BORDER CAVE

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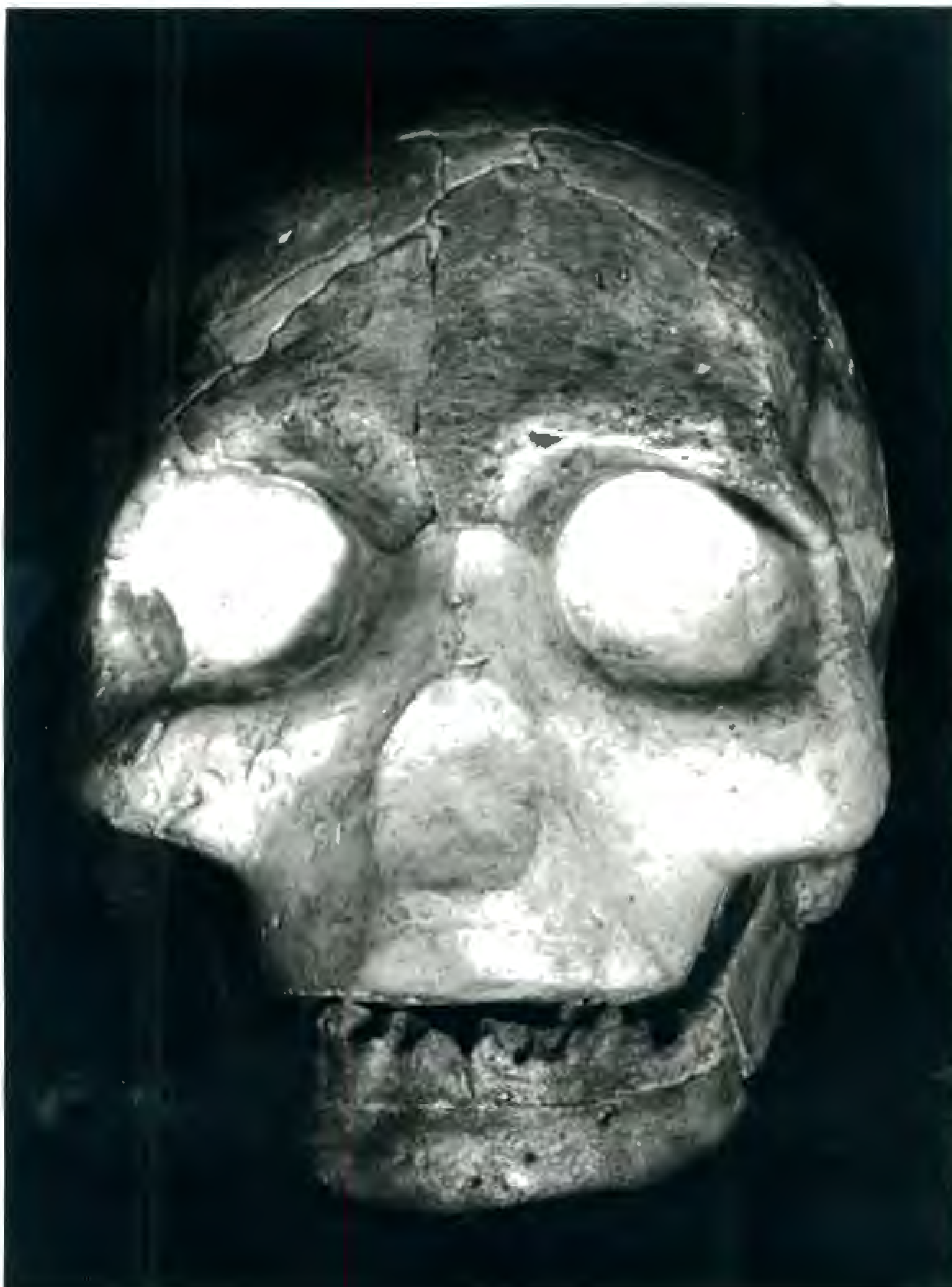
Rondebosch, 1978

BORDER CAVE

VOLUME I



Frontispiece. A composite of Border Cave 1 and 2

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1. INTRODUCTION

1.1 Aims and Themes

Border Cave was investigated by R.A. Dart in 1934, by H.B.S. Cooke and others in 1941-2, and most recently by the author with the help of various volunteers (see Acknowledgements) over a total period of eleven weeks between late 1970 and mid 1975 (Cooke et al.,1945; Beaumont and Boshier, 1972; Beaumont,1973). The original objectives were:

(a) To isolate good C-14 samples in order to obtain evidence additional to published data being amassed at the time, which suggested that the Middle Stone Age technocomplex of sub-Saharan Africa was substantially older than the ~10-40 Kyr range then envisaged (Klein,1970).

(b) To see if a radiometric age could be deduced for the infant burial (Border Cave 3) found in 1941 (Archaeological Survey File B 20/1/2) and recorded there and by Cooke et al. (1945) as lying below "an ash horizon at the very base of the overlying zone of 'advanced' industry", which Malan (1949a) subsequently termed the 'Epi-Pietersburg'.

