclusive to the herders, and the stock breeds and their origins.

The Khoi were well versed in management techniques and had a great affection for and intimate knowledge of the individual histories of all their animals. Cattle, in particular breeding stock, were highly prized. They were trained to answer to a whistle (Raven-Hart 1967:82) and oxen in particular were used for riding, as pack animals, and in warding off enemies, both animal and human, by forming a barrier between their owners and the enemy (Engelbrecht 1936:114; Raven-Hart 1967:82, 1971:119). Riding oxen were guided by a rawhide 'bridle', the bit being a piece of wood or leather passed through a hole in the nose cartilage (Schapera 1930:297).

Khoi cattle were the ancestors of the modern Afrikander breed, classified today as a member of the cervico-humped Sanga group that has evolved through interbreeding between humped zebu and cattle characterized by long or gigantic horns (Epstein 1971:556). Epstein (op. cit.) suggests they began their evolution in Ethiopia or Uganda after the introduction to eastern Africa of humped zebu from south Baluchistan and southern Arabia during the second millennium B.C. A study of the haemoglobins of Afrikander cattle by Singer & Lehmann (1963:125), however, indicates that they are decisively of African rather than Asiatic origin. The hump was not always well developed amongst Khoi cattle (Kolben 1731), but it is mentioned by several observers of the 16th and 17th centuries (Raven-Hart 1967:19, 20, 1971:213) and Epstein (1937) suggests that it would only have developed prominently if the cattle were well fed. Contemporary observers estimated that Khoi cattle were on average larger than European breeds and oxen weighed between 225 and 275 kg. They were mostly reddish in colour with rare yellow-brown individuals and rarer white ones. The Nama are known to have selected their breeding stock for particular colours and to have traded or exchanged animals in order to obtain herds of the same colour (Schultze 1907).

Cattle were owned by families and jointly by husband and wife, with

Table 78

Sources of livestock obtained by the Dutch settlers from Khoi herders at the Cape from 1662 - 1713 (after Elphick 1977:160).

KHOI GROUP	LOCATION	NUMBER OF ANIMALS OBTAINED Cattle	Sheep	RATIO OF SHEEP:CATTLE
Peninsulars	Adjacent to Cape Town	613	1 951	3,2 : 1
Cochoqua	Immediately north of Cape Town	2 310	9 328	4,0 : 1
Mainly Chainouqua & Hessequa	East of Cape Town to the Gouritz R.	6 634	10 475	1,6 : 1
Guriqua & Namaqua	West coast north of Saldanha	99	372	3,8 : 1
Unknown, or combinations of above		4 707	10 682	2,3 : 1
	TOTAL	14 363	32 908	

Note: Khoi to the east of Cape Town in the southern Cape were more willing than other groups to part with their stock at this time but the figures may also indicate the success of trading ventures with Xhosa and Fingo in the eastern Cape (Harinck 1969) whose cattle in particular passed through the hands of the Khoi who acted as middle-men.

The ratio of sheep to cattle is of interest in indicating the difference between the herders to the north of Cape Town and those to the east. The former had far more sheep than cattle in the drier grazing regions of the western Cape and Namaqualand.

the result that they were passed on to children and other relatives when the owners died. All the cattle belonging to families living together as a residential unit were herded together, owners taking it in turns to tend the herd daily by sending young boys and children out with them (Schapera 1930). Wealthy families with very large herds would dispense their cattle to client herdsman (often San hunters) who would care for them and earn cattle of their own in return (Schapera 1930:296). Such a practice could well complicate the task of the archaeologist in establishing who were the herders. Additions to herds could be made by breeding, raiding other groups, trading and exchange. Estimates of the size of Khoi herds are difficult to find and differed from region to region, but one made in November 1658 of the holdings of the Cochoqua in the western Cape suggested about 20 000 cattle and 15-16 000 sheep (Elphick 1977:118, footnote 3) to have been owned by 16-18 000 people. The ratio of cattle to sheep was apparently higher in the southern Cape where grazing was better than to the north of Cape Town (Table 78).

Cattle grazed around the camp during the day and were brought in (with the exception of oxen and old cows) to an enclosure of branches or stones surrounded by huts at night (Epstein 1937:650 ff), but it is only when stones were used that these camps would be visible archaeologically. Bulls were not separated from cows and breeding took place when the cows were in good condition; as this was usually at the end of the rainy season, the time of year was different in summer and winter rainfall areas.

Cows were milked morning and evening by the women and the milk was generally eaten when sour by both men and women (men were not allowed to drink ewe's milk, however). The milk was stored in a variety of containers from leathern sacks with hair inside (Raven-Hart 1971:130, 350) to finely woven baskets in the eastern Cape (Sparrman 1785), gourds and clay pots. Butter was used mostly for smearing on the body, together with soot, herbs and even dung. The practice was the subject of much pious comment from European observers who found the smell 'unsavoury' (Raven-Hart 1971:395), but it is interesting to note that the purpose of smearing the body was to demonstrate wealth and prosperity (Elphick 1977: 60); those without greasy bodies were considered to be poor (Raven-Hart 1971:16). It may, therefore, have served as an outward sign or status symbol for herders making it possible to identify them as distinct from hunters who did not have access to butter (Stow 1905:314-5).

Neither sheep nor cattle were slaughtered simply for meat, but were kept for special occasions such as weddings, farewells, sacrifices to combat illness, or celebrations of victories, and even then it was only old or 'otherwise damaged' individuals that were eaten (Raven-Hart 1967:101,162, 1971:113,119,343; Wilson 1969:55: Elphick 1977:38). This does not correlate with the archaeological evidence for sheep which indicates that numbers of immature individuals were also killed, although they may have been stolen; the very small numbers of cattle that have been identified in archaeological deposits may have been the result of such practices, however. Men were responsible for the slaughtering and cutting up of the carcass and although women were allowed to drink the blood, they were not allowed to eat the meat of cattle (Schapera 1930). Intestines were eaten with relish and were often hung about the body (Raven-Hart 1971).

Two breeds of sheep were seen at the Cape in historic times, both hairy rather than woolly, and both with fat tails. They are the larger, less rangy Ronderib Afrikaner represented today by small herds in the north-central Cape, and the Namaqua Afrikaner sheep of the north-western Cape that is well adapted to drier conditions (Mason & Maule 1960: 101-4; Epstein 1971:147-60). The live weight of adult Ronderib rams varies from 60-80 kg and that of Namaqua rams from 50-64 kg. The fat tail, which some observers claimed could be cut from the animal while it was alive and would grow again, is variously estimated at between 4 and 14 kg in weight (Raven-Hart 1967:35; 1971:166, 343; Epstein 1971). The ancestral stock of the Ronderib were owned by all Cape Khoi except the Nama who kept Namaqua sheep, while those kept by the Iron Age Bantu-speakers of southern Africa had more in common with the Namaqua breed than with those of other Khoi (Epstein 1971:156). The thin-tailed sheep kept by the Bantu-speaking people occur in Zambia and along the east coast of Africa today from Kenya to Mozambique, Swaziland and Zululand, but fat-tailed Ronderib have close relatives today only in the sheep of East Africa (Epstein 1971:157) suggesting that at least three different breeds were introduced to southern Africa at different times during the last 2000 years.

Historic information on management of flocks is seldom differentiated from that on cattle herds. Slaughtering was again limited to special occasions and ceremonies. The hides were favoured for cloaks and harboured numerous lice which were shaken from the cloaks from time to time and eaten (Raven-Hart 1971:509).

Dogs were kept to help with rounding up the herds and flocks and to warn off predators. They were observed by the first European visitors (Raven-Hart 1967:3,18. 1971:119), but the Khoi do not seem to have valued their dogs very highly (Epstein 1937:654). Some controls against indiscriminate breeding were observed (Epstein 1937). Khoi dogs found today in Namibia are of African pariah stock, possibly with a strain of greyhound blood carried south from East Africa (Epstein 1971:49-50). Those noted by Kolben (1731) at the Cape were seldom higher than 0,45 m with an ash-grey coat, a small head, sharp muzzle and erect pointed ears. Dogs observed with Khoi in the north-central Cape still had the characteristic ridge of hair along their backs turned forward, as is present in their hybrid modern descendants, the Rhodesian ridgeback (Epstein 1971). All these breeds, however, are considered to belong to the same sub-species, Canis familiaris palustris, found throughout southern Africa and closely related to eastern African domestic dogs.

Historic evidence for seasonal transhumance amongst herders is often vague and may be ambiguous in that some Khoi movements may have changed with the attraction of the trading post at Cape Town. Nevertheless, it is clear that a regular grazing regime was followed, even if the Dutch could not predict precisely where the Khoi would be at a particular time (Avery, G. 1976; Elphick 1977:58). In the north-western Cape the availability of standing water for stock was a critical factor and led to groups congregating around reliable water holes during the dry season (Le Roux 1945). Data on territorial ranges of Khoi 'tribes' at the Cape are again difficult to estimate from the brief historic records, but Maingard (1931) and Le Roux (1945) have attempted to delineate the geographic distributions of these people at about A.D. 1700. Sixteen apparently distinct Khoi tribes (i.e. with allegiance to a leader and presumably speaking the same dialect) were noted between the coast and the inland margin of the Cape Folded Belt. Le Roux (1945) has plotted the location of kraals visited by Europeans and his map allows a rough calculation of the territorial range of each group to be estimated in Table 79. It can be seen that the Klein Namaqua, who occupied the driest region, had the largest area of over 47 100 km^2, while in the southern Cape where

Table 79

Approximate areas of 'territories' occupied by Khoi groups visited by the Dutch ca 1700 A.D. Calculated from a map compiled by Le Roux (1945) from historic records

KHOI GROUP (from north-west to south-east)	AREA IN KM^2
Klein Namaqua	47 124
Guriqua (Grigriqua)	21 432
Cochoqua	9 411
Peninsulars	3 019
Chainouqua	12 242
Hessequa	6 574
Guriqua	4 025
Attaqua	6 708
Outeniqua	4 528
Gamtours	3 689
Inqua	14 590
Damaqua	4 864
Damasonqua	6 540
Hoengeyqua	7 378
Gonaqua	11 404

Note: Groups inhabiting drier areas such as Namaqualand and the western Cape (Klein Namaqua, Guriqua, Cochoqua) covered a far larger area than those in the southern Cape where rainfall is higher. The territories of the Inqua and Gonaqua included parts of the Karoo in the vicinity of Aberdeen and Queenstown respectively.

the rainfall is higher the smallest territory is that of the Gamtours at about 3 600 km². While the details of this distribution and territorial size may be faulty due to the vagaries of both the historic records and our interpretations of them, it would nevertheless seem that there is a relationship between rainfall and territorial size amongst herders at least. Archaeologically, therefore, we would expect greater lateral variability along the southern Cape coast than in the north-western Cape.

Archaeological evidence for herding is limited to the remains of domesticated animals amongst the faunal remains (Tables 75, 77), accumulations of dung and the occurrence of stone walled kraals with no evidence of their having been used by Iron Age farmers (Humphreys 1972a; Carr et al 1978). The largest and best preserved assemblage of sheep remains so far excavated (34 individuals) comes from Die Kelders in the south-western Cape (Schweitzer & Scott 1973; Schweitzer 1974, 1979) where 78% of the sample that could be aged is represented by sexually immature individuals, most of which were males. This suggests that they may have been culled from flocks rather than raided by opportunistic hunters, but this interpretation is open to doubt (Schweitzer 1974; Avery, G. 1976). At BPA, where burnt sheep dung in the floor of the cave indicates that the site was used as a kraal, younger sheep are under-represented with only 33% of the sample being sexually immature (Klein 1978b). Klein (op. cit.), however, believes that this may be the result of high temperatures in the burning deposit having destroyed the bones and teeth of the younger individuals thereby biasing the age distribution. At all other sites where sheep have been identified (NBC, Dikbosch, Big Elephant Shelter and ?Aar 1), the frequencies are too low for age group statistics to be relevant. The preservation of quantities of sheep dung at Mirabib (Sandelowsky 1977) and BPA shows that rock shelters were used as kraals and that the cultural material associated can be firmly linked to herders rather than hunters or Iron Age farmers. The unburnt dung at Mirabib included hairs identified as those of sheep, although the breed could not be ascertained with certainty (Sandelowsky et al 1979:50). The fact that it was hair and not wool, however, leads to the assumption that they were Namaqua sheep. Analysis of the dung showed that the sheep had obtained most of their food from browsing rather than from grass at Mirabib.

The incidence of bones that can be securely assigned to cattle, Bos taurus, is very low (Table 75). Goats appear late in the sequence at Striped Giraffe shelter in Namibia (Plug 1979; Vogel & Visser 1981) which may confirm the historic record that they were introduced relatively late into southern Africa. The undoubted presence of a domesticated dog is recorded at Cape St Francis where it was associated with a shell midden with pottery (Chappel 1968; Voigt 1978:183). The absence of dog from pre-pottery sites suggests that they may have been introduced together with other domesticated animals and pottery, particularly because dogs were apparently used to help control flocks and herds. The archaeological record may be unreliable here, however, as it is difficult to identify domestic dog without key anatomical parts and in any event the bones of a domestic pet may not have found their way into the food waste at home bases on a regular basis.

Stone-walled kraals without Iron Age affinities are known in the northern Cape (Sampson, pers. comm.), along the Riet River in the Orange Free State (Humphreys & Maggs 1970; Humphreys 1972a) and, with occasional finds of iron, in Namibia (Carr et al 1978). To date no firm correlations have been drawn between them and their associated pottery and artefacts, but they do indicate the adoption of stone walling techniques that were common amongst Iron Age people in the vicinity and date within the last 400 years.

All occurrences of domestic stock associated with the LSA and so far described in print have come from Namibia and the northern, western and southern Cape. Data from Zimbabwe, Botswana, the Transvaal and Natal are urgently needed to test hypotheses of the routes taken by the earliest herders into southern Africa. Rock paintings of sheep in Zimbabwe (Cooke 1969) are tantalizing evidence that they were there. The fact that the breed of sheep kept by Khoi is different from that found amongst Iron Age people in South Africa and that cattle and sheep were milked by women and not by men, sets the Khoi herding pattern apart from that of the Iron Age and encourages the view that domestic stock filtered southwards a few hundred years ahead of the Iron Age farmers.

The breakdown of Khoi identity and economy within 100 years after the establishment of the Dutch settlement at the Cape in 1652 (Elphick 1977:236-7) was largely due to the fact that they had livestock which the colonists and passing ships wanted for consumption and not for breeding stock. Despite the fact that they valued their cattle and sheep very highly, the Khoi were willing, initially at least, to trade them for very low prices by European standards, for iron bars, nails, brass, copper, beads and tobacco (Harinck 1969). Over the first seven years of occupation at the Cape, the Dutch estimated their livestock needs (probably an under-estimate of what they actually used) at around 4 600 cattle and 18 600 sheep (Elphick 1977:153), the vast majority of which were traded from the Khoi and killed for meat. As local supplies dwindled and Khoi became less and less willing to sell their livestock, Khoi entrepreneurs obtained sheep and cattle from tribes further afield (Table 78) and further large numbers of stock were lost in this way. The combined effect of this practice and the competition for land, plus related social factors such as inter-tribal clashes amongst the Khoi, the death of several powerful leaders, the ravages of European diseases and depredations by hunters and dispossessed Khoi, the loss of status and wealth made it necessary for Khoi to join the Dutch in much the same client relationship as had been observed amongst Khoi and San. They acted as herdsmen on farms and as labourers in towns and unless they lived in areas inhospitable to Europeans, their social order and subsistence economy broke down altogether. The detailed causes of this process have been described by Elphick (1977) and the rapidity with which it occurred is the main reason why we have so little enthographic data on the economy and material culture of the Cape Khoi herders.

Table 72

KEY TO ABBREVIATIONS, WITH REFERENCES, USED IN TABLES 70, 71, 75 AND 77 AND FIGS 150, 151, 152 AND 156. ABBREVIATIONS ARE LISTED ALPHABETICALLY.