(c) To determine if a closer study of the aggregates than that attempted by Cooke et al. (1945) would provide clues bearing on the nature and course of Middle Stone Age typological and metrical changes additional or supplementary to those previously outlined by Mason (1957, 1962, 1967) and Sampson (1972, 1974).

(d) To provide a possible cultural, temporal and environmental framework for the mainly open and single-level Middle Stone Age sites in Swaziland and Natal, as excavated by the author at about 15 localities in 1965-8, and variously recorded by Brien (1932, 1935), Chubb (1932), Cramb (1950, 1961), Farnden (1968), Farnden and Gibbs (1962, 1963), Goodwin and van Riet Lowe (1929), Johnson (1908), and Malan (1945, 1948, 1949b, 1950).

The author and his co-workers were fortunate in that the excavations in the central and inner recesses of the cave revealed:

(a) An abundance of charcoal nodules in good stratigraphic context which has enabled the Natural Isotopes Laboratory in Pretoria to obtain a reasonably comprehensive and conformable series of C-14 readings ranging back to > 49 Kyrs B.P. for the uppermost levels of the Middle Stone Age.

(b) Unique preservation of plant remains, thereby permitting for the first time an objective estimation of to what extent and for which purposes

Stone Age man prior to 30 Kyrs B.P. made use of surrounding trees and grasses, nuts and berries, bulbs and tubers.

(c) A further hominid fragment of anatomically modern Homo sapiens in undoubted association with the Middle Stone Age (de Villiers, 1973, 1976). This discovery by itself must be taken to indicate that at least some people of fully modern type already occupied Southern Africa at a time when only 'classic' Neanderthalers are known from Western Europe and the Near East (Oakley, 1969; Oakley, Campbell and Molleson, 1975).

(d) One of the most complete Upper Pleistocene sequences yet found in sub-Saharan Africa. Of particular note was the recovery from three major horizons of Middle Stone Age aggregates which overlie and thus postdate material ascribable to the old 'Second Intermediate', thereby corroborating comparable observations previously made by Wymer at Klasies River Mouth (Wymer and Singer, 1972).

It is the purpose of this dissertation to record in full the results of the various interdisciplinary investigations either directly based on or motivated by these most recent excavations at Border Cave. Within that framework evidence will be led which demonstrates or suggests:

(a) That at this site and as here defined the Later Stone Age had commenced by $\sim$ 38 Kyrs B.P. and the Middle Stone Age had ended by $>$ 49 Kyrs B.P. These determinations are of more than casual interest in view of the established dating of the Middle/Upper Palaeolithic interface in Western Europe at $\sim$ 34 Kyrs. B.P. (Vogel, 1971 and n.d.).

(b) That the Middle Stone Age reveals the very early inception and gradual development of a variety of technological processes and typological forms, such as ground bone artefacts, punch-struck blades, 'Emireh-type' points, and knives with Abri Audi and Châtelperronian affinities, which are usually regarded as being strongly associated in temporal terms with the onset of the Upper Palaeolithic elsewhere in the Old World.

(c) That the floral debris recovered from the deposit provide no good evidence that this component of man's material environment supplied the Stone Age occupants with any significant proportion of their diet at these times when the cave was occupied by them within the range of $\sim$ 30 - $\sim$ 90 Kyrs.B.P. Furthermore, there are as yet no clear indications that bark or fibre were used for activities such as plaiting or that wood formed a major constituent of their artefactual repertoire, although it is likely that some such objects would have been more susceptible to loss elsewhere (e.g. spear-shafts).

(d) That the Middle Stone Age at this site is associated with anatomically modern Homo sapiens remains with physical characteristics which seemingly fall within the compass of extant Khoisan and South African Negro populations, although differing from these in terms of skull size and endocranial capacity (Keith, 1931; de Villiers, 1973). This evidence is regarded as providing preliminary support for a Presapiens scheme (Howells, 1967) in which sub-Saharan Africa is seen as being a focal area for the hitherto unperceived and formative phases in the evolution of our own species (Beaumont, de Villiers and Vogel, n.d.).

(e) That the Middle and Later Stone Ages appear to be portions of a single and largely unbroken cultural continuum undergoing progressive shifts in a manner seemingly responsive to environmental changes only at the tool class frequency level (Deacon, 1972). One implication is that those current subdivisions into sequential discrete 'industries' based on largely technical criteria are prehaps arbitrary portions of this trajectory. The possibility of a classification based purely on stylistic grounds is seen to be problematical, in view of:the low proportion of formal items which typify most of these aggregates; possible distortions induced by the uneven spatial distribution and wide variety of utilized raw materials having differing potentials; and the presumed difficulty of isolation and defining possibly diagnostic forms in focal areas of change and development, as opposed to peripheral areas when intrusive and pre-existing entities may be expected to show sharp typological interfaces.