ABBREVIATION	NAME OF SITE	REFERENCES
A	Amadzimba	Cooke & Robinson 1954
AAR	Aar 2 Namibia	Vogel & Visser 1981
AK1	Andrieskraal 1, s Cape	Hendey & Singer 1965
AND	Andriesgrond, s-w Cape	Parkington 1980:108
ANN	Ann Shaw, e Cape	Derricourt 1973, 1977
AP	Apollo 11, Namibia	Wendt 1972, 1976; Freundlich et al 1980; Vogel & Visser 1981
AR	Arniston, s-w Cape	Maggs 1977:172
ARD	Arrisdrift, Namibia	Vogel & Visser 1981
ARP	Aar pot, Namibia	Vogel & Visser 1981
ARS	Aar 1, Namibia	Vogel & Visser 1981
AS	Aspoort, s-w Cape	Smith & Ripp 1978
AUR	Aurus 6, Namibia	Vogel & Visser 1981
AUS	Austerlitz, Namibia	Freundlich et al 1980
B	Bushman Rock Shelter, e Transvaal	Vogel 1969; Plug 1978, 1981
BAM	Bambata, Zimbabwe	N.J. Walker, pers. comm.
BAN	Banda Cave, Swaziland	Stuiver 1969; Beaumont & Vogel 1972a,b
BC	Border Cave, KwaZulu	Beaumont & Vogel 1972a,b; Linick 1977; Beaumont 1978, 1980; Beaumont et al 1978
BEL	Belleview, Lesotho	Carter & Vogel 1974; Carter 1978
BEN	Benfica, Angola	Dos Santos & Ervedosa 1978 Vogel & Visser 1981
BL	Blydefontein, n Cape	Sampson 1972; Humphreys 1979:305
BON	Bonteberg, s-w Cape	Maggs & Speed 1967; Grindley et al 1970
BPA	Boomplaas, s Cape	Deacon et al 1976, 1978; Fairhall et al 1976; Deacon, H.J. 1979; Vogel pers. comm.
BUF	Buffelskloof, s Cape	Opperman 1978
BUR	Burchell's Shelter, n Cape	Humphreys 1975, 1979:215

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
BWE	Bonawe, n-e Cape	Opperman, pers. comm.
BY	Byneskranskop, s-w Cape	Schweitzer & Wilson 1978, 1982; Klein 1981b
C	Calder's Cave, Zimbabwe	Cooke & Simons 1969; Cooke 1979
CAN	Cango Caves, s Cape	Vogel pers. comm,; Deacon, J. 1979
CHA	Cha-Ré Shelter, Namibia	Vogel & Visser 1981
COB	Cave of Bees, Zimbabwe	N.J. Walker, pers. comm.
COL	Colwinton, n-e Cape	Opperman, pers. comm.
CON	Conception Bay, Namibia	Vogel & Visser 1981
CR	Chalumna R, e Cape	Derricourt 1973, 1977
CSF	Cape St Francis, s Cape	De Villiers 1974; Thackeray & Feast 1974
CY	Cymot Shelter, Namibia	Sandelowsky & Viereck 1969
D	Duncombe Farm, Zimbabwe	Wadley 1973
DE	Duiker Eiland, s-w Cape	Robertshaw 1979
DF	Doornfontein, n Cape	Beaumont & Boshier 1974
DH	De Hangen, w Cape	Parkington & Poggenpoel 1971
DIK	Dikbosch 1, n Cape	Humphreys 1974a, 1979
DIK2	Dikbosch 2, n Cape	Humphreys 1974a, 1979
DK	Die Kelders, s-w Cape	Schweitzer 1970, 1979
DKF	Diepkloof, w Cape	Parkington 1977a
DO	Dombozanga, Zimbabwe	Robinson 1964
DR	Driel Shelter, Natal	Maggs 1977; Maggs & Ward 1980
DV	Diana's Vow, Zimbabwe	Cooke 1979
E	Etemba 2, Namibia	Wendt 1972; Freundlich et al 1980
EB	Elands Bay Cave, w Cape	Parkington 1977a & pers. comm.
EBO	Elands Bay Open, w Cape	Horwitz 1979
EMA	Emambeni, Swaziland	Stuiver 1969; Beaumont & Vogel 1972a,b
EQ	Equus Cave, n Cape	Beaumont, pers. comm.
ER	Eros Shelter 1, Namibia	Beaumont & Vogel 1972a,b; Wendt 1972
ES	Eros Shelter 2, Namibia	Beaumont & Vogel 1972a,b
ET	Etemba 14, Namibia	Wendt 1972; Freundlich et al 1980
FA	Fackelträger, Namibia	Wendt 1972; Vogel & Visser 1981; Freundlich et al 1980

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
FIS	Fish River, Namibia	Vogel & Visser 1981
G	Gwisho, Zambia	Fagan & Van Noten 1971
GAT	Gatboskloof, s Cape	Wilson, pers. comm.
GB	Gordons Bay, s-w Cape	Van Noten 1974
GE	Great (Big) Elephant Shelter, Namibia	Clark & Walton 1962; Wadley 1976, 1979
GH	Good Hope Shelter, Natal	Carter 1978:167; Cable et al 1980
GI	Girls School Shelter, Namibia	Jacobson 1978; Vogel & Visser 1981
GL	Glen Elliot, n Cape	Sampson 1972
GOB	Gobabeb, Namibia	Vogel & Visser 1981
GOR	Gorob skeleton, Namibia	Vogel & Visser 1981
GRA	Grassridge, n-e Cape	Opperman, pers. comm.
GT	Grootdrink pot, n Cape	Rudner, J. 1971, 1979:24
HAA	Haalenberg, Namibia	Vogel & Visser 1981
HAW	Hawston, s-w Cape	Avery 1975:112
HBC	Hout Bay Cave, s-w Cape	Buchanan 1977
HBP	Hottentot Bay Pot, Namibia	Vogel & Visser 1981
HK	Heuningneskrans, e Transvaal	Vogel & Marais 1971; Beaumont 1978, 1981
HOA	Hoarusibmund, Namibia	Vogel & Visser 1981
HOP	Hoanibmund, Namibia	Vogel & Visser 1981
HR	Highlands, n Cape	Deacon, H.J. 1976:222-4
HUN	Huns, Namibia	Freundlich et al 1980
KAL	Kalemba, Zambia	Phillipson 1976:27
KC	Kruger Cave, Transvaal	Mason & Vogel 1974
KLP	Klipfonteinrand, w Cape	Parkington 1980:108
KLY	Kalanyoni, Zimbabwe	Walker, pers. comm.
KR	Klasies River 5, s Cape	Singer & Wymer 1969
KRA	Kangkara, s Cape	Vogel pers. comm.
KRM	Klasies R main, s Cape	Sampson 1972; Singer & Wymer in prep.
KUM	Kumakams, Namibia	Vogel & Visser 1981
LEM	Lemoenfontein, n Cape	Klein 1979
LC	Lion Cavern, Swaziland	Dart & Beaumont 1968
LH	Leopard's Hill, Zambia	Miller 1969, 1971

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
LI	Limerock 1, n Cape	Humphreys 1979:240
LIM	Limerock 2, n Cape	Humphreys 1979:140
LN	Lower Numas 1, Namibia	Rudner 1957, 1972; Vogel & Marais 1971; Jacobson 1978; Vogel & Visser 1981
LUP	Luderitz potsherd, Namibia	Vogel & Visser 1981
MA	Mlaula, Swaziland	Beaumont & Vogel 1972a,b
MAG	Maguams, Namibia	Freundlich et al 1980; Vogel & Visser 1981
MAK	Makwe, Zambia	Phillipson 1976:72
MAL	Maleme Dam, Zimbabwe	N.J. Walker, pers. comm.
MAT	Matupi, Zaïre	Van Noten 1977
MEL	Melikane, Lesotho	Carter 1978:167
MES	Messum 1, Namibia	Freundlich et al 1980; Vogel & Visser 1981
MG	Magabengberg, w Tvl	Mason 1962
MGT	Maguams Terrace, Namibia	Freundlich et al 1980
MHB	Melkhoutboom, s-e Cape	Deacon, H.J. 1969, 1976
MIR	Mirabib, Namibia	Sandelowsky 1977; Vogel & Visser 1981
MO	Munro's site, s Tvl	Vogel & Marais 1971; Mason & Vogel 1974
MON	Montagu Cave, s Cape	Keller 1970, 1073
MOS	Moshebi's Shelter, Lesotho	Carter & Vogel 1974; Carter 1978
MO	Mpato, Zimbabwe	Cooke & Simons 1969
MR	Matjes River, s Cape	Louw 1960; Vogel 1970
MTA	Mtanye, Zimbabwe	Cooke 1979:146
N	Nachikufu, Zambia	Miller 1969, 1971
NAM	Namtib, Namibia	Freundlich et al 1980; Vogel & Visser 1981
NAP	Nautilis pot, Namibia	Vogel & Visser 1981
NAR	Narob grave, Namibia	Vogel & Visser 1981
NBC	Nelson Bay Cave, s Cape	Inskeep 1965 and pers. comm.; Vogel 1970; Klein 1972a,b; Switsur & West 1973; Fairhall et al 1976; Deacon, J. 1978
NE	Numas Entrance, Namibia	MacCalman 1965

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
NOS	Nos, Namibia	Vogel & Visser 1981
NP	Numas Plateau, Namibia	Vogel & Marais 1971
NTI	Nswatugi, Zimbabwe	Walker 1980:19, 21
NUP	Numas pot, Namibia	Vogel & Visser 1981
OAK	Oakleigh Farm, e Cape	Derricourt 1973, 1977
OB	Olieboompoort, w Tvl	Mason 1962
OHT	Oakhurst, s Cape	Goodwin 1938; Deacon, J. 1979:36; Vogel, pers. comm.
ORA	Orabes Upper and Lower, Namibia	Jacobson 1978; Vogel & Visser 1981
OST	Ostrich Shelter, Namibia	Jacobson 1978; Vogel & Visser 1981
P	Pomongwe, Zimbabwe	Cooke 1963; Beaumont & Vogel 1972a,b; Walker 1980:22
PAT	Paternoster, w Cape	Robertshaw 1977
PB	Pearly Beach, s-w Cape	Avery 1974 and pers. comm.
PH	Philip Cave, Namibia	Martin & Mason 1954
POC	Pockenbank, Namibia	Freundlich et al 1980; Vogel & Visser 1981
POW	Powerhouse Cave, n Cape	Humphreys 1979:173
Q	Castle Quarry, Swaziland	Dart & Beaumont 1968; Vogel 1970
RC	Rose Cottage, Orange Free State	Vogel 1970; Vogel & Marais 1971; Beaumont & Vogel 1972a,b; Beaumont 1978:637
RE	Rooiels Cave, s-w Cape	Smith 1981
RED	Redcliff, Zimbabwe	Beaumont & Vogel 1972a,b; Cooke 1978; Klein 1978a
RM	Riversmead, n Cape	Sampson & Sampson 1967; Sampson 1972
ROB	Robberg caves D, E & F, s Cape	Vogel & Marais 1971; Rudner & Rudner 1973; Hausman 1980
RR	Riet River, Orange Free State	Humphreys 1974b
SB	Steenbras Bay, Namibia	Vogel & Visser 1981
SEH	Sehonghong, Lesotho	Carter & Vogel 1974; Carter 1978
SG	Striped Giraffe Shelter, Namibia	Sandelowsky & Viereck 1969; Jacobson 1978; Wadley 1979; Vogel & Visser 1981
SHA	Shashabugwa, Zimbabwe	Walker 1980 and pers. comm.

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
SHO	Shongweni, Natal	Davies 1975:657-8
SMT	Smitswinkelbaai, s-w Cape	Poggenpoel & Robertshaw 1981
SOS	Sossusvlei, Namibia	Vogel & Visser 1981
SS	Scott's Cave, s Cape	Deacon & Deacon 1963; Deacon, H.J. 1967; Klein & Scott 1974
STF	Stofbergsfontein, w Cape	Robertshaw 1978a
T	Tshangula, Zimbabwe	Cooke 1963, 1979:146
TAB	Tsisab Open T30, Namibia	Vogel & Visser 1981
TAF	Twyfelfontein Affen-felsen, Namibia	Jacobson 1978; Freundlich et al 1980
THA	Twyfelfontein Hasenbild, Namibia	Wendt 1972; Jacobson 1978; Freundlich et al 1980; Vogel & Visser 1981
TIA	Tiara Shelter, Namibia	Jacobson 1978; Vogel & Visser 1981
TIE	Tienfontein 2, 4A & 7, Orange Free State	Brooker 1980
TIR	Tiras 5, Namibia	Freundlich et al 1980; Vogel & Visser 1981
TZS	Twyfelfontein Zwei Sch-neider, Namibia	Vogel & Visser 1981
U	Uitkomst, Transvaal	Mason 1962; Vogel 1970
UH	Uri Hauchab 4, Namibia	Freundlich et al 1980
UM	Umhlanga Rocks, Natal	Vogel & Marais 1971
UNI	Uniondale, e Cape	M Leslie Brooker, pers. comm.
UNJ	Unjab midden, Namibia	Vogel & Visser 1981
URU	Ururu, Namibia	Vogel & Visser 1981
VEN	Ventershoek, n Cape	Klein 1979
VP, VPO	Voigtspost 1, Orange Free State	Horowitz et al 1978:154
WAR	Warmquelle, Namibia	Vogel & Visser 1981
WOR	Wortel, Namibia	Vogel & Visser 1981
WT	Wilton Shelter, e Cape	Deacon, J. 1972
WK	Wonderwerk, n-w Cape	Butzer et al 1979; Thackeray et al 1981; Beaumont & Thackeray pers. comm.
Z	Zoo Park, Namibia	MacCalman 1965

Table 72 contd

ABBREVIATION	NAME OF SITE	REFERENCES
ZEB	Zebrarivier, Namibia	Vogel & Visser 1981
ZM	Zerrissene Mts, Namibia	Carr et al 1978; Vogel & Visser 1981
ZOM	Zombepata, Zimbabwe	Cooke 1971
ZY	Zaayfontein, n Cape	Sampson 1972

8

DISCUSSION AND CONCLUSIONS

DISCUSSION AND CONCLUSIONS

The data described in the preceding chapters have been analysed to highlight changes through time in the LSA of the southern Cape and two main categories of change have been identified. These are innovative changes in which new items appear in the archaeological record or in which known items change their guise, and post-innovative changes in which there are shifts in the frequency, size, shape and raw materials used in the manufacture of tools and in the by-products of tool manufacture. The pattern of innovative changes closely follows that identified in models of modern technological evolution and indicates that southern Africa was on the receiving end of many of the technological advances known throughout the Old World from the last glacial maximum through the Holocene. While pottery and domesticated stock were adopted very rapidly and seem to have been spread by migrating people, others such as the small hafted tool tradition of the Holocene spread somewhat slower, probably as the result of the gradual borrowing of ideas and techniques.

Subsequent to their initial appearance, most of the innovations as well as other artefact classes not new to the system, were modified and underwent changes which can best be described as secular or cyclic and which, in their diachronic patterning, closely approximate to changes noted in fashion in modern times. These changes appear to be non-functional in the sense that particular artefact classes and sub-classes do not correlate with particular climatic regimes or faunal remains. The southern Cape data indicate that the timing of the cyclic fashion changes in stone artefact manufacture is independent of technological evolution and innovation, apparently because changes at each level are stimulated by different cues. The former seem to be far more susceptible to regional changes in environment than the latter and probably reflect social and demographic adjustments, while innovations mark stages in the evolution of technological systems which have a momentum of their own. It is when these changes coincide at particular points in time that we consider a major technological shift to have taken place. Any terminological scheme needs to take the differences between innovative and post-innovative changes into account by placing them at different levels in the hierarchy of change, while explanations for processes of change need to specify which scale of technological change is involved.

While the mechanisms and underlying reasons for biological evolution may not be directly applicable to change in artefact systems, the debate about the importance of differentiating between micro- and macroevolution in plants and animals is certainly relevant to archaeology because both disciplines are unique in dealing with long-term changes through time and because of the methodological implications. The three main talking points amongst palaeontologists and geneticists in recent years have been (1) the identification of an observed change as micro- or macroevolutionary; (2) the question whether they occur gradually or in punctuated equilibria; and (3) whether macroevolutionary changes are merely an extension of microevolutionary ones, or whether they should be treated as totally different phenomena (Ridley 1980; Smith, J.M. 1981; Stebbins & Ayala 1981).

In the light of these questions, the data analysed in this thesis suggest that (1) both macro- and microevolutionary trends can be discerned in the stone artefact record, the former incorporating innovative changes and the latter the stylistic mode; (2) that in as far as microevolution within the LSA in the southern Cape is concerned, there is evidence for punctuated equilibria being the dominant pattern, relatively rapid changes occurring at ca 12 000 B.P. and again at ca 8000 B.P.; the macroevolutionary trends are more gradual with the majority, but by no means all, of the innovations being spread by borrowing rather than by population migrations on a large scale; and (3) macroevolutionary changes appear to be quite independent of microevolutionary ones in that the former do not represent the cumulative effects of the latter.

Archaeologists are well known for their propensity for borrowing 'general laws' from other disciplines and of these ecology and biological evolution have given their fair share. In addition to the trends in modern technological evolution outlined in Chapter 6 and the similarities between the scales of change in biological and technological evolution outlined above, several recently published papers (for example, Bray

1973; Thomas 1974; Durham 1976; Dunnell 1978, 1980; Diener et al 1980; Trigger 1981) have suggested that the concept of evolution has much to offer the study of cultural change in developing a theory of cultural evolution that will have universal applicability in much the same way as did Darwin's theory for biological evolution, but they have stopped short of providing one (Dunnell 1980:89). One of the main stumbling blocks has been the identification of cultural traits or features that can be equated with biological processes. This leads to discussion of whether industries=species or invention=mutation, for example, or whether there is a cultural analogue for genes. Some of these problems may be resolved more easily if it were accepted that cultural and technological evolution probably owes more to the hypotheses of Lamarck than to those of Darwin because acquired characteristics are indeed passed on from one generation to the next. Transmission of characteristics aside, most archaeologists believe implicitly if not explicitly that there is a cultural/technological process analogous to natural selection; it is the selection of the tool best suited to the toolmaker and the task in hand from the range of options available. Regional variations of this choice are seen as 'adaptations'.

The concept of adaptation in the context of stone tool technology has been criticized by Burnham (1973:94, 99) who believes that there is no validity in the abstract notion of 'maximum adaptation' to an environment, only in the relative notion of 'maximizing adaptation' given the material available, and regards attempts to apply functional analyses in the framework of homeostatic systems as science-fiction. This somewhat disillusioned view is useful, however, in stressing the importance of finding out the nature of ancestral traditions so that assemblages can be placed in their historic context before functional analyses are applied. The complexity of the concept of adaptation is noted in the biological field by Gould & Lewontin (1979:584), for example, who suggest that some characteristics are an 'adaptation' only as secondary epiphenomena resulting in the use of them only because they happen to be there and thus representing a "fruitful use of available parts, not a cause of the entire system." This realization of the complexity of the interrelationship between variables has led also to a greater appreciation of the difficulties involved in the unravelling of cause-and effect in the archaeological record in both the cultural (Service 1971:25-6) and biological (Leach 1981) spheres which demonstrate that the prime mover concept is inadequate and that simple cause-and-effect models are often absurdly simplistic. Rappaport (1977:68) expresses the problem thus:

> "The circularity of both cybernetic and eco-systemic structure blurs the distinction between cause and effect...(and) simple linear notions of causality ...are inadequate, for purposeful behaviour seldom affects only a single object."

And Grassé (1977:243) observes in relation to biological evolution that:

> "...evolution is quite unlike the simplified, scaled-down and totally inaccurate picture of it represented in theories. It is so vast as to make one stop and consider that its problems are very far beyond the means of present-day science. Interpretations and explanations...can only be partial and tentative."