(f) That certain definable fractions (irregulars, blades, points), of the flake component in the various assemblages at this site have quite distinctive metrical and statistical characteristics which change with time according to different patterns and rates. This finding would seem inexplicable unless it is assumed that 'waste flake' subclasses are in fact intentionally made tools. It is taken that the evidence strongly supports the position on this issue most forcefully stated by Mason (1967), and that it corroborates the view that untrimmed flakes are best regarded as unspecialized forms, with any convenient specimen being actually or potentially used or useable and "secondary work being the result of utilization and the extent of utilization being dependent on the amount of work done" (Clark, 1960).

The following abbreviations will be used in all subsequent text:

I. I.A. = Iron Age.

II. L.S.A. = Later Stone Age.

III. M.S.A. = Middle Stone Age

IV. E.S.A. = Earlier Stone Age

1.2 Site and Setting *

Border Cave (Zulu : Ingodini) is located at 27°1' 19"S, 31°59'24"E, within KwaZulu (or Zululand, annexed to Natal in 1897), and apparently 365m (Cooke et al, 1945:6) from the undefined border with Swaziland (letter from Surveyor-General : Natal, dated 10 April, 1972), marked in this area by occasional beacons along the crest of the western scarp face of the southern Lebombo Mountains (South Africa 1 : 50,000 topographical sheet 2731BB/ 2732 AA 'Ingwavuma', 1969). The site faces towards the Lowveld from high up on this precipitous slope, at an elevation of about 605m, only slightly less than the escarpment rim at 676 m locally (Fig.1). By direct line, the cave is: 1km east of the Canterbury Estates farmhouse (250m) of G.F.Scheepers; 5 km east of the small agricultural settlement of Nsoko (183m) in Swaziland; 12 km north of the district centre, Ingwavuma (610m) in KwaZulu; and 82 km west of the Indian Ocean (Fig. 2).

Border Cave has a roughly semi-circular plan-form, with a maximum width (at mouth) and depth (to drip-line) of ~50m and ~30m respectively (Fig.3). The roof arches upwards from the sides but height is very variable, with a maximum established value (from bedrock) of about 7,5m (Fig. 4). The deposit surface slopes down fairly regularly towards the talus edge at an angle of 13-15° (Figs. 3 and 4). Safe access to the site is only possible by way of a narrow and exposed ledge leading to its northern corner along a near-vertical face, or by a long and steep talus slope below (Figs. 5 and 6). The only perennial sources of water are the Ngwavuma River some 1,85 km to the south, and a spring on the mountain itself, about 3 km to the north.

The Lebombo range, deeply incised by steep-sided valleys, has an average width of 15 km and crest elevations of about 650m. Dip is gently eastward, with a regional gradient of about 2°, towards a fringe of low hills that merge with the Zululand-Mozambique Coastal Plain, while trend is north-south, parallel to the 35 km wide Lowveld erosional plain which flanks it to the west. These lowland flats have a slightly tilted and gently undulating surface with a mean slope of less than 2° and an elevation in the Nsoko area of 170-220m (Hunter,1961). The escarpment footslope rises at 10-12°, with smooth midslope segments of 18-24° punctuated by high cliffs of 72-88°, formed by a succession of thick lava flows, while crest slopes range from 35 to over 80°, depending on lithology. The major regional

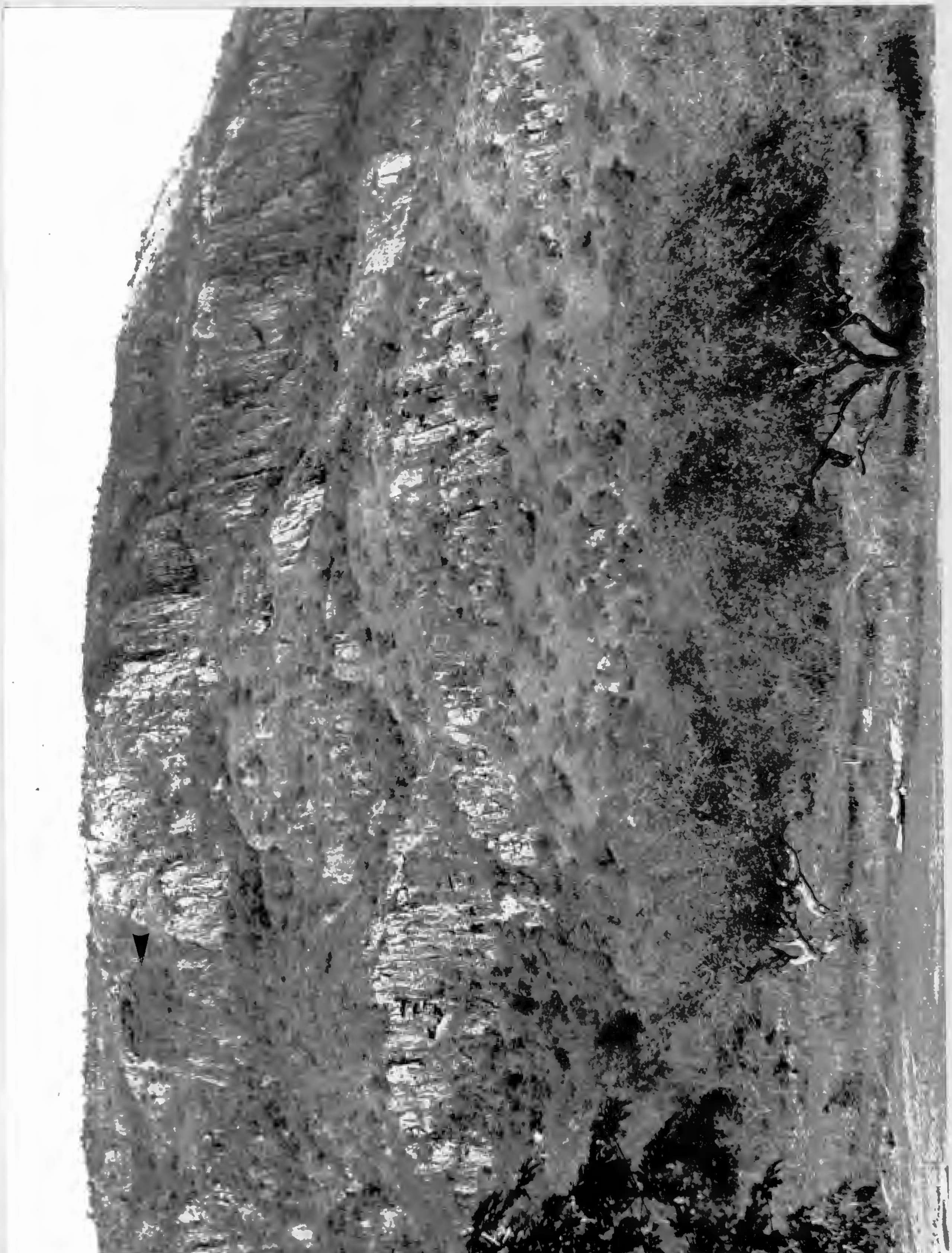


Fig. 1 A view of Border Cave from the Canterbury Estates farmhouse. Arrow indicates the position of the site.
Photograph by courtesy of the Archaeological Research Unit, University of the Witwatersrand, Johannesburg.