Disenchantment with the simplistic deductive strategy employed by the first crop of New Archaeologists in the 1960s and !970s has been growing (Binford 1977, 1981; Dumond 1977; Salmon 1978) and Binford, in particular, has stressed the need for middle range theory to replace assumptions that were initially used as hypotheses. His observations on the lifestyle of the Nunamiut Eskimo (Binford 1978) have shown a wealth of detail that has particular relevance to the interpretation of spatial patterning and the association of artefacts and food remains in North America, but may be less applicable to African contexts than Binford would like to believe (see Binford & Todd 1982; Shipman et al 1982). Coupled with the fact that all ethnographic observations are short-term ones, we are still left with a dearth of middle range theory from which we can derive hypotheses about long-term change in the stone artefact record. For this reason the strategy adopted in this thesis has been a modest one in which unrealistic correlations have been avoided and only the general evolutionary trends have been followed. I have suggested that the interpretation of these long-term changes is most appropriately compared with long-term changes in modern technology to identify 'universal' trends as distinct from local ones. Although stylistic change has received only cursory examination to date (but see Richardson & Kroeber 1947; Clarke, D.L. 1968), the general principles and patterns observed seem nevertheless to be applicable to stone tool sequences.

Comparison between the southern Cape LSA sequence and that from the rest of southern Africa (Chapter 7) has shown that many of the broad trends identified at a regional level can be seen in sequences elsewhere in the sub-continent and it remains to establish a hierarchy of changes through time to construct a framework against which to view technological change and to establish the extent to which observed variability is site-specific, regionally specific, specific to southern Africa or virtually universal. Different levels of technological development need explication with different models and theories of evolution, however, and the fundamental differences between the evolutionary, functional-ecological and stylistic elements of technology need to be appreciated. One theory will not be suitable for the explication of all variability and, by extension, different methodologies will be required for the study of each. This is the case in all subjects, for even when systems and their sub-systems are precisely characterized, the same principles do not govern both. Trying to infer properties of the system from known properties of a sub-system is a risky business even in a subject like physics or chemistry in which the vagaries of human nature and its propensity for deception are not involved (Salmon 1978:180; Leach 1981; Stebbins & Ayala 1981:970). It is for this reason that the theme followed in this thesis has been limited deliberately to the study of diachronic change and does not investigate functional hypotheses or spatial distributions. It is nevertheless useful to place these diachronic observations within the perspective of a culture-stratigraphic hierarchy.

At the lowest hierarchical level are penecontemporaneous assemblages in which variability in the relative frequency of tools may be interpreted as variations in activity because the functions of the tools may be held constant. Terminologically these can be referred to as local activity variants. At the next level are assemblages which are regional variants or what have become known as Industries (Clark et al 1966; Sampson 1974). Regional variants come closest to what may be considered as adaptations to local conditions in that the range of tools is the result of a series of historical processes or accidents of diffusion and invention that have in turn been modified to the raw materials available and to the range of activities and subsistence strategies dictated by the regional habitat.

When seen as time units they represent a somewhat arbitrary division of the continuum of change, but only in that some variables are considered more important than others and are therefore selected as 'indicators'. Generally speaking, however, the artefact assemblages within an industry are more similar to each other than they are to assemblages preceding and succeeding them in stratigraphic sequences. The temporal or diachronic record is vital, for where long-sequence well-dated sites are not known in a region, it may not be possible to define industries adequately on the basis of a few observations scattered in time and in space.

A number of penecontemporaneous industries in different ecozones may be grouped within an Industrial Complex (Clark et al 1966) or Complex (Sampson 1974) which represents a geographically widespread tradition of artefact manufacture, the temporal boundaries of which are defined regionally by its component industries. We would not expect to be able to define the boundaries of an industrial complex with data from one region or ecozone only.

The next level in the hierarchy is the Stage embodied in the concept of Earlier, Middle and Later Stone Ages. It is essentially a temporal division which incorporates a series of innovations in much the same way as a family incorporates a number of generations. For this reason, it is more difficult to define the boundaries between stages as the indicators chosen by archaeologists for this purpose may not have had the same significance for the stone tool makers.

This hierarchical classification is in effect an alternating series of temporal and spatial groupings, the former marked by innovations and post-innovative changes and the latter by maximizing adaptations at different levels of ecological significance from the ecozone through to local activity variants. Does the subdivision of the Stone Age into these various industries, complexes and stages imply punctuated equilibria or merely the arbitrary subdivision of a continuum ? Can we claim, as biologists have done, that the features used to distinguish LSA, MSA and ESA are macroevolutionary and cannot be explained as a mere extension of the microevolutionary changes between industries and complexes ? These questions are important in evaluating the utility of a culture-stratigraphic classification scheme and in interpreting the reasons for stasis and change.

Data from NBC and BPA have shown that there were periods during the last 20 000 years when change was more rapid than at other times, but they show also that change in some parts of the technological system was continuous, while yet other variables remained relatively stable. Apart from site-specific idiosyncratic changes in the relative frequencies of artefact classes which may be explained as activity variation, the lowest order of change is that identified as post-innovative which may be likened to microevolutionary change in biological systems. In stone tool technologies, microevolution shows progressive change in the long term (as, for example, in the trend towards miniaturization), but the shorter term oscillations around a gradually changing mean may sometimes result in the long-term trend being reversed in alternate cycles. An example here is the increase in untrimmed flake and scraper lengths between 12 000 and 8000 B.P. in the southern Cape. In this sense, then, these microevolutionary trends are non-cumulative in that the small size of untrimmed flakes and formal tools in the mid-Holocene is not the final stage in a long sequence of progressively smaller tools because reversals are known to have occurred from time to time. A similar pattern of oscillatory changes can be seen in raw material frequencies and, at a different time scale, in the relative thickness of untrimmed flakes.

Macroevolutionary changes, on the other hand, mark the appearance of successive generations of innovations in the form of new toolmaking techniques, new tool designs or the use of old designs in new combinations to improve performance. Macroevolutionary innovations, which are borrowed from outside the regional system, are superimposed upon an established artefact tradition that is itself undergoing changes within the artefact system, but at a microevolutionary level and pace.
For this reason we can subscribe to the conclusion drawn from biological data that macroevolutionary patterns cannot be deduced from microevolutionary principles (Stebbins & Ayala 1981:967). What the observed LSA patterns suggest is that microevolutionary changes are more susceptible to the model of punctuated equilibria than are macroevolutionary ones, if only because the dating evidence we have is not refined enough to monitor such changes closely at the macroevolutionary scale.

The most sophisticated interpretation of diachronic change in the LSA has been that published by H J Deacon (1976) who views the sequence of Robberg-Albany-Wilton industries in the southern and eastern Cape as representing a series of three periods of relative stasis punctuated by two periods of rapid change between them. Stasis within each industry is the result of the settling-in of communities as they adapted to local resources at the time. The stasis is only relative, however, for the concept includes minor adjustments within each plateau (Deacon, H.J. 1976:fig. 43). The people who made Robberg-type artefacts during the late Pleistocene geared their lifestyle around the hunting of larger grazers and gregarious antelope that lived under cooler conditions than those of today when grassland was more extensive in the southern Cape. The seasonal movements of these large herds made it advantageous for the people to live in large groups that occupied territories large enough to enable them to follow the game in its annual round. The low archaeological visibility of sites in this time range may be a result of this demographic pattern and, possibly, a rarer use of rock shelter sites. The use of bladelet cores to make large numbers of unretouched bladelets and the appearance of items known ethnographically occurs after 20 000 B.P. in the southern Cape marking the first generation of LSA innovations, but these innovations are not accompanied by a noticeable shift in hunting strategy.

By contrast, the inception of what has been labelled the Albany Industry in the southern Cape is closely linked to a marked shift in hunting patterns between 12 000 and 11 000 B.P. away from large gregarious grazers towards more solitary territorial browsers. Possibly triggered by demographic and/or subsistence changes there is a marked and sudden microevolutionary shift at this time with changes in the incidence of raw materials and in the size and shape of scrapers and untrimmed flakes. With the exception of bone fish gorges at the coast, no new formal tools were introduced at this time and several of the changes can be seen as reversals in the long-term trends.

By 8000 B.P. the shift in hunting patterns was complete and the subsistence economy of the next 6000 years was focused on the game animals then most widely available, namely the small solitary territorial browsers, which, although they came in smaller packages, may have been a more reliable source of meat than the larger grazers which were by then much reduced in numbers. In the absence of seasonal movements of game, the people adopted a cycle of transhumance that was geared instead around the seasonal abundance of staple plant foods where were dominated by corms of the Iridaceae family. During times of scarcity and stress coastal resources were utilized. The archaeological visibility of living sites increased dramatically at this time both as a result of people fragmenting into smaller groups and smaller territories and probably also as a result of a general increase in population numbers. Between 7000 and 6000 B.P. in the southern Cape another generation of LSA innovations in the form of a series of microlithic hafted formal tools was introduced to the toolkit and this coincided with a reduction in the length of both untrimmed flakes and scrapers as well as a shift in raw material preferences. This technological change does not coincide with another shift in hunting patterns but is broadly coeval with warmer and drier conditions in the mid-Holocene. Within the last 2000 years the economy was modified again with the introduction of domesticated stock, but it is notable that adjustments to the toolkit were minimal, despite the fact that demographic changes must have taken place as the herders formed larger groups and moved seasonally with the grazing.

The details of this integrated model of artefactual, demographic and subsistence changes in the southern Cape may not be applicable to all regions in southern Africa for it depends to some extent on the switch in hunting strategy which was not as obvious elsewhere in regions where grassland persisted despite climatic changes. In the Matopos in Zimbabwe, for example, a different set of controlling factors was almost certainly involved, while the very low incidence of mid-Holocene sites in the drier regions of the South African interior indicates a lower population there in the mid-Holocene that is very different from that observed in the southern Cape.

Criticism of the model by Parkington (1980) has focused on the value of using terms such as Robberg, Albany and Wilton to describe what are seen by some, but not all, researchers as arbitrary subdivisions of a continuously changing artefact system of short-term adjustments to environmental and social conditions. While the 'arbitrariness' of the criteria chosen to demonstrate change depends to a large extent on the scale of changes observed and the time periods covered by long-sequence sites, there is no doubt that macro- and microevolutionary patterns can be seen in the southern Cape data that are representative of changes that took place to a greater or lesser degree in regions throughout southern Africa. Long sequence sites are urgently needed in regions other than the southern Cape to test the observations made here. It is premature to offer a new classification scheme for the southern African Later Stone Age before we can place inter-regional comparisons on a sounder footing with comparable data.

The conclusions that can be drawn from the analysis of change through the last 20 000 years in the artefact assemblages from NBC, KRA and BPA are of both local and wider significance. At a local level we can state that:

1. Some changes are site-specific and relate primarily to the range of raw materials used and to the idiosyncratic changes in frequencies of relatively rare items in the toolkit. At the sites studied these mostly include non-lithic artefacts such as beads, decorated ostrich eggshell and bone tools which clearly have different patterns of discard from stone tools. They are not considered to be relevant to the study of evolutionary changes in technology.

2. At an inter-site level there are differences in the relative frequencies of some formal tools that probably relate to activity variation. NBC, for example, has no adzes while fish gorges are absent at the inland sites of KRA and BPA. These variations are again considered to be irrelevant to the study of evolutionary changes.

3. The comparison of the patterns of change at the three sites shows that although the actual measurements and frequencies differ from one site to the next, the timing of changes is similar and where this occurs we can suggest that they indicate regional changes rather than site-specific ones. Such changes occur in the incidence of bladelets and bladelet cores, in the incidence of formal tools, in the size and shape of untrimmed flakes and in the size and shape of scrapers. Although the sample of backed microliths from late Pleistocene assemblages is very small, it seems that there was less stylistic variation in their

manufacture through time than occurred amongst scrapers, and as a long sequence of adzes is available from BPA only it is not possible to assess the shift in adze parameters at this stage.

4. Some parameters, such as the relative thickness of untrimmed flakes and the ratio of utilized to untrimmed flakes, show very little variability within the last 20 000 years, but the variables that do change tend to do so relatively suddenly between 12 000 and 11 000 B.P. and again between 7000 and 6000 B.P. confirming broadly the validity of the subdivision of the sequence into the Robberg, Albany and Wilton industries and demonstrating that microevolutionary change conforms to the model of punctuated equilibria.

5. Analysis of faunal and floral remains and sediments from BPA, of faunal remains from NBC and of oxygen isotope ratios from the Cango Caves shows that changes in hunting patterns post-dated major climatic and vegetational changes by about 3000 years at the end of the Pleistocene in the southern Cape. Hunting patterns changed most dramatically between 12 000 and 11 000 B.P. while rapid changes in temperature, in microfaunal distributions and body size and in vegetation were most dramatic between about 15 000 and 14 000 B.P. in the Cango Valley. This gives some idea of the scale of temporal lag between environmental changes and technological/subsistence adjustments during the Later Stone Age that may be applicable to other periods during the Stone Age as well.

6. The change in technology that took place between 7000 and 6000 B.P. is of a slightly different nature to that which occurred at the end of the Pleistocene in that it is the result of the diffusion of highly standardized microlithic formal tool designs that were linked to a different hafting method, as well as of a change in the size of both untrimmed flakes and scrapers and a re-appearance of bladelet cores and fine grained raw materials. It does not correlate with an obvious shift in either hunting patterns or climatic variables, but it coincides with the Holocene hunting and gathering pattern geared to staple geophyte plant foods and solitary territorial browsing antelope and equates broadly with warmer and drier conditions experienced during the mid-Holocene.

7. The introduction of pottery and domesticated stock within the last 2000 years is more likely to have been the result of population migrations into the southern Cape than of gradual acculturation, although both processes undoubtedly played their part in the rapid spread of this new subsistence economy. It does not correlate with an obvious change in stone artefact manufacture indicating that the immigrants had been part of the same basic toolmaking tradition as the indigenous hunter-gatherers who preceded them at BPA. This would confirm the impression that the toolmaking traditions or complexes of the LSA were widespread phenomena in the sub-continent and not the result of independent regional evolution.

When the local sequence is compared with that from other regions in southern Africa we can conclude that:

8. The microevolutionary trends observed in the style of tool manufacture in the southern Cape (most obvious in the length measurements for untrimmed flakes and scrapers and in related changes in raw materials and core sub-types) were essentially oscillations around a gradually changing mean that can be compared to secular stylistic changes in modern fashions. While individual parameters may not follow precisely the same time patterns and may appear to be static when other variables are changing, the variability in the key parameters appears to be regionally specific and more closely correlated with regional changes in subsistence strategy than does change at the macroevolutionary level.

9. Macroevolutionary change, which involves the introduction and spread of technological innovations that follow directions expected from general trends in modern technology, is a much more diffuse phenomenon that cuts across microevolutionary patterns and does not result from the accumulation of them. Macroevolutionary change is not regionally specific but is responsible for the widespread occurrence of new artefact designs that transcend environmental boundaries and subsistence strategies.

10. The Later Stone Age is seen as a loosely defined temporal stage that groups together a series of generations in a family of macroevolutionary

innovations including the manufacture of bladelets from bladelet cores, the manufacture of standardized microlithic hafted formal tools as well as the bow and arrow, pottery and a range of ethnographically known non-lithic items, notably those that had a decorative purpose or could be regarded as art objects. The southern African Later Stone Age is itself a regional variant of a series of toolmaking traditions that can be found in archaeological sequences throughout the Old World and further afield. The vast geographical spread of these traditions demonstrates the effectiveness of the communication networks along which these innovations were diffused.

11. Comparison between the temporal patterns of modern technology and those of the LSA has shown a broad correspondence at the macroevolutionary level. The importance of change at the microevolutionary level has perhaps been under-estimated in modern technology, however, where it has been limited to observations on fringe items such as dress fashions, clocks and gravestones. General trends noted in Stone Age studies on a scale that is generally not possible to emulate for modern items suggest that a pattern of secular changes may be expected to occur in modern technological items and that at times these may take directions contrary to the general evolutionary trend. During the Stone Age such reversals have at times been triggered by social and technological adjustments that post-dated major environmental changes with a distinct time lag between the two. Long-term archaeological observations such as those from Nelson Bay Cave and Boomplaas may therefore be of use in predicting changes at the microevolutionary level, but not at the scale of macroevolution, in modern technological systems.

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APPENDIX I

NUMERICAL CLASSIFICATION SCHEME FOR SOUTHERN AFRICAN STONE AGE ARTEFACTS WITH SPECIAL REFERENCE TO THE LATER STONE AGE

This scheme is based on the reduction sequence from raw material to formal tool, with the type of retouch, the size of the artefact and the morphology of the working edge taken into account in the classification of formal tools. The numerical coding may be extended to include non-lithic artefacts and additional formal and other tools may be incorporated where appropriate.

The coding system is based on two sets of digits, with the facility to add more on the right hand side. The hierarchy of the code is described below, the digit numbering starting from the left hand side of the code, thus 12-345-6 (after Akazawa et al 1980).

DIGIT	CODE NUMBERING	DEFINITION
1	0	Stone artefacts
Material	1	Pottery
	2	Metal
	3	Wood, bark, reed, grass
	4	Leather
	5	Bone
2	00-	Manuports, or unused lumps of raw material brought to a site. Ochre and other colouring matter can be included
Category	01-	Waste, or the unretouched by-products of stone artefact manufacture. Included are pieces which may have been used, but which show no sign of damage visible to the naked eye.
	02-	Utilized pieces, or artefacts with damage visible to the naked eye. Utilization damage is less sustained than deliberate retouch and the pieces in this category are not made to a repeated pattern.
	03-	Formal tools usually made on flakes in which deliberate retouch is used to shape the working edge and the tool to a repeated pattern.
	04-	Formal tools usually made on large cores. This category would include Earlier Stone Age bifaces and similar tools. Not used for the Later Stone Age.
	05-	Formal tools shaped by grinding and/or polishing

DIGITS 3, 4 AND 5 REFER RESPECTIVELY TO THE CLASS, TYPE AND SUB-TYPE WITHIN A CATEGORY. VARIATIONS ON SUB-TYPES MAY BE LISTED UNDER A SIXTH DIGIT TO THE RIGHT.