FIG. 2 LOCALITY MAP

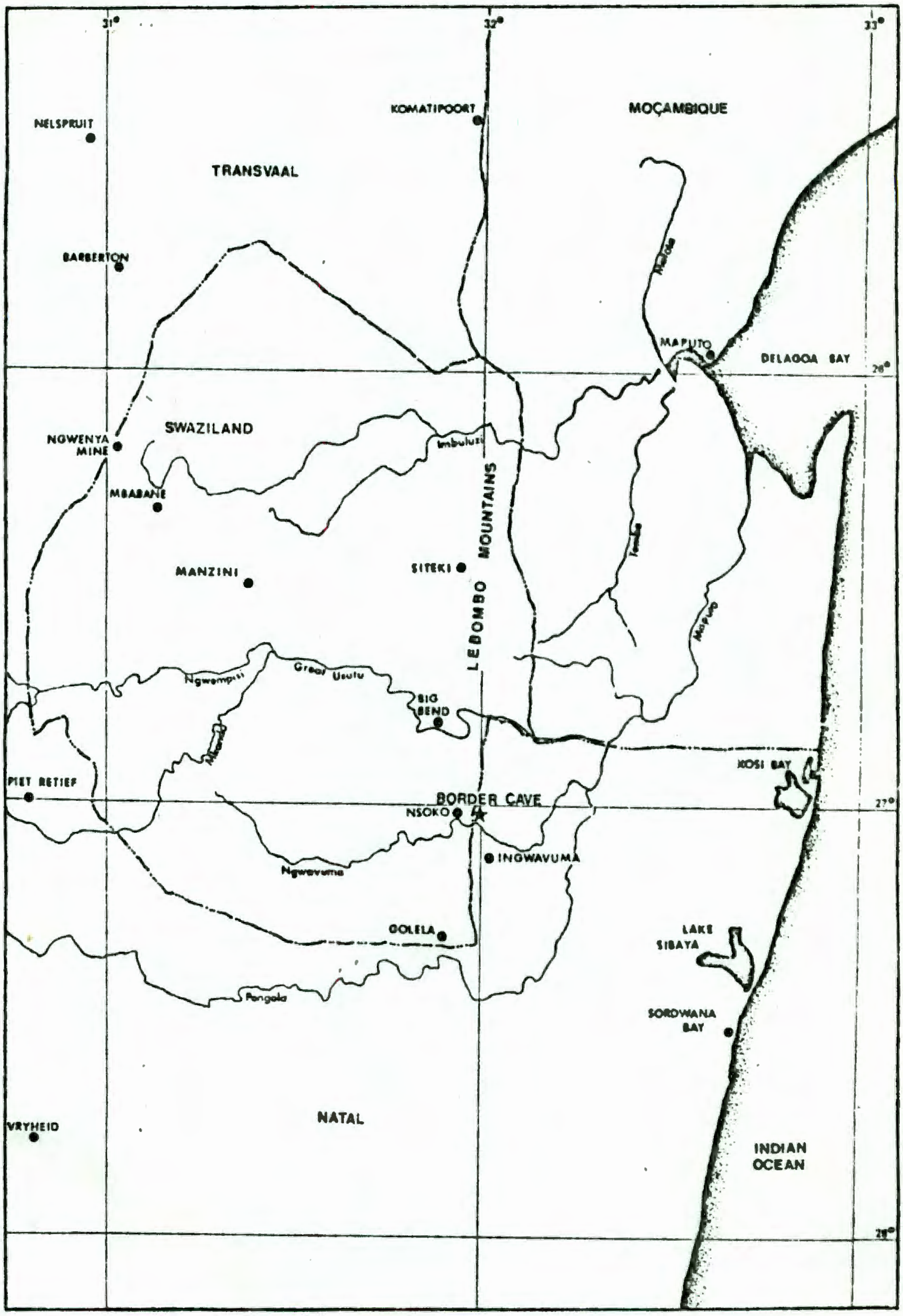


FIG. 3 BORDER CAVE : PLAN

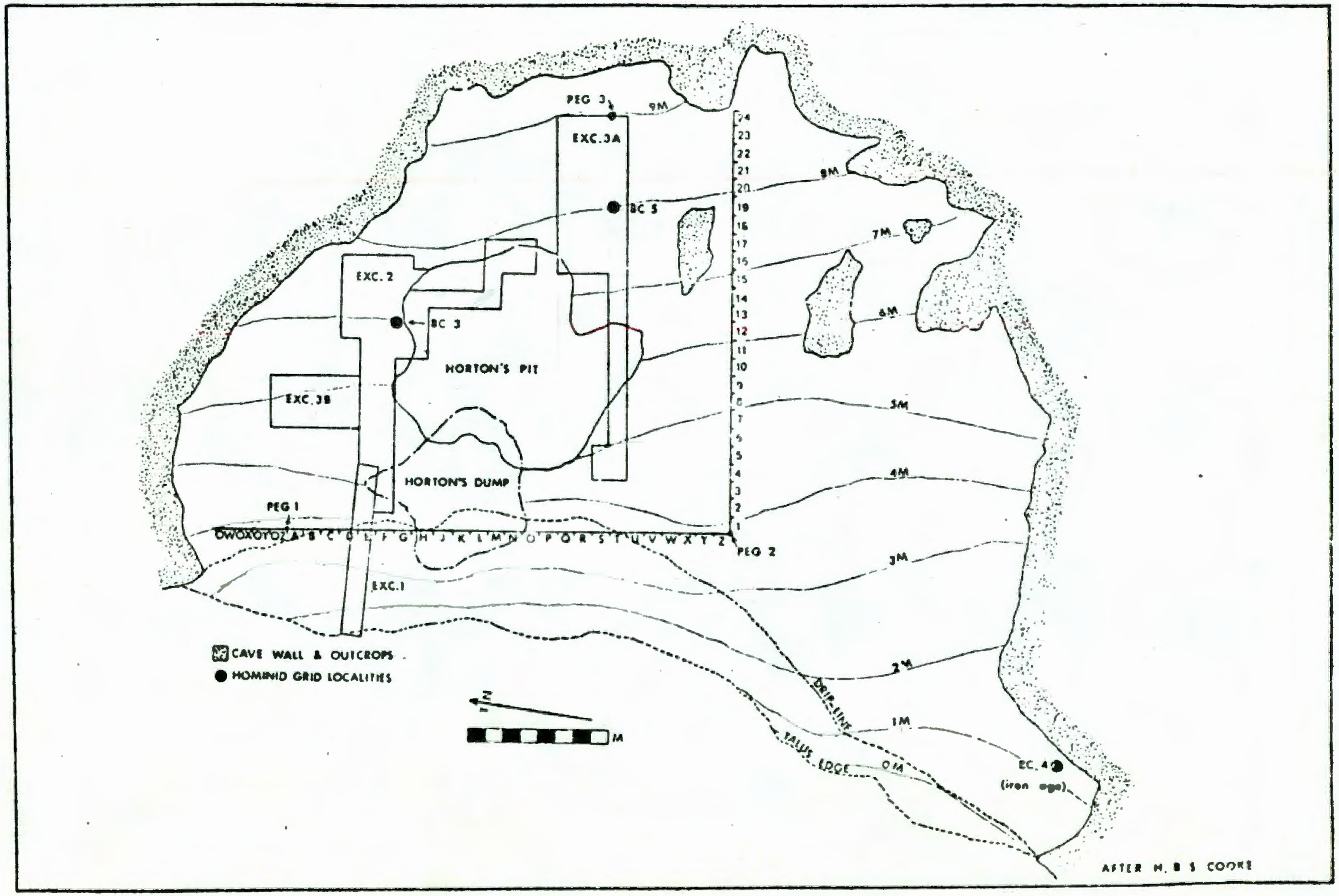


FIG. 4 BORDER CAVE: SECTION ALONG STRIP T.

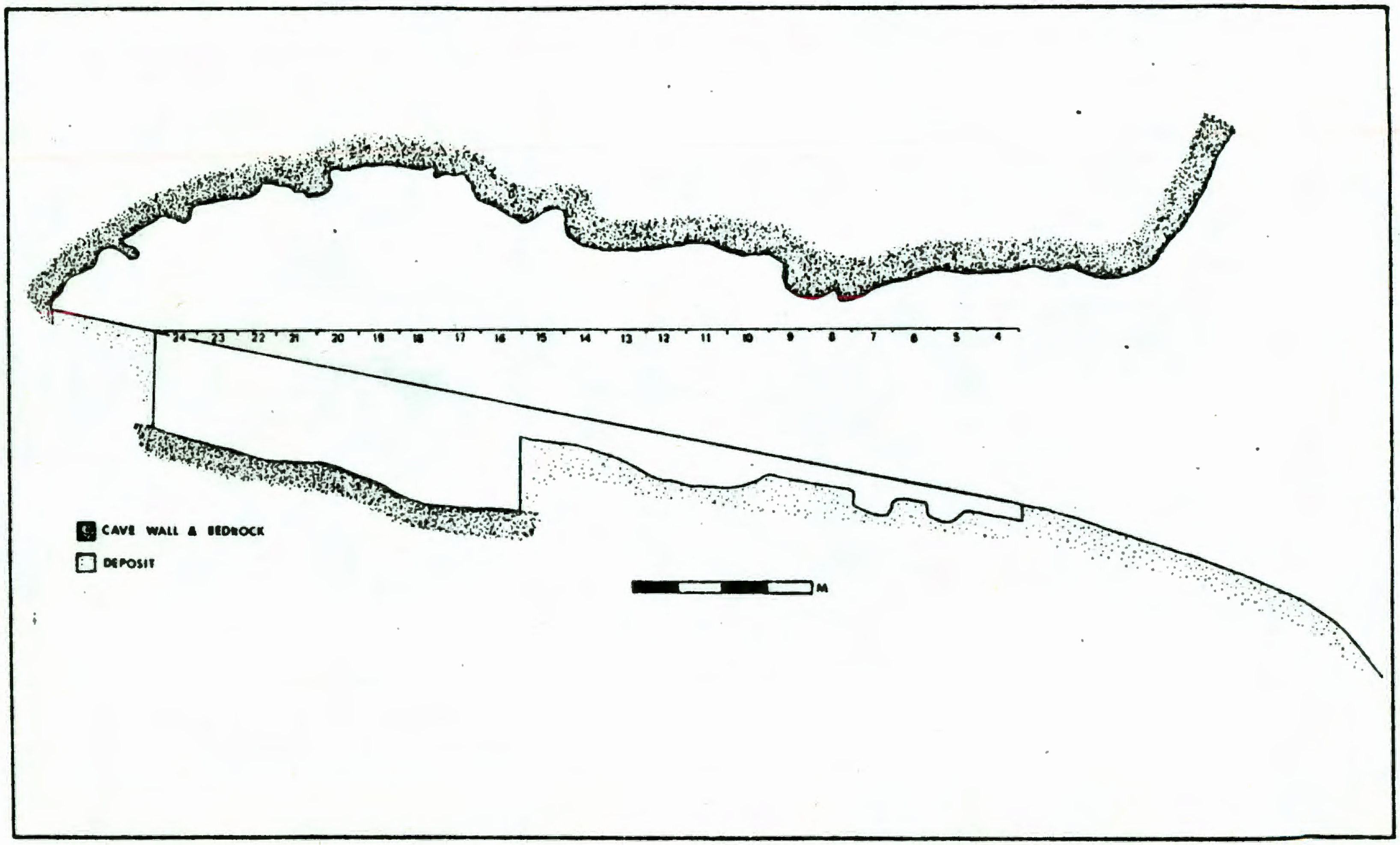


Fig.5 Two people on the ledge leading to Border Cave.
The arrow points to them.
Photo by courtesy of G. Baker.

Fig. 6 Malan, Williams and Wells on ledge entrance to Border Cave. Photograph by courtesy of the Archaeological Research Unit, University of the Witwatersrand, Johannesburg

drainage lines (Usutu, Ngwavuma and Pongola Rivers) flow from west to east cutting through the mountains as superimposed streams, ultimately to emerge in Delagoa Bay via the Maputo River (Fig. 7).