MANUPORTS

00-100	Unused cobbles or pebbles or lumps of rock brought to a site as raw material
00-110	Raw material listed above that has been stained with ochre
00-120	Raw material listed above that has been burnt
00-200	Ochre
00-210	Unmodified ochre
00-220	Smoothed ochre
00-230	Engraved or notched ochre
00-300	Micaceous sandstone

WASTE

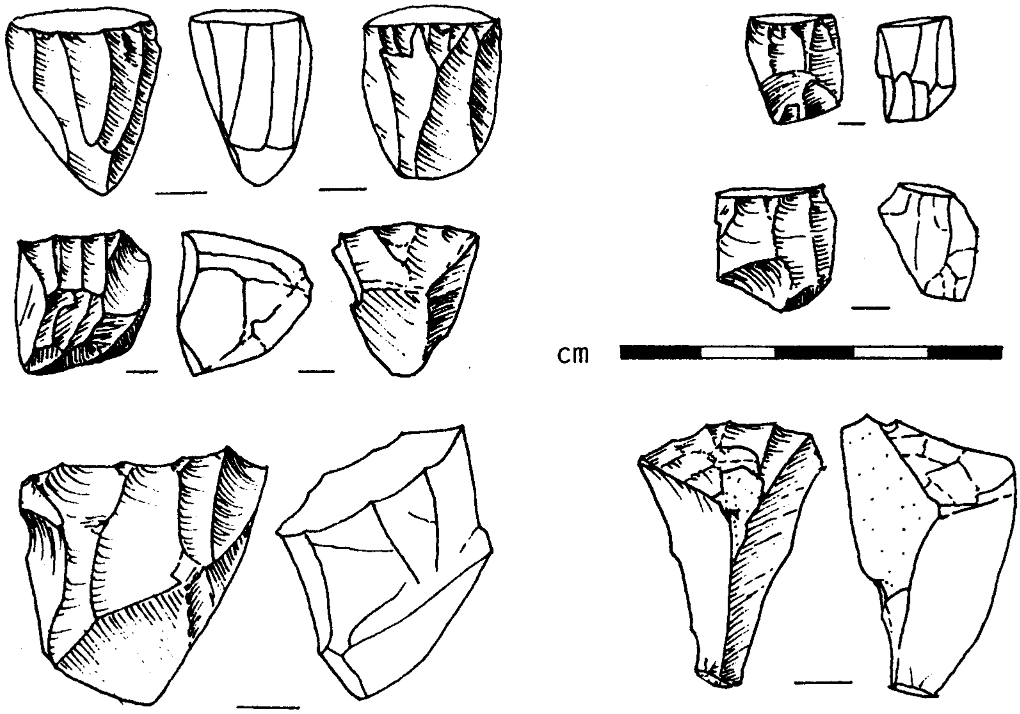
01-100	Cores
01-110	Chunks with one or two negative flake scars
01-120	Core with three or more negative flake scars
01-121	Irregular core
01-122	Radial core
01-123	Prepared core
01-123-1	Tortoise core
01-123-2	Victoria West core
01-124	Blade core
01-125	Bladelet core
01-126	Flat bladelet core
01-200	Core by-products
01-210	Core reduced pieces
01-220	Core rejuvenation flakes
01-300	Chips, less than 10 mm maximum dimension
01-310	Flake origin
01-311	Irregular
01-312	Bladelet
01-320	Chunk origin
01-400	Unretouched flakes with no utilization visible to naked eye
01-410	Irregular, unbroken
01-411	broken
01-420	Quadrilateral, unbroken
01-421	broken
01-430	Convergent, plain platform, unbroken
01-431	broken
01-440	Convergent, facetted platform, unbroken
01-441	broken
01-450	Convergent, no platform, broken
01-460	Blade, unbroken
01-461	broken
01-470	Bladelet, unbroken
01-471	broken

Type no.	Type name
1-125	BLADELET CORE

Definition

Cores with one and occasionally more platforms from which parallel-sided flakes of bladelet dimensions have been systematically struck. Damage along the striking platform often resembles scraper retouch.
In the southern Cape they are commonly made on quartz, silcrete and, occasionally, fine-grained quartzite.
They occur most frequently in Robberg Industry assemblages, but are also found in Wilton assemblages.

SOME TYPICAL EXAMPLES



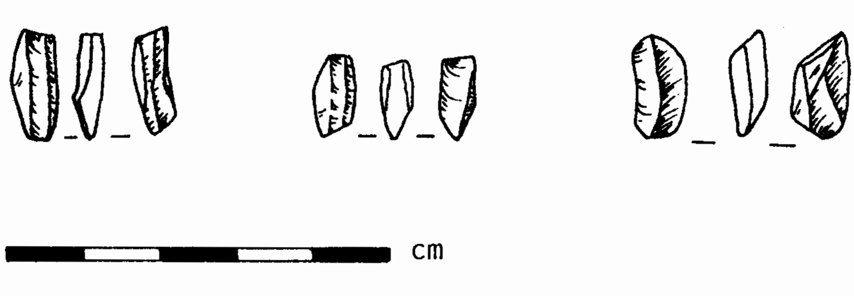
Type no.	Type name
1-126	**FLAT BLADELET CORE**

Definition

A small core (usually less than 20 mm long) from which bladelets have been struck, but the core does not have a flat platform. The flakes have been removed leaving instead a chisel-like end and the bi-polar technique has often been used. They are made almost exclusively in clear and milky quartz. They are found in assemblages with more bladelets than are usually present and are undoubtedly the result of bladelet manufacture. They resemble in all significant respects the core residues that result when the raw material is bound with leather or fiber to hold the flakes together during the flaking process (White & Thomas 1972:278).

Flat bladelet cores are found only in Robberg assemblages at Nelson Bay and Boomplaas in the southern Cape and at Elands Bay and Byneskranskop in the south-western Cape. They do not seem to be associated with bladelet production during the Holocene.

SOME TYPICAL EXAMPLES

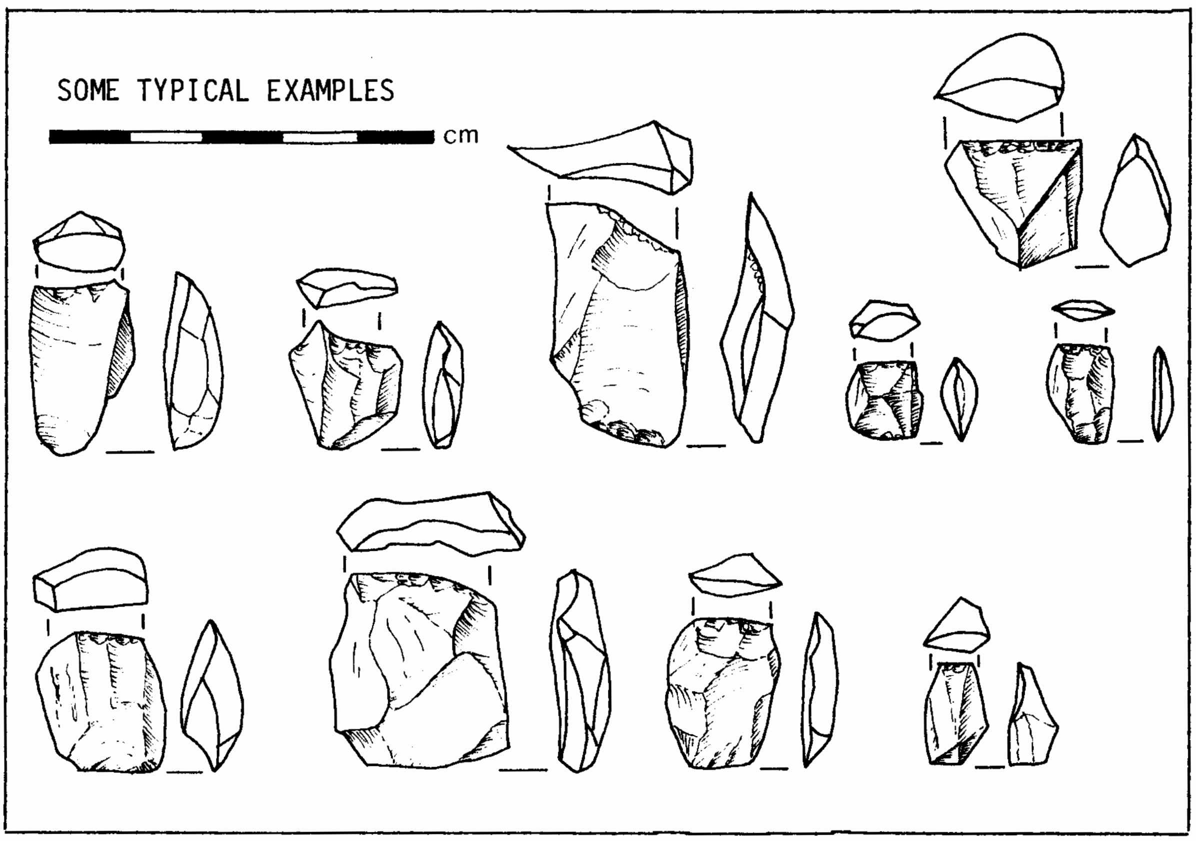


Type no.	Type name
1-210	CORE REDUCED PIECES

Definition

Core reduced pieces are residues of cores that can no longer be flaked. They are usually quadrilateral in plan form with a chisel-like striking platform and are made in a variety of raw materials. They differ from flat bladelet cores in the lack of regular-shaped flake scars and may have few complete flake scars at all. They differ from pièces esquillées in having no crushing along the chisel-like striking platform. They are usually smaller than 25 mm in length.

Core reduced pieces may be found in any LSA assemblage, but are more common in Robberg assemblages.

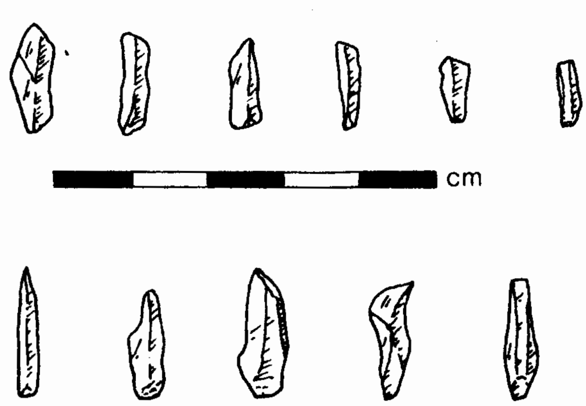


Type no.	Type name
1-470	BLADELET, unbroken

Definition

A narrow parallel-sided flake with a length greater than twice the maximum width, and a width of less than 12 mm. Bladelets are commonly made of quartz or silcrete and occur most abundantly in assemblages assigned to the Robberg Industry in the southern Cape where they seem to have been struck from cores bound by fibre or leather during flaking (White & Thomas 1972:278). In Holocene assemblages they do not occur in such large numbers and are not commonly found clumped together on occupation floors.

Some typical examples



UTILIZED PIECES

02-100 Natural pieces with utilization. If ochre-stained, add '1' on right.

- 02-110 Anvils
- 02-120 Hammerstones
- 02-130 Lower grindstones
- 02-140 Upper grindstones
- 02-150 Combination hammerstones/upper grindstones
- 02-160 Milled-edge pebbles
- 02-170 Smoothed slate 'palettes'

02-200 Cores/chunks with utilization damage

- 02-210 Heavy edge-flaked pieces
- 02-220 Pièces esquillées
- 02-230 Chunks with utilized margins

02-300 Flakes with utilization damage

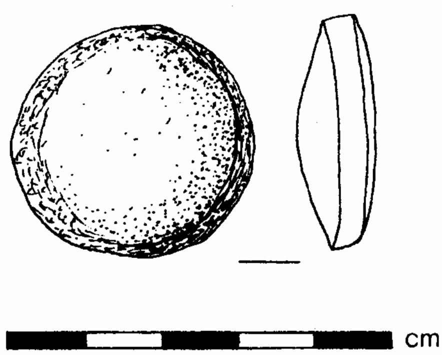
- 02-310 Damage to cutting edge
  - 02-311 Irregular flake
  - 02-312 Quadrilateral flake
  - 02-313 Convergent flake, plain platform
  - 02-314 Convergent flake, facetted platform
  - 02-315 Convergent flake, no platform
  - 02-316 Blades
  - 02-317 Bladelets
- 02-320- 327 Steep damage
- 02-330- 337 Notched edges

Type no.	Type name
02-160	MILLED EDGE PEBBLE

Definition

Milled edge pebbles are made on small, round, relatively flat pebbles. The outer perimeter has been 'milled' or pitted due to use as a hammerstone or for some other purpose against a hard material. They are found in Holocene assemblages throughout the southern and eastern Cape, but occur in small numbers. They are usually made of quartzite.

A TYPICAL EXAMPLE

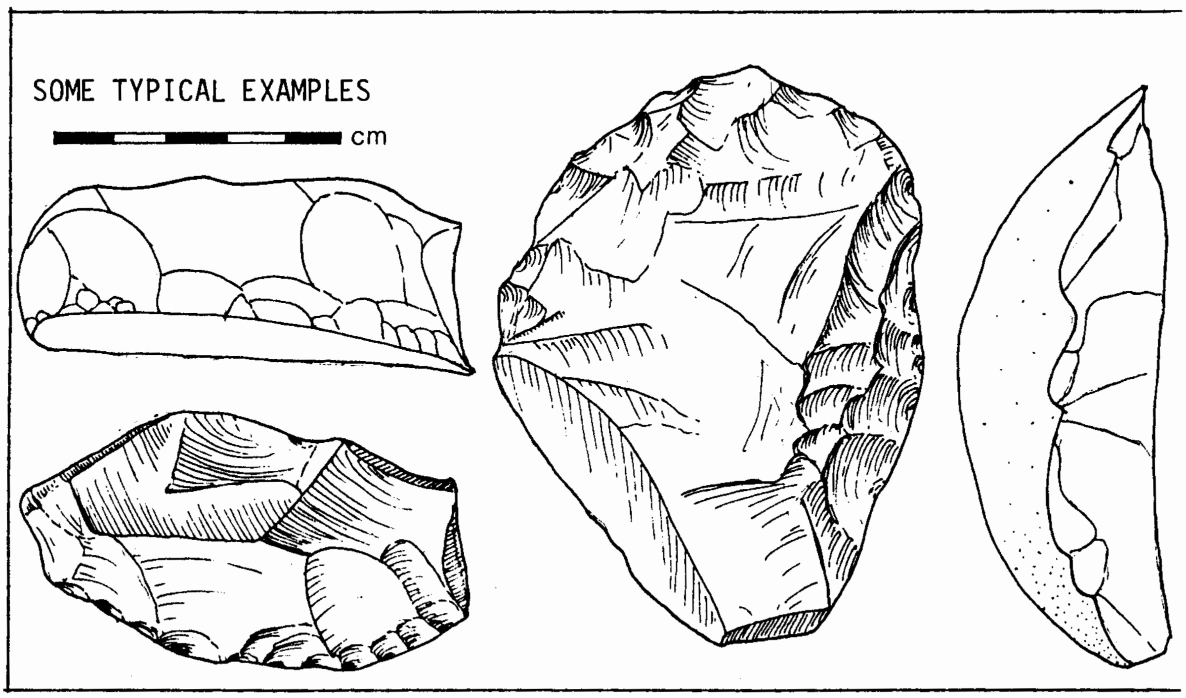


Type no.	Type name
2-210	HEAVY EDGE-FLAKED PIECES

Definition

Split cobbles of about fist-size or larger that have a flat base from which flakes have been struck around the perimeter, sometimes emphasizing a blunt point at one end. Crushing of the edge of the platform between the flat base and the side of the tool indicates utilization against a hard material, possibly as a result of tool manufacture, or otherwise as a hammer to remove shellfish from rocks. These artefacts are made exclusively in quartzite.

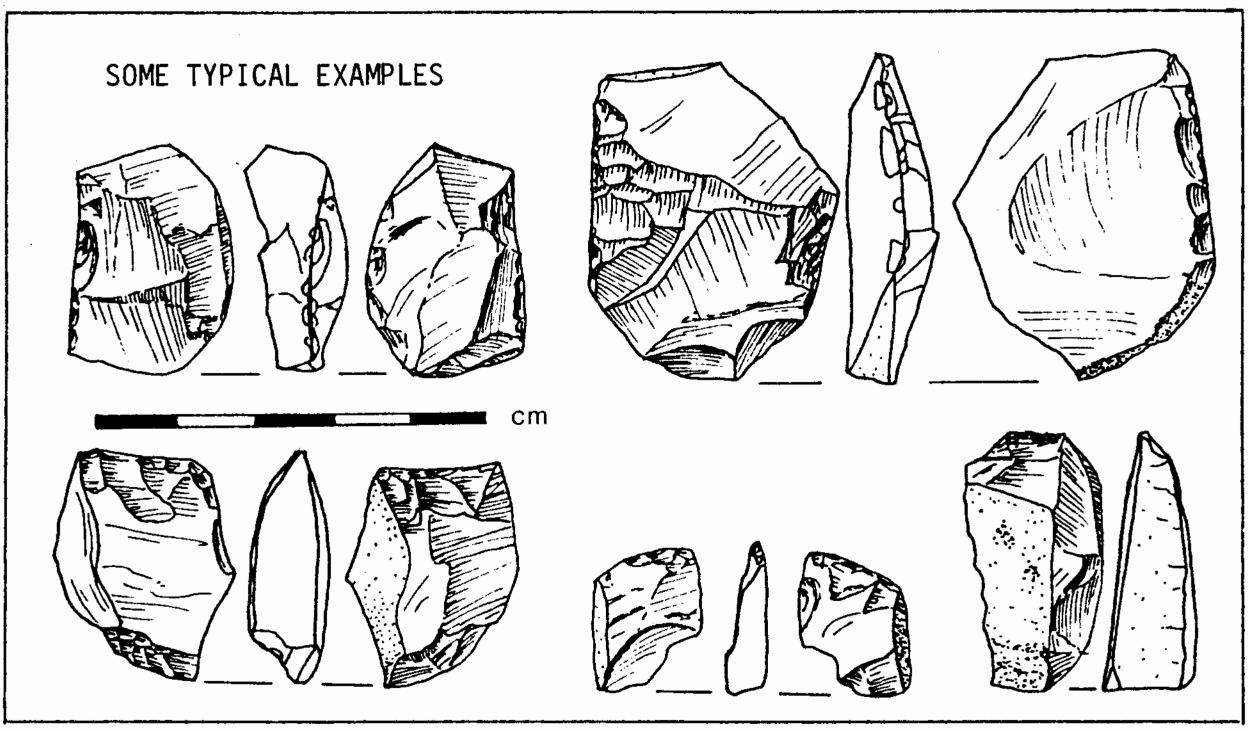
Heavy edge-flaked pieces appear to be associated with coastal sites where quartzite (in the form of water-worn cobbles) has been used extensively as a raw material. Although some examples were found with the Robberg Industry at Nelson Bay Cave, they are much more common in the assemblages assigned to the Albany and Wilton industries at that site.