The Lebombo uplands consist of up to 9000m of rhyolitic extrusions which relate to a north-south crustal fissure (King, 1967a; Wachendorf 1973) and belong to the uppermost Stormberg Series of the Karoo System. Adjusted rubidium-strontium isochrons of 191 $\pm$ 13 million years indicate a terminal Triassic or basal Jurassic age for this outpouring (Fitch and Miller, 1971). Although these volcanics dip by as much as 30-40° (but generally 15°) eastwards (Wachendorf, 1973), their 2-3° surface projection has been attributed to Miocene ('Post-African') erosion and Plio-Pleistocene tilting as part of the Lebombo or Natal monocline (King, 1967a and 1967b). The eastern margins are gently inclined at 5-10° and conformably overlain by lightly dissected late Cretaceous sandstones, conglomerates and shales, that dip below the undifferentiated late Cenozoic sands of the Coastal Plain (Fig. 8; Geological Map of the Republic of South Africa. 1 : 1 million, 1970). These include, in northern KwaZulu, at least 6 fossil dune-cordons, said to range over the entire 'cold' Pleistocene (Davies, n.d.).

The Lowveld represents a younger erosional surface cut across older Karoo rocks, mainly Stormberg basalts and Ecca shales, both extensively intruded by north-south trending dolerite dykes and covered in parts by alluvium (Geological Survey - Swaziland 1 : 50,000 sheet 2731 BB and 2731 BP (Part of), 1967). No faults delimit the rhyolite escarpment, so that creation of the Lowveld depression can best be ascribed to differential erosion of the physically weaker shales and chemically weaker basalts. On the other hand King (1976a) has attributed erosion to the readily-weathered crystalline rocks of the Basement Complex, but these are only exposed further west, beneath the higher and older Middleveld surface (see Baillie, 1970 for a map of Swaziland geomorphological regions). Equally problematical is some 500m of vertical erosion across a 35 km wide surface since the inferred Plio-Pleistocene uparching of the monocline, as is explicit from King's (1967a and 1974) stratigraphic framework. So much erosion in less than 5 million years is difficult if not impossible to accept in default of detailed regional studies.

Cooke et al. (1945) attributed development of the cavern to differential weathering of welded agglomerate (pyroclastic interbeds) within a sheer rhyolite face, just below the cuesta rim of the escarpment and 400m