Type no.	Type name
2-220	PIÈCES ESQUILLÉES

Definition

Pièces esquillées are similar in most respects to core reduced pieces except that there is secondary crushing along the curved, chisel-like striking platform. This crushing appears to be the result of the core reduced piece having been used in a chisel-like action, but it is also possible that this damage may result from attempts to remove further flakes from the piece. Pièces esquillées are usually 20-25 mm long and 15-20 mm wide with a quadrilateral plan form. The utilized edge is straight in plan form, but when viewed from above it is gently curved. While particularly common in quartz, they are also found in other raw materials. They are more common in Holocene microlithic assemblages than in older ones, but are also numerous in late Pleistocene microlithic assemblages.

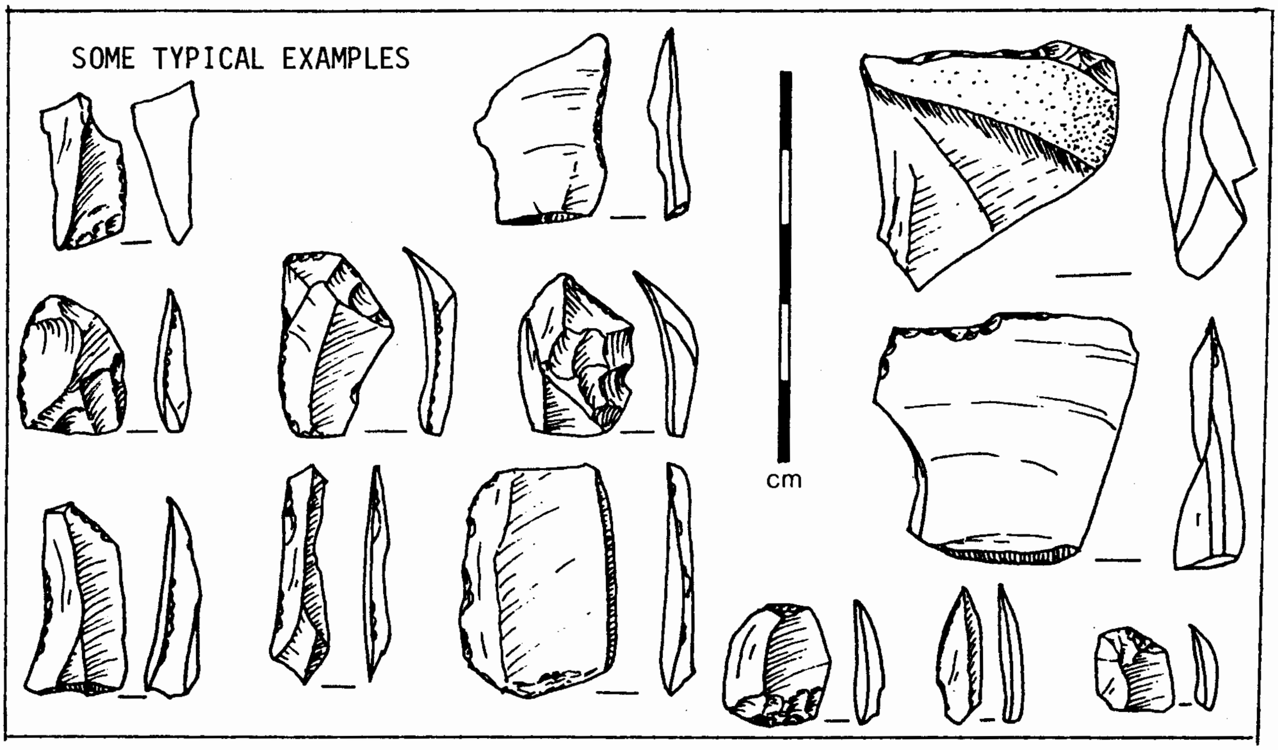


Type no.	Type name
2-310	FLAKES WITH UTILIZATION DAMAGE TO CUTTING EDGE

Definition

Flakes or flake fragments with an edge sharp enough to have served as a cutting tool on which there is visible damage in the form of a series of small flakes removed along the cutting edge, usually on the dorsal surface. Can usually be distinguished from damage caused by post-excavation damage in sieves and packets by weathering of the flake scar and by the fact that utilization damage is usually restricted to a small portion of the edge in the form of three or more flake scars, whereas post-excavation damage is usually in the form of isolated flake scars at several points along the cutting edge.

Utilized flakes occur in all forms of raw material and in assemblages of all ages.



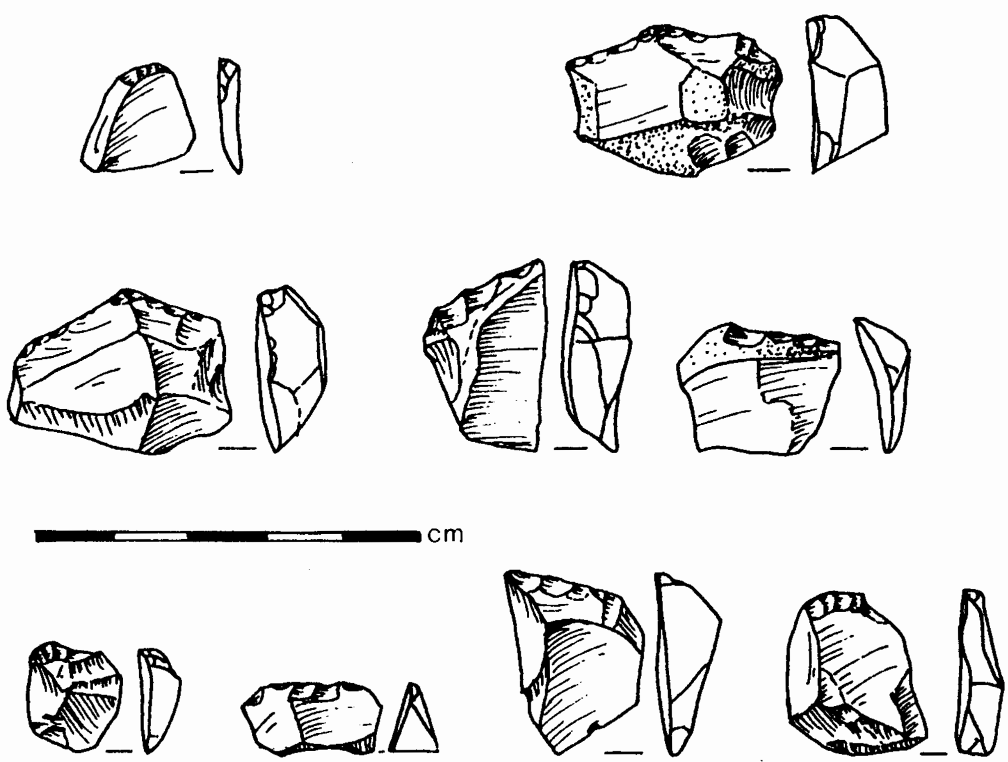
Type no.	Type name
2-320	FLAKES WITH STEEP UTILIZATION DAMAGE

Definition

Flakes or flake fragments with damage to the edge that resembles scraper retouch but is not as sustained, and is not necessarily along a convex edge. Utilization of the flake would have been at a steeper angle than in the case of utilization damage to a cutting edge. There are no shaping scars to indicate deliberate preparation of the piece before utilization.

Flakes with steep utilization damage are found in all raw materials and in assemblages of all ages.

SOME TYPICAL EXAMPLES



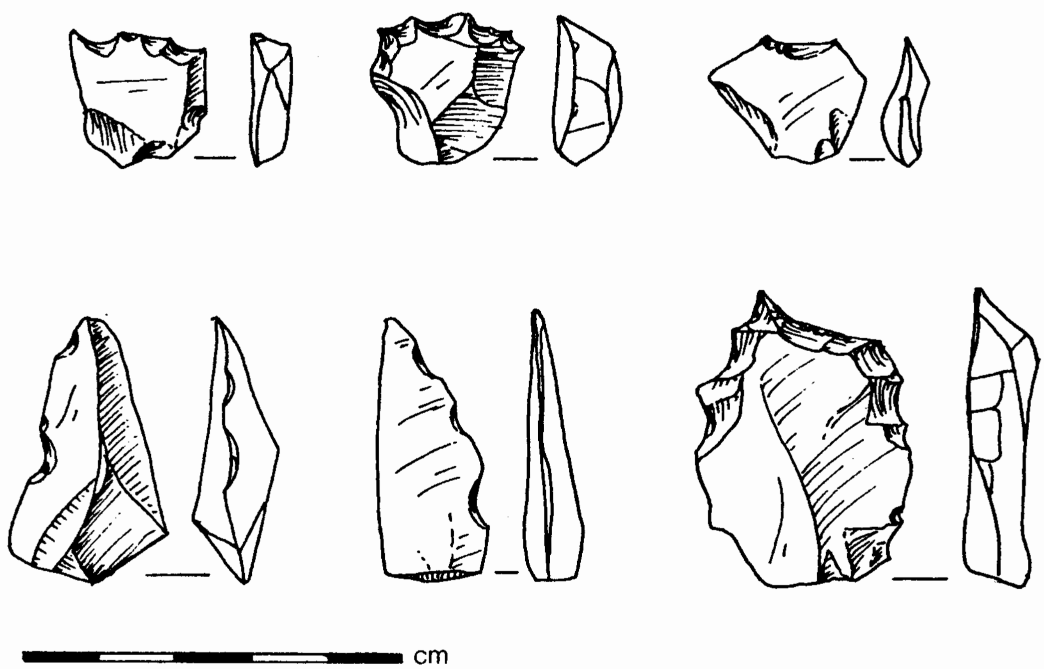
Type no.	Type name
2-330	FLAKES, UTILIZED WITH NOTCHED EDGES

Definition

Utilized flakes with notched edges show no retouch to shape the working edge, but have sustained damage to the edges which has resulted in a small notch or notches being formed. To qualify as a notch, there should be at least two flake scars that have formed a distinct concavity along the working edge through pressure on a small section of this edge.

Flakes with utilization in the form of notched edges are found in all types of material and in assemblages of all ages.

SOME TYPICAL EXAMPLES



FORMAL TOOLS BASED ON FLAKES

03-100 Scraper

- 03-110 Large scraper, maximum dimension greater than 30 mm
  - 03-111 End scraper
  - 03-112 Side scraper
  - 03-113 Circular
  - 03-114 Backed
  - etc etc
- 03-120 Medium scraper, maximum dimension between 20 and 30 mm
  - 03-121 - Sub-types as above
- 03-130 Small scraper, maximum dimension less than 20 mm
  - 03-131 - Sub-types as above

03-200 Backed tool

- 03-210 Backed blade, length greater than 25 mm
  - 03-211 Segment
  - 03-212 Backed blade
  - 03-213 Obliquely truncated blade
  - 03-214 Tranchet
  - 03-215 Irregular backed piece

- 03-220 Backed microliths, length less than 25,1 mm
  - 03-221 Segment
  - 03-222 Backed bladelet
    - 03-222-1 Distal discard
    - 03-222-2 Backed point
    - 03-222-3 Segmented backed bladelet
    - 03-222-4 Proximal discard
  - 03-223 Petit tranchet
  - 03-224 Irregular backed piece
  - 03-225 Broken backed piece

Type no.	Type name
3-100	SCRAPER

Definition

Scrapers are usually made on flakes, but core types are found. They are characterized by two main features: a flat ventral surface that is unretouched and a convex working edge that has been deliberately shaped by secondary retouch. Utilization results in smaller flakes being removed from the working edge and this will steepen the angle between the ventral surface and the working edge which can range from 30^{o} to over 90^{o}.

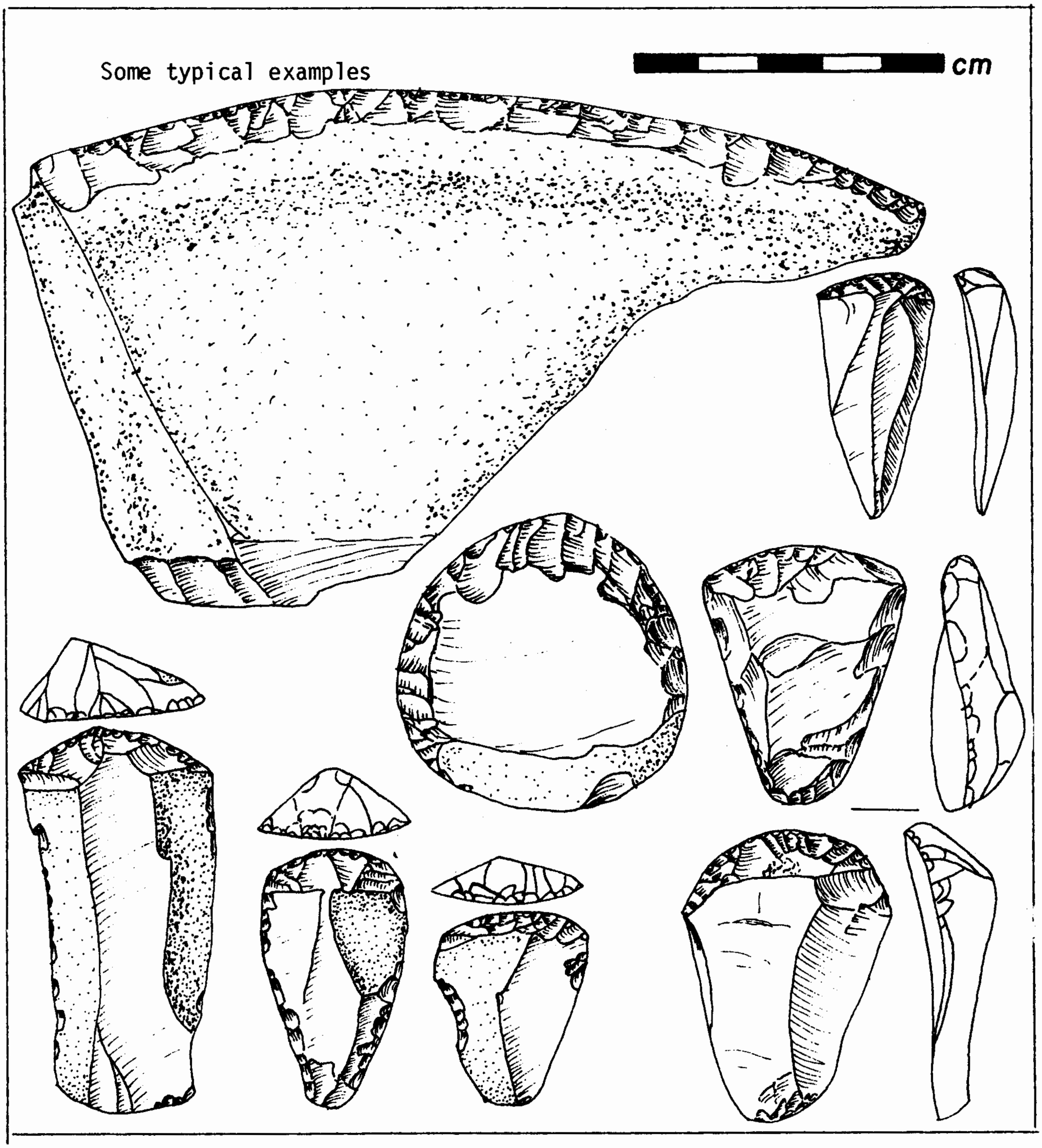
Sub-classes of scrapers have been recognized either on the position of the working edge in relation to the bulb of percussion and the long axis of the piece, or on the basis of size. A size classification is preferred here with large scrapers including those with a maximum dimension of greater than 30 mm, medium scrapers between 20 and 30 mm and small scrapers having a maximum dimension of less than 20 mm. Further subdivisions may be made based on the shape of the blank or the position of the retouch, but in this analysis these features are measured as continuous variables.

Scrapers can be distinguished from adzes because they have a convex rather than a straight or concave working edge. Scrapers are differentiated from flakes with steep utilization damage because the working edge is shaped by secondary retouch and not by utilization. The result is that scrapers have more flake scars on the working edge and the retouch/utilization is more sustained. In any assemblage there are usually some pieces which are difficult to classify, but the majority are relatively easy to distinguish when the above criteria are applied.

Scrapers are made in all raw materials and are found in assemblages of all ages.

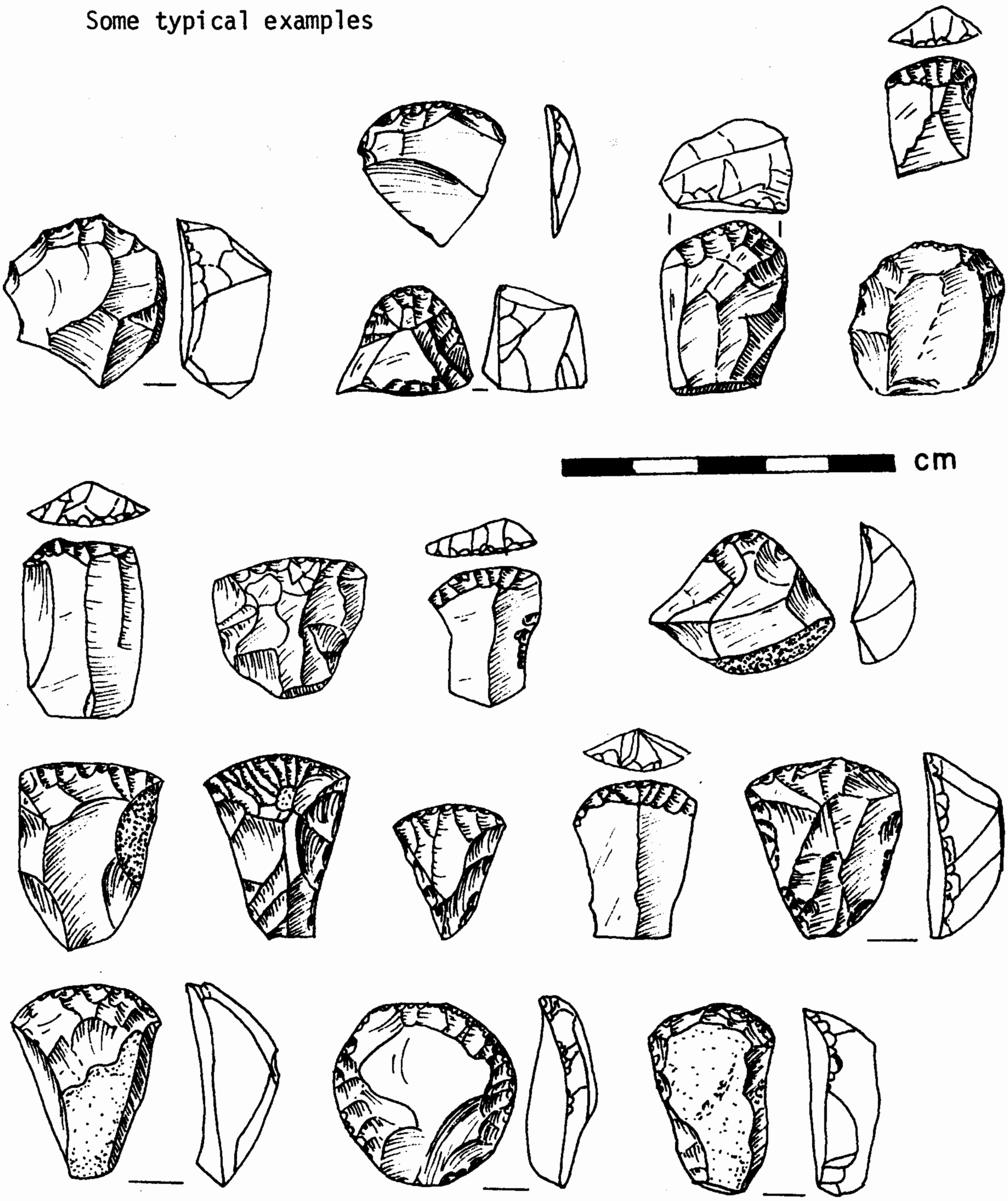
<u>Type no.</u> <u>Type name</u>

03-110 LARGE SCRAPER



Type no.	Type name
03-120	MEDIUM SCRAPER

Some typical examples



Type no.	Type name
03-130	SMALL SCRAPER

Some typical examples

Type no.	Type name
3-220	BACKED MICROLITHS

Definition

Backed microliths are less than 25,1 mm long. They have a sharp cutting edge along one margin and one or more opposing margins are blunted by abrupt retouch. They are usually made on bladelets or portions of bladelets, or on flakes reduced to bladelet proportions by secondary retouch, but backed flakes also occur. Abrupt retouch is most commonly effected by pressing the edge of the margin against a hard anvil with either the ventral or dorsal surface uppermost. Some backed microliths show retouch from both the ventral and dorsal surfaces.

Sub-classes of backed microliths are commonly defined on the shape of the backed margin (straight or curved) and the plan form of the finished artefact. Where sufficient numbers of backed microliths are found, a reduction sequence such as used by Wendt (1972) and H.J. Deacon (1976:142) can be worked out and can be employed in the classification of sub-types. In this analysis only segments, backed bladelets, backed flakes and broken backed pieces are used as sub-classes because of the relatively low frequencies found.

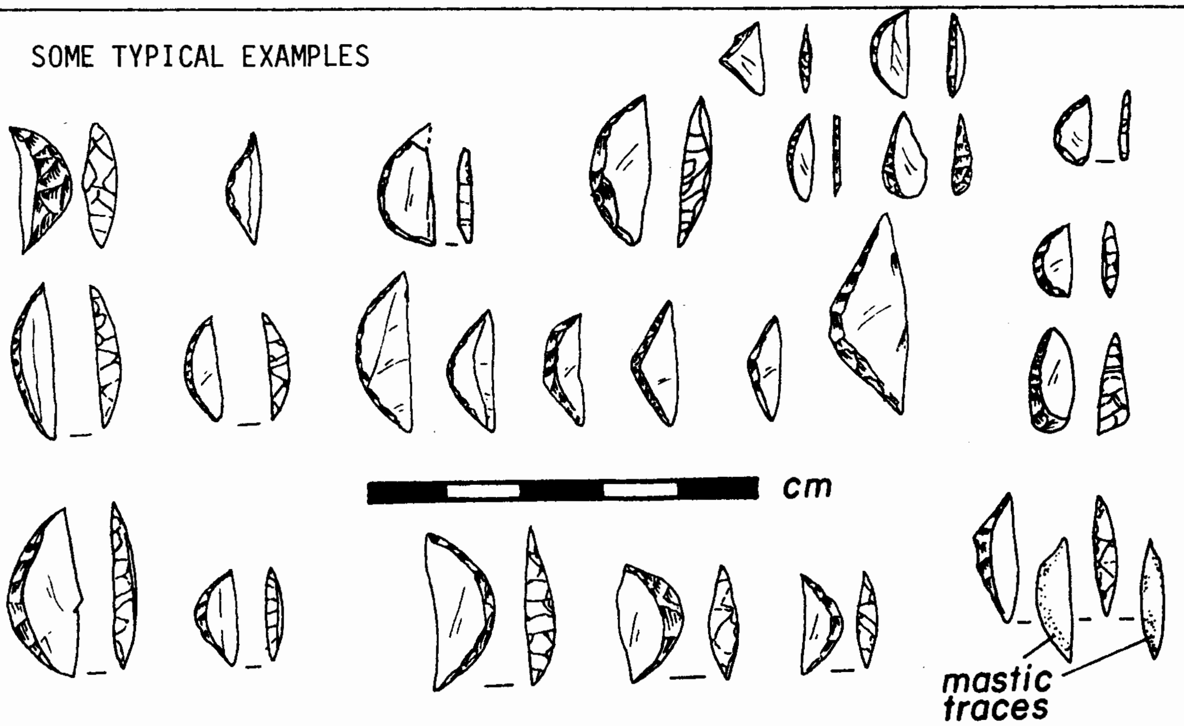
Backed microliths are characteristic of Later Stone Age assemblages, but may occur rarely in Middle Stone Age contexts where larger backed blades are found. They are usually made on fine grained raw materials such as chalcedonies, agates, hornfels, quartz and silcrete.

Type no.	Type name
3-221	SEGMENT

Definition

In plan form a segment is a portion of a circle with a curved arc backed with abrupt retouch and a straight, sharp cord. The shape may be exaggerated to a relatively thin and elongated segment or to a deep segment which is more like a truncated oval. Eared segments, recognized in Zimbabwe and Zambia, have exaggerated points at the junction of the arc and cord. Specimens in which abrupt retouch is present along only a portion of the arc are included with segments as long as the plan form is segment-shaped and the cord transects the arc at both ends. Where the base is flat, however, due either to abrupt retouch or the presence of the platform and bulb the piece is classified as a curved backed point or backed point. Broken segments may be snapped (presumably accidentally) at one or both ends of the cord.

SOME TYPICAL EXAMPLES

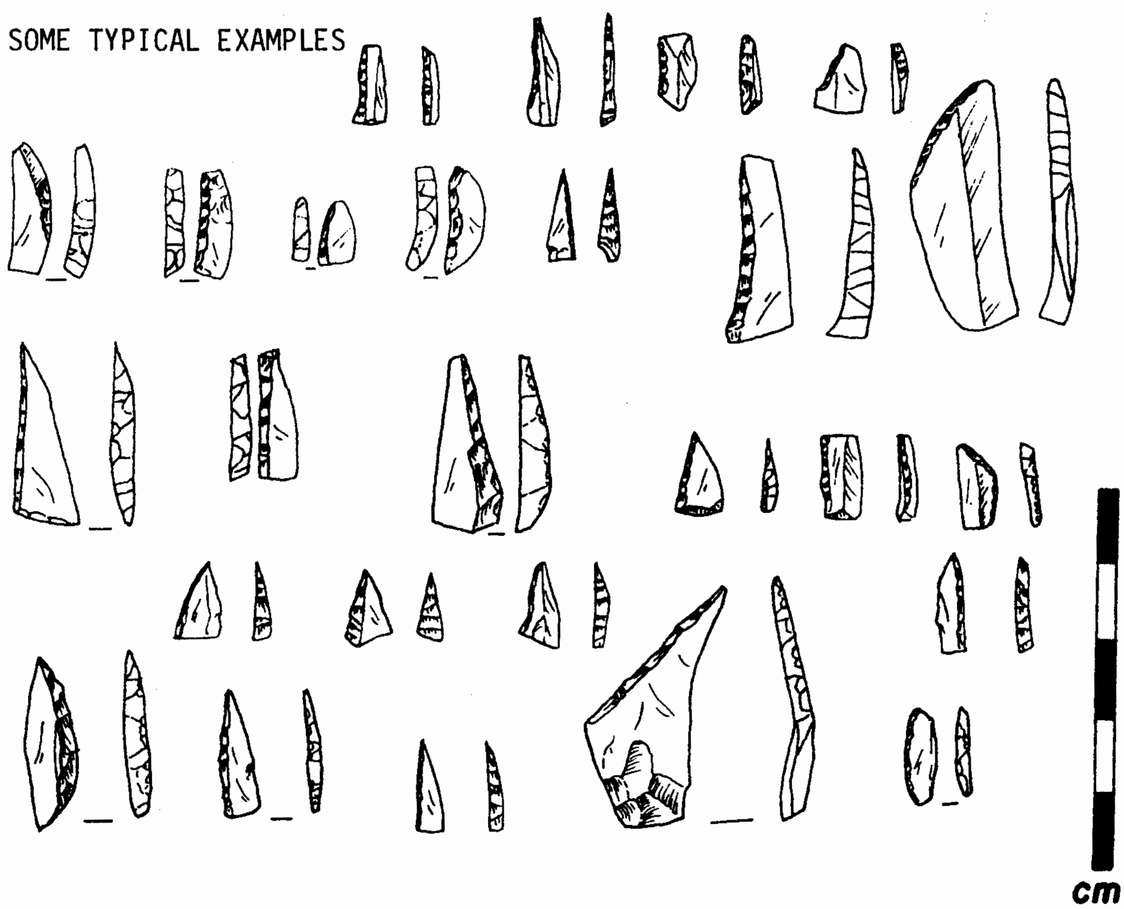


Type no.	Type name
3-222	BACKED BLADELET

Definition

In plan form backed bladelets have two or more straight margins of which one or more are blunted with abrupt retouch and one is a straight cutting edge. Sub-classes are recognized as deliberate end-products or discards made at various stages of a reduction sequence. The former include backed points and segmented backed bladelets, while the latter may be distal or proximal discards.

SOME TYPICAL EXAMPLES



03-300	Step-flaked tool
03-310	Adze
03-311	Pebble adze
03-312	One side retouched
03-313	Both sides retouched
03-320	Spokeshave
03-321	One notch
03-322	Two notches
03-323	More than two notches
03-400	Pointed tools
03-410	Reamer
03-420	Awl
03-430	Borer
03-500	Point
03-510	Unifacial point
03-511	Retouched along one lateral
03-512	Retouch along two laterals
03-513	With basal tang
03-514	With notched laterals, e.g. oak-leaf point
03-520	Bifacial point
03-511	Stillbay point (fully bifacial)
03-512	Partly bifacial point
03-513	With basal tang
03-600	Burin
03-700	Miscellaneous retouched piece
0-710	Flat invasive retouch
0-720	Steep retouch
0-730	Notched retouch

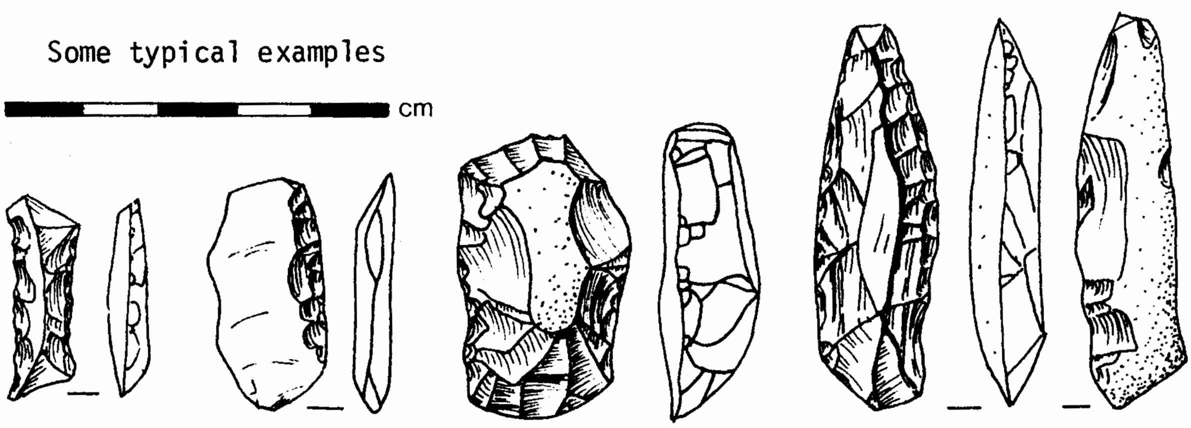
Type no.	Type name
3-310	ADZE

Definition

Adzes may be made on flakes or on pebbles which retain cortex on the ventral surface. They have one or more straight or slightly convex working edges which have been shaped by one set of flake scars and also show secondary step-flaking resulting from use at a steep angle and in a chopping motion. They are generally larger than scrapers, the mean length of measured samples from the southern Cape being between 25 and 40 mm, but show less variability in size through time. In areas where hornfels is available, this is the preferred raw material, but silcrete and chalcedony are also used. Quartz and quartzite are rarely selected for adze manufacture. Mastic traces on adzes from Melkhoutboom show they were hafted and a few specimens still in hafts suggest they were hafted at the end of a handle, i.e. more like a chisel than the traditional adze which is mounted at right angles to the handle. Retouch on opposing ends suggests they were sometimes reversed in the mount when one edge was worked down.

Adzes are found in small numbers in most Later Stone Age assemblages, but are better represented in late Holocene sites where they sometimes outnumber scrapers.

Some typical examples

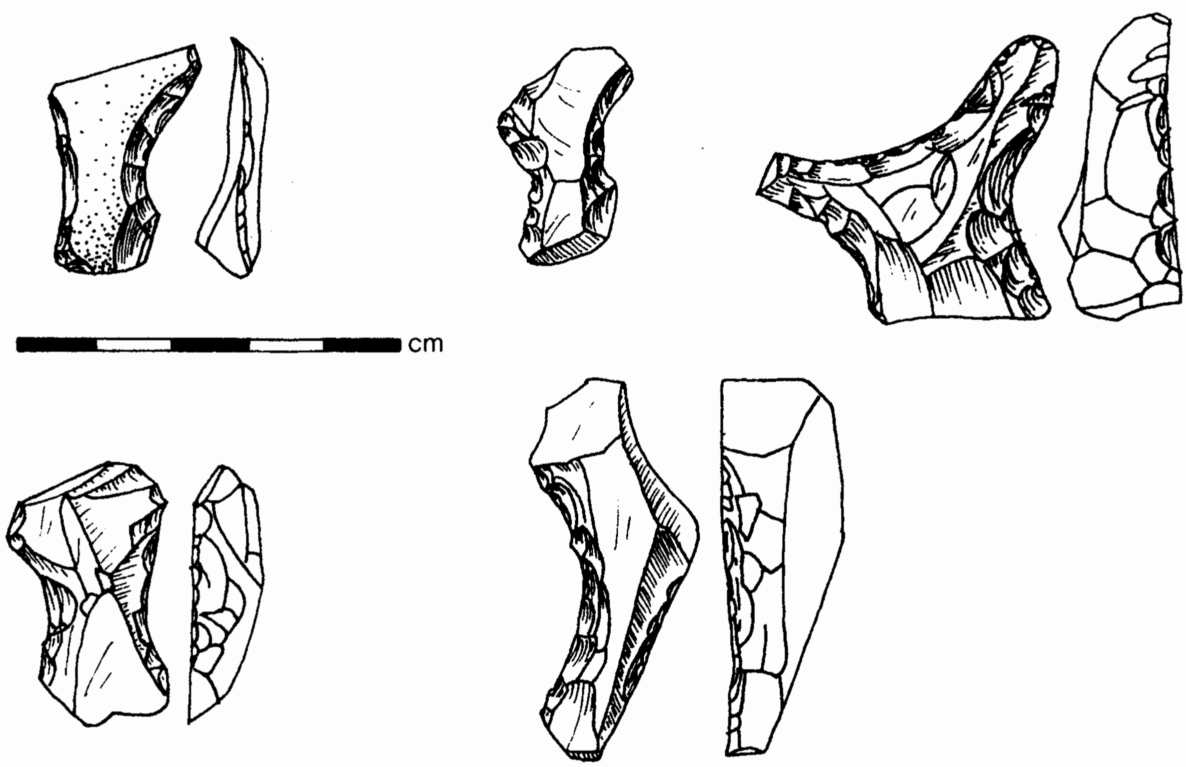


Type no.	Type name
3-320	SPOKESHAVE

Definition

Spokeshaves are similar to adzes in the occurrence of shaping scars and step-flaking. They differ, however, in the shape of the working edge in having concave working edges, often with two or more notches or concavities, and they are generally larger than adzes. Spokeshaves are again preferrentially made on hornfels and appear to be a geographical variation of adzes in that they are most commonly found in the eastern half of southern Africa, including parts of Zambia and Zimbabwe, the eastern Transvaal and Natal.

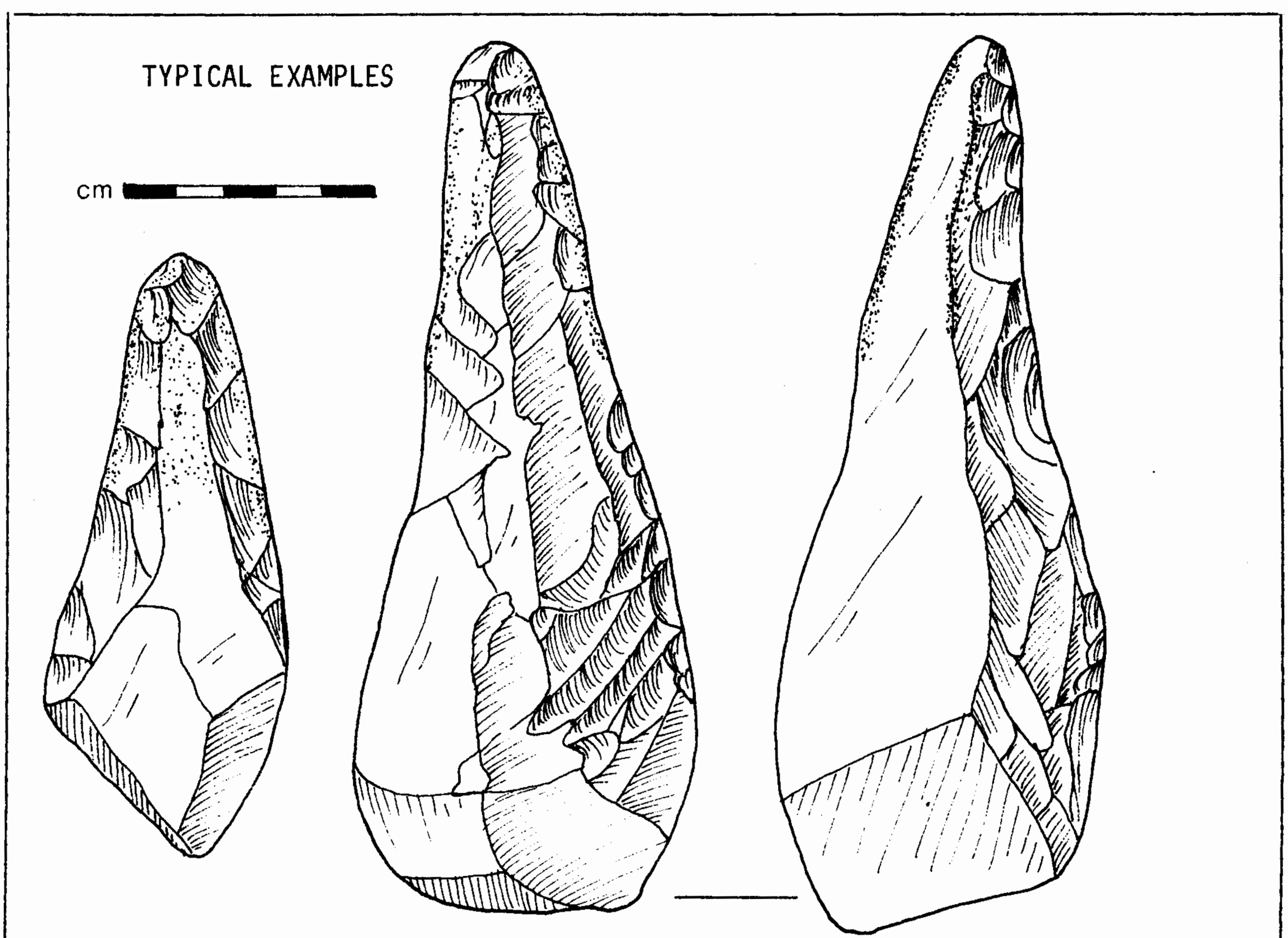
Some typical examples



Type no.	Type name
3-410	REAMER

Definition

A reamer (or rimer (Goodwin 1947)) is designed to make the hole in a bored stone. The working end is therefore round in cross-section and has been smoothed to a blunt point by utilization. The back of the tool opposite to the working end is generally roughly flaked to improve the hand grip. The length varies with the size of bored stone, but is usually at least 100 mm. Preferred raw materials for reamers are quartzite and hornfels. They are known from late Pleistocene deposits dating to ca 20 000 B.P. at Matupi in Zaire (Van Noten 1977), but in southern Africa the earliest dating is at ca 11 000 B.P. from Matjes River cave (Louw 1960).

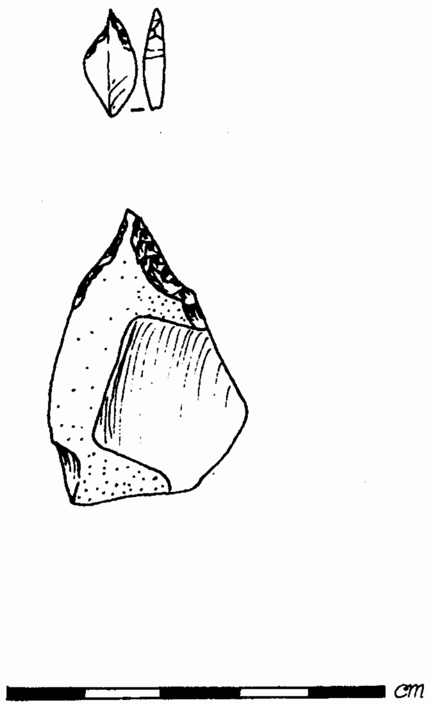


Type no.	Type name
3-420	AWL

Definition

Awls are intermediate in size between reamers and borers. They are made on flakes and a portion of the piece has been shaped to an elongated point leaving the rest of the flake unretouched. Polish is usually present at the tip of the working end. Preferred raw materials are finegrained hornfels, silcrete, chalcedonies, etc. Awls are known from Earlier, Middle and Later Stone Age contexts.

SOME TYPICAL EXAMPLES

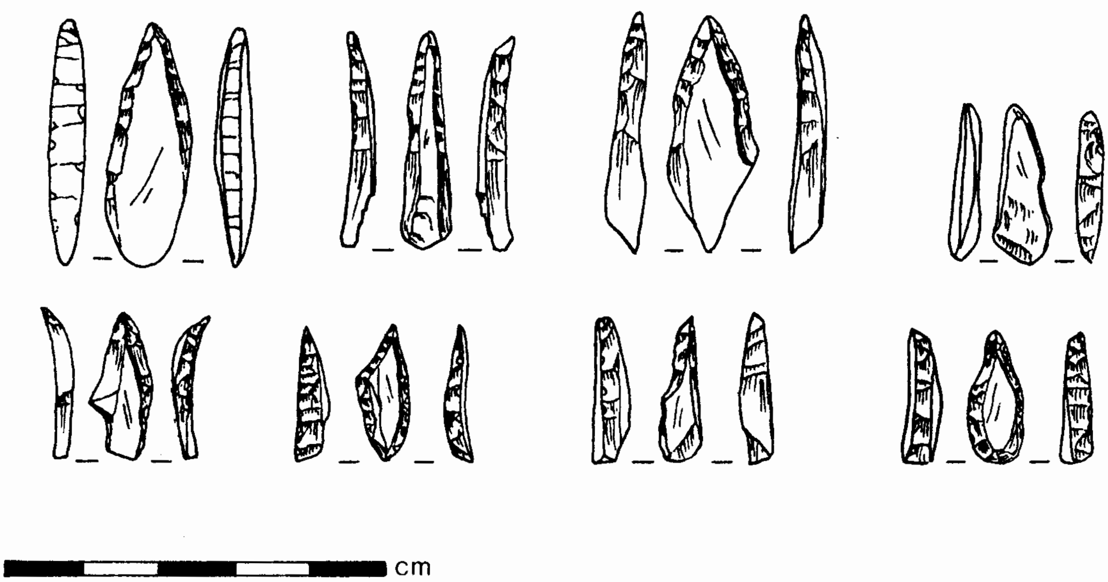


Type no.	Type name
3-430	BORER

Definition

A borer is of blade or bladelet proportions and was probably designed primarily for perforating ostrich eggshell beads. One end of the blade or bladelet has been blunted by abrupt retouch on two or more sides and the end is polished through use. Mastic traces on some specimens from Melkhoutboom show them to have been hafted. Preferred raw materials are silcrete, quartz, hornfels, chalcedonies and similar fine grained rocks. Borers are not known from Earlier or Middle Stone Age contexts. To date, the earliest dated specimens come from the ca 14 000 B.P. levels at Boomplaas.

SOME TYPICAL EXAMPLES

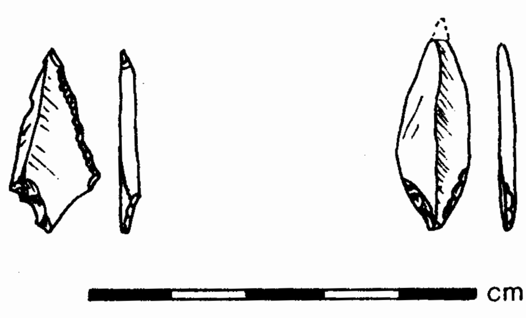


Type no.	Type name
03-513	UNIFACIAL POINT WITH BASAL TANG

Definition

Tanged unifacial points are made on convergent flakes, the bulbar end reduced by retouch to form a narrow tang, presumably to facilitate hafting. These artefacts are relatively rare in the Later Stone Age and tend to date within the last 3000 years (as at Nelson Bay Cave and Driel). They are made on fine-grained raw materials such as hornfels and silcrete.

SOME TYPICAL EXAMPLES

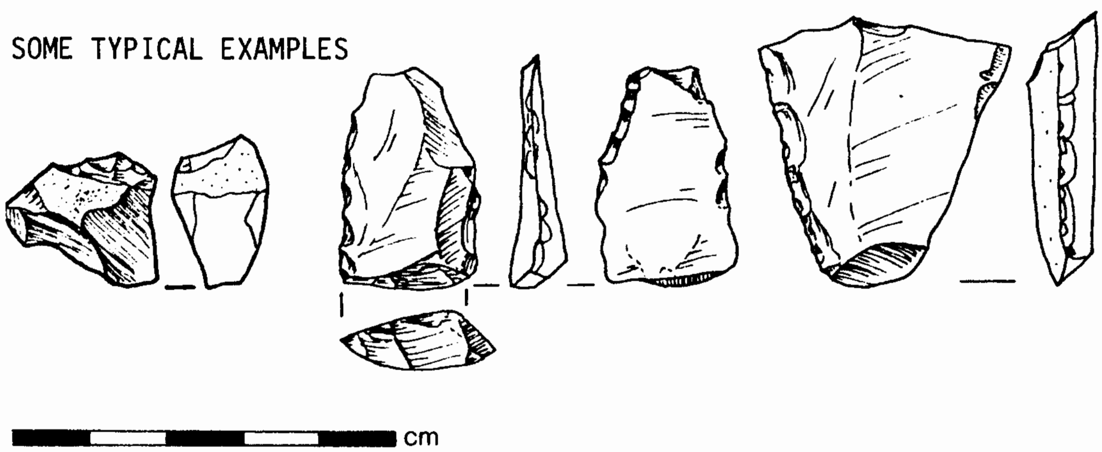


Type no.	Type name
3-700	MISCELLANEOUS RETOUCHED PIECE:

Definition

Miscellaneous retouched pieces form a loose category for tools that show sustained formal retouch, but which do not fall into any of the common shaped classes. The retouch may be of the flat invasive kind extending over one or two thirds of the dorsal or ventral surface of the tool, or it may be steep retouch on a piece that does not conform to other attributes required for a scraper class, or sustained notching of the laterals. Miscellaneous retouched pieces are an extension of the utilized flake class in that they have similar characteristics, but the retouch is more deliberate and extends over a longer portion of the tool. Middle Stone Age assemblages may include bifacial pieces of unusual shape that may be included in the Miscellaneous Retouched class. All raw materials may be used and Miscellaneous Retouched Pieces may be found in any Stone Age assemblage.

SOME TYPICAL EXAMPLES



FORMAL TOOLS BASED ON CORES OR VERY LARGE FLAKES

04-100	Biface
04-110	Proto-biface
04-120	Handaxe
04-130	Cleaver
04-140	Pick
04-150	Other biface
04-200	Discoid
04-300	Polyhedral

FORMAL TOOLS SHAPED BY GRINDING AND POLISHING

05-100 Bored stone
- 05-110 Large, greater than 150 mm diameter
- 05-120 Medium, 75 - 150 mm diameter
- 05-130 Small, less than 75 mm diameter

05-200 Grooved stone
- 05-210 One groove
- 05-220 Two grooves
- 05-230 More than two grooves

05-300 Sinker

05-400 Stone bowl

05-500 Ground stone axe
- 05-510 Pecked and ground
  - 05-511 Tapered butt
  - 05-512 Broad butt
  - 05-513 Small
  - 05-514 Chisel-shaped
  - 05-515 Semi-circular

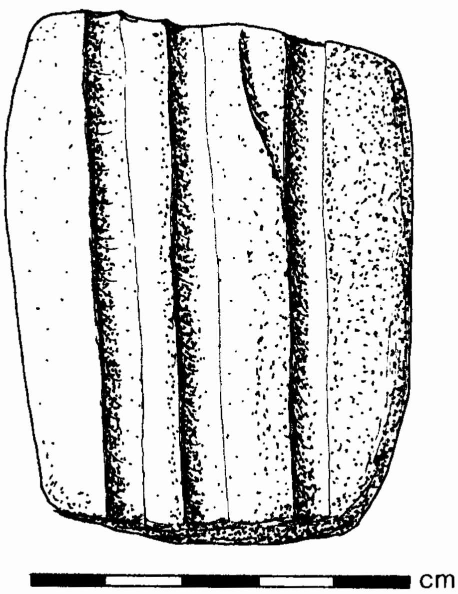
- 05-520 Flaked and ground
  - 05-511 - Types as above

Type no.	Type name
5-120	GROOVED STONE

Definition

A grooved stone is generally made on a natural pebble or small cobble. One or more grooves may be pecked into the surface and then ground smooth. The grooves usually run the length of the pebble but may cross-cut one another. They are seldom more than 10 mm wide. There are ethnographic and historic records to show they were used for smoothing and straightening bone arrow points, reed arrow shafts and wooden shafts by heating the stone in a fire and drawing the bone, reed or wood through the groove. They are also known to have been used to apply poison to arrowheads, the poison being held in the groove and the arrow drawn through it. Grooved stones appear to be restricted to the Holocene assemblages of the Later Stone Age, dating from the early Holocene at Pomongwe and Matjes River.

SOME TYPICAL EXAMPLES

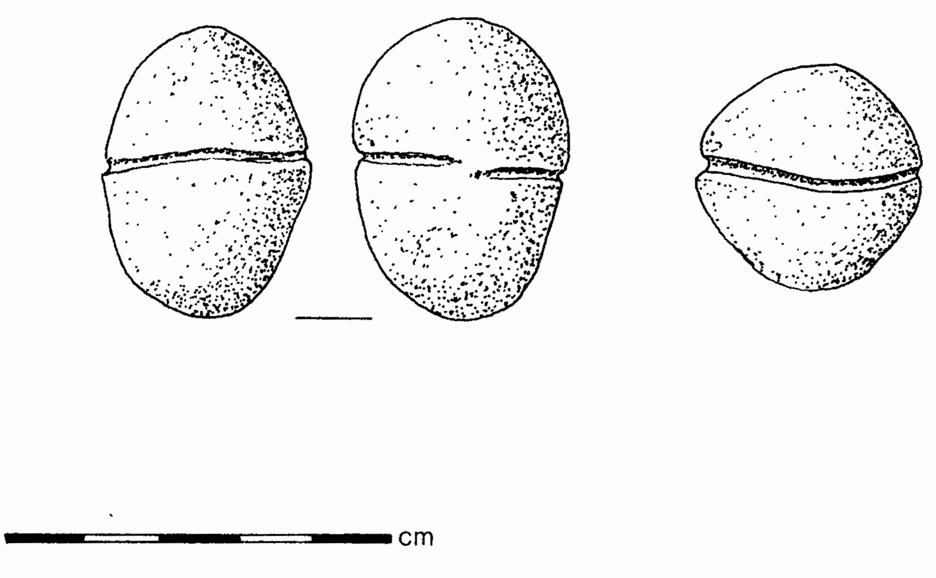


Type no.	Type name
5-130	SINKER

Definition

A sinker is a small pebble with a groove around the perimeter to facilitate its suspension from a string. They are not usually longer than 50 mm or shorter than 25 mm and examples so far found are usually made in quartzite. They are found exclusively at coastal sites in the southern Cape and date from the mid-Holocene at Nelson Bay cave.

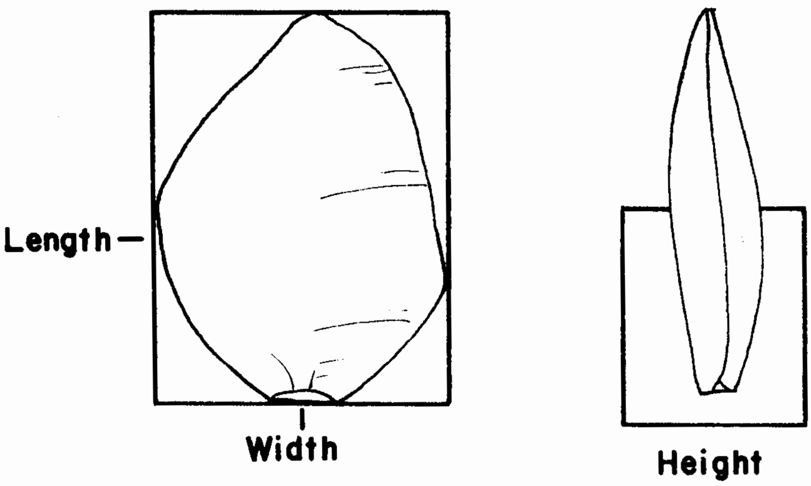
SOME TYPICAL EXAMPLES



APPENDIX 2

Fig. A2:1

MEASUREMENT OF UNTRIMMED FLAKES



$$\text{Width/Length ratio} = \frac{W}{L} \times \frac{100}{1}$$

$$\text{Relative thickness} = \frac{\frac{\text{Height}}{\text{Length}} + \frac{\text{Height}}{\text{Width}}}{2}$$

APPENDIX 2

THE MEASUREMENT OF ARTEFACTS AND STATISTICAL TESTS

ATTRIBUTES

Untrimmed flakes

The attributes measured for untrimmed flakes were as follows:

Length (L) : maximum dimension from the butt or striking platform

Width (W) : maximum dimension of an enclosing rectangle at right angles to length

Height (H) : Maximum thickness of the flake

W/L ratio : $\frac{W}{L} \times \frac{100}{1}$

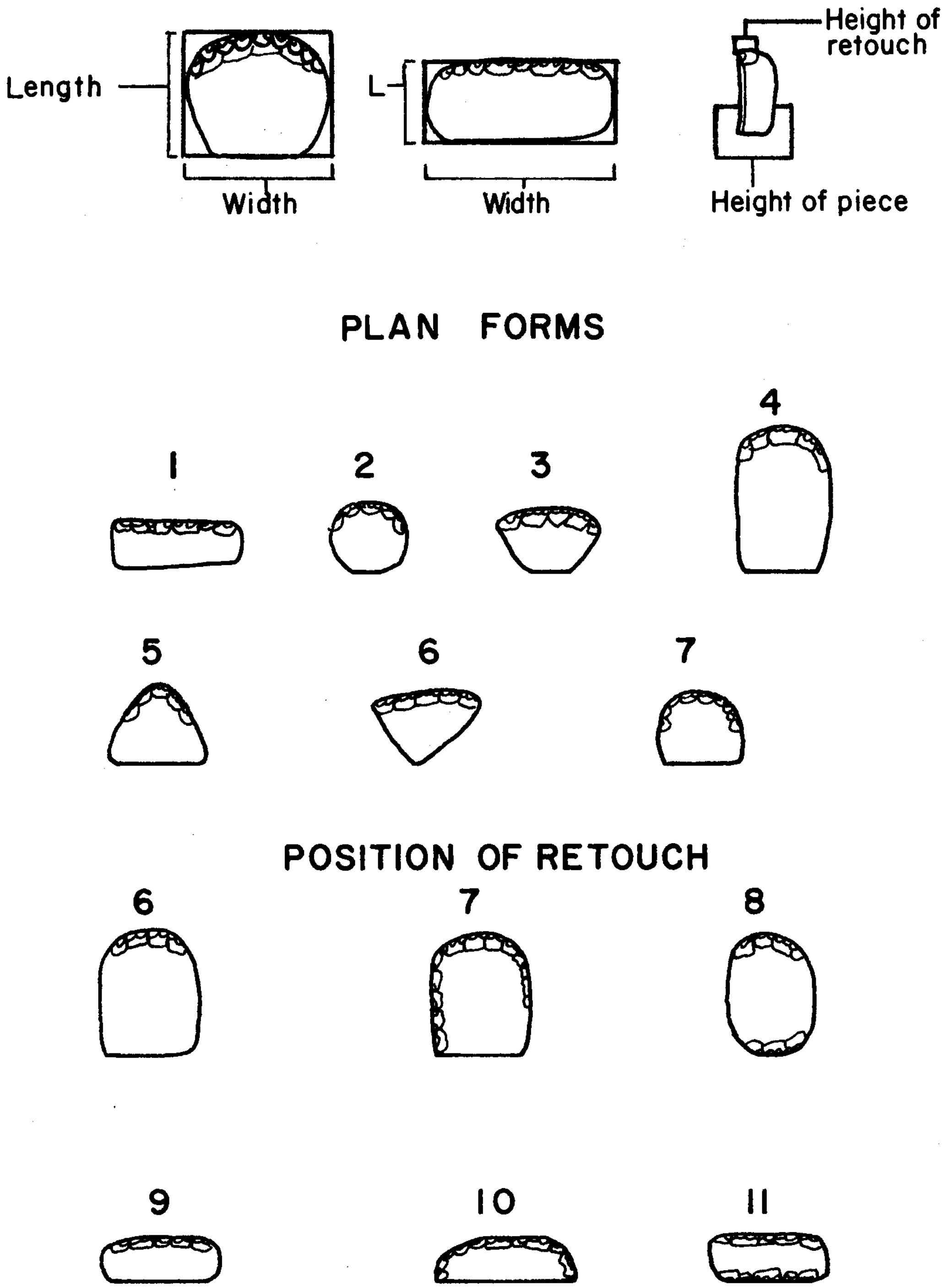
Relative thickness : $\frac{\frac{H}{L} \times \frac{H}{W}}{2}$

The procedure for measurement was to place the flake, dorsal surface up, onto graph paper and to orientate it with the butt along a base line. Because only whole flakes were measured, the butt was always present. The length and width were thus the dimensions of the enclosing rectangle as can be seen in the accompanying Fig. A2:1. The height of the flake was measured with calipers. All measurements were to the nearest mm, thus 0,5 = 1,0 mm.

The length, width and height measurements, together with a code for raw materials (1= quartz, 2= chalcedony, 3=hornfels, 4= silcrete, 5= quartzite) were put onto computer cards and a standard SPSS programme (Nie et al 1975) for condescriptive statistics was used to calculate w/l ratios and relative thickness, as well as the mean, standard deviation, standard error, variance and range for each sample from each stratigraphic unit

Fig. A2:2

MEASUREMENT OF SCRAPERS



at NBC and BPA on the University of Stellenbosch UNIVAC 1100 computer.

At Boomplaas in particular the variety of raw materials in the vicinity of the site and the difficulty of distinguishing at times between them without the aid of thin sections made it practical to classify pieces into broad categories on the basis of similar fracture properties. Thus the category 'quartzite' includes greywackes and possibly some coarse hornfels, while 'chalcedony' includes a variety of chalcedonic silicates, and quartz includes both quartz crystal and vein quartz. Hornfels includes indurated shales of various kinds and silcrete is perhaps the 'purest' category in that it includes only pieces with visible quartz inclusions in a silica matrix.

The sampling procedure for untrimmed flakes involved the random selection of whole flakes with at least 100 from each stratigraphic unit. In cases where there were fewer than 100 flakes to measure, the entire sample of unbroken flakes was included. The exceptionally large sample size in the upper units from NBC is the consequence of an initial decision to measure all unbroken flakes, but the logistics of this policy became apparent and smaller numbers were measured thereafter.

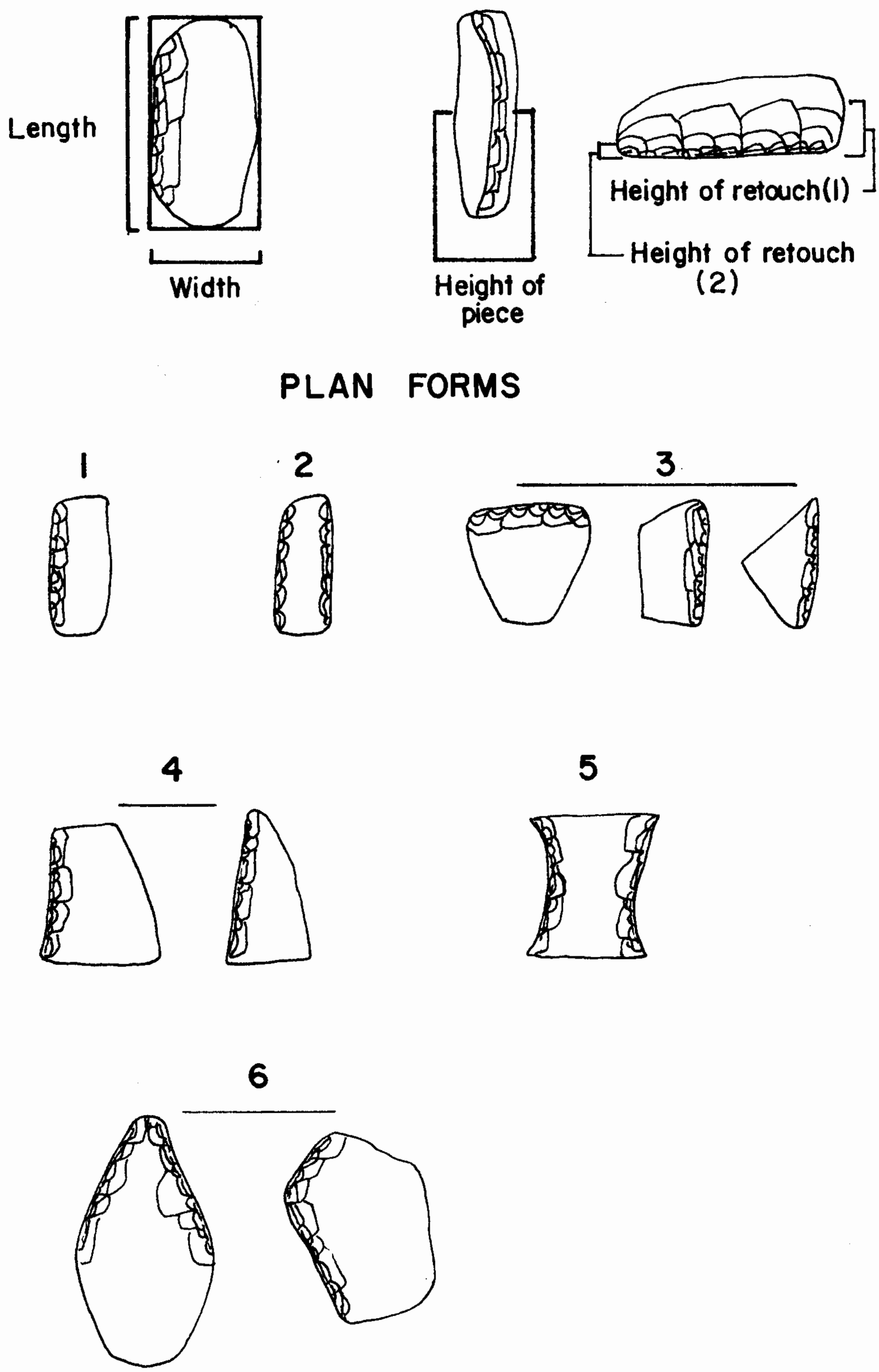
Scrapers

Because the striking platform and bulb of percussion are frequently absent on formally retouched scrapers, they could not be consistently orientated in the same way as untrimmed flakes. The working edge was therefore taken as the point of reference from which all other measurements were taken. Each scraper was placed, dorsal surface up, onto graph paper with the working edge equally distributed on either side of a central point. Length and width were taken as the maximum dimensions of the enclosing rectangle or square as illustrated in Fig. A2:2. Height of both the piece and the retouch was measured with calipers, the maximum height being measured in each case. Measurements were all taken to the nearest mm.

The SPSS condescriptive programme calculated the mean, mode, median, standard deviation, standard error, variance, kurtosis, skewness, range and maximum/minimum for each sample and the frequency distribution programme calculated the absolute frequency, relative and adjusted percentages and cumulative percentages for each mm size class in each continuous variable. W/L ratios were calculated in the course of the SPSS programme.

Fig. A2:3

MEASUREMENT OF ADZES



In addition to the continuous variables listed above, the following discontinuous variables were recorded: plan form, position of retouch and raw material. The code numbers of the former two variables are given in Fig. A2:2 and those for raw material are the same as for the untrimmed flakes. The SPSS frequency distribution programme calculated the absolute and percentage frequencies in each class for each stratigraphic unit.

All scrapers from all excavated units were measured for all three sites, with the exception of those pieces that were broken across the working edge; there is therefore a discrepancy at times between the number of scrapers listed in the data sheets and in those listing the scraper attributes. In addition, data on scrapers from Wilton (including alternate stratigraphic units not measured in 1969 (Deacon, J. 1969, 1972)), Melkhoutboom and Wonderwerk (A.I. Thackeray 1981) were placed on file and condescriptive statistics were calculated.

Adzes

Because adzes are for the most part rectangular in plan form they were orientated with the maximum dimension of the enclosing rectangle as the length, the working edge being generally parallel to the length. Width was taken as the maximum dimension of the enclosing rectangle at right angles to length. Height, measured with calipers, is expressed as height of piece (maximum), height of retouch 1, which measures the maximum height of retouch scars, and height of retouch 2, which measures the maximum height of the lower set of retouch and utilization scars. These measurements are illustrated in Fig. A2:3. Plan form classes, drawn from the range observed at BPA , are also illustrated.

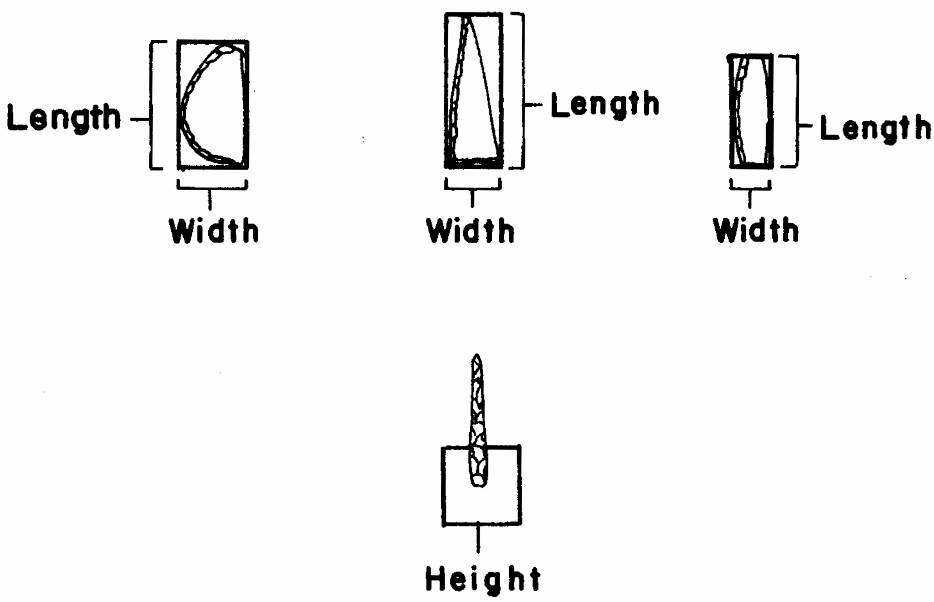
The SPSS condescriptive programme calculated the same statistics for adzes as for scrapers. Adzes from Kangkara were not included in the sample and they were absent from NBC.

Backed tools

Segments and backed bladelets were orientated with the backed margin on the left hand side of an enclosing rectangle. Length was thus the maximum dimension of this rectangle (invariably parallel with the backed margin) and width was the maximum dimension at right angles to length. This is illustrated in Fig. A2:4. Height was measured along the backed edge with calipers.

Fig. A2:4

MEASUREMENT OF BACKED TOOLS



Because of the small size of most samples, the data were not processed by computer, but means, standard deviations, standard errors, variances and ranges were calculated on a HP-65 desk calculator where samples were large enough. The low frequencies made it impractical to compute frequency distributions of plan form classes, other than segments and backed bladelets, although these have been recorded.

COMPARATIVE STATISTICAL TESTS OF SIGNIFICANCE

In order to obtain a statistical measure of differences and similarities between scrapers at an inter- and intra-site level, the continuous variables of length, width, w/l ratio and height were compared in all pairs of samples from NBC, KRA, BPA, Wilton, Melkhoutboom and Wonderwerk using the Mann-Whitney U-test and the Kolmogorov-Smirnov two-sample test. Both may be used to test whether two independent samples have been drawn from the same population or, in the case of Kolmogorov-Smirnov, from populations with the same distribution (Siegel 1956:116,127). They were used in preferererence to the more robust t-test because they do not have the same restrictive assumptions and requirements of a normal distribution. Both have a power efficiency of 95% or more when compared with the t-test and this is considered adequate for present purposes. Differences in the probability values obtained in the two tests reflect the fact that Mann-Whitney U-test is a ranking test whereas Kolmogorov-Smirnov uses the cumulative frequency distribution and focuses on the largest deviation between the two samples. The Kolmogorov-Smirnov is thus more sensitive to differences in central tendency (location), dispersion and skewness than is the Mann-Whitney (Siegel 1956).

The data were processed using a standard SPSS package for the two tests (Nie et al 1975).

LINEAR REGRESSION AND COEFFICIENTS OF DETERMINATION

To obtain a measure of how much increase or decrease in one variable may be expected from a unit increase in another amongst stone artefact samples, coefficients of determination (r^2) were calculated from regression coefficients by the least squares method for linear regression. A programme from the Hewlett Packard Stat Pac 1 for their HP-65 machine was used (Stat 1-22A) for all the calculations. The r^2 quoted in each scatter diagram in Chapters 5 and 6 can be interpreted as the "goodness of fit" of the regression line plotted in each case. The significance of the correlations (p) has been drawn from significance probabilities in Simpson, Roe & Lewontin (1960:426). In each case a perfect fit would be indicated if $r^2=1$.

Regression is useful in prediction, but also in reasoning from observations to underlying mechanisms and it is for this reason that it has been applied to the stone artefact data here. It has been used to test whether there are statistically significant linear correlations between the variables selected. The absence of a significant r^2 does not mean that the variables have no dependence on each other, but rather that there is no rectilinear dependence. It should also be noted that a high correlation does not necessarily denote a cause and effect relationship between the two variables, although variables have been selected with a view to evaluating relationships which are thought to be connected in some way during the process of making stone artefacts. The results are a crude measure of relationship and must be seen as a preliminary step towards more detailed studies. An obvious possibility here is to test for correlations that are non-linear.