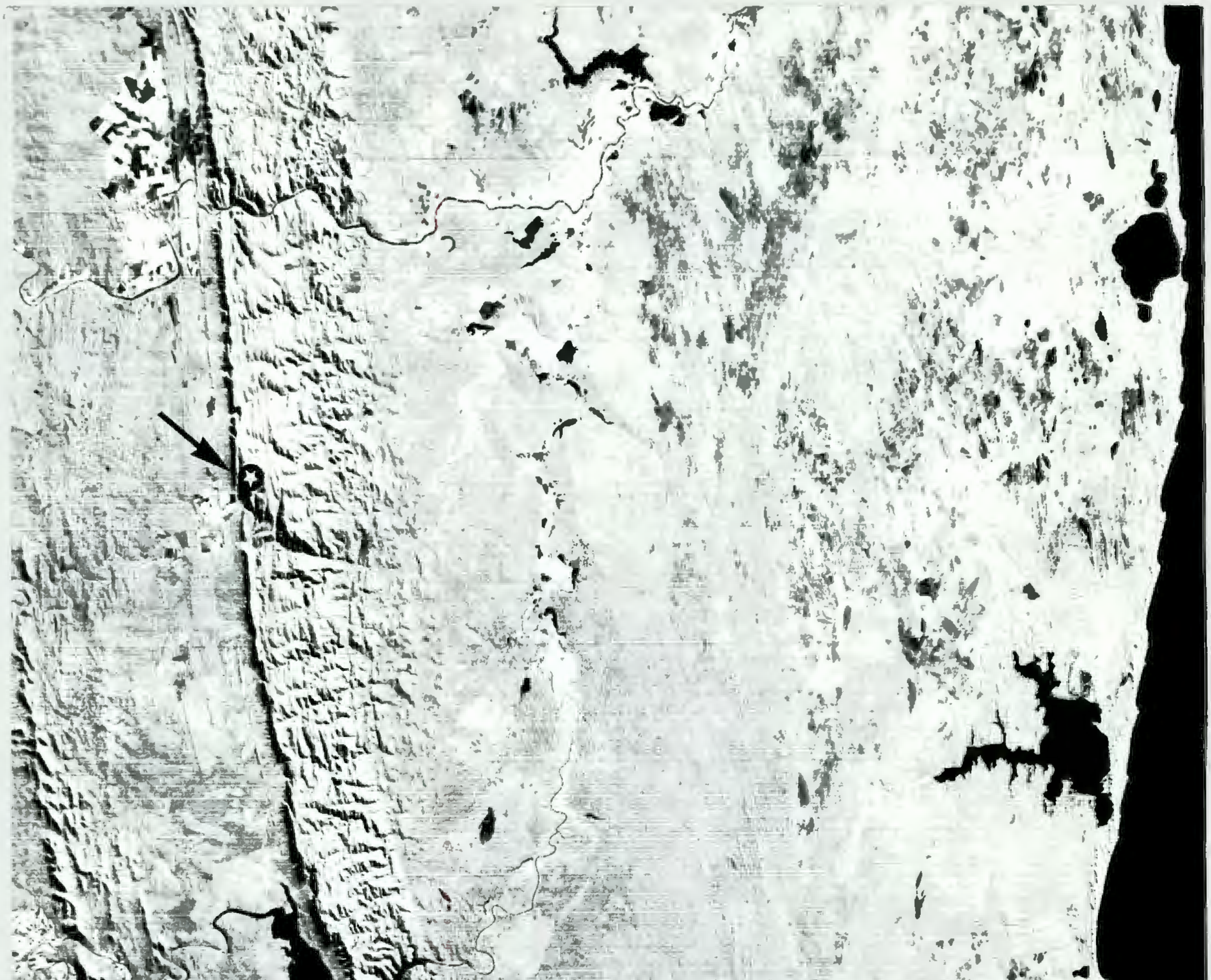
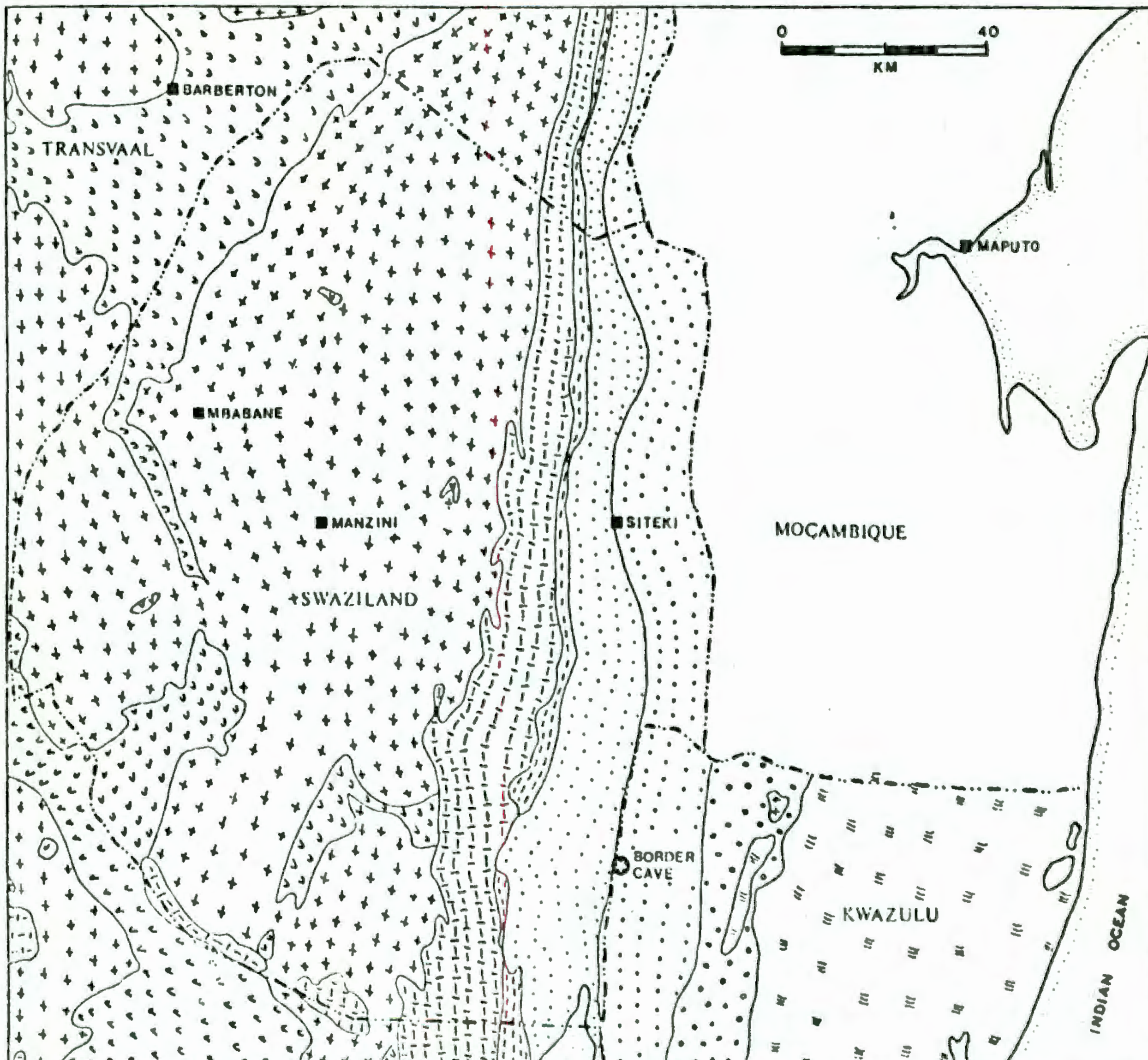


Fig. 7 The southern portion of the Lebombo Mountains as shown by Landsat 2. Arrow indicates the position of Border Cave. Photograph by courtesy of the C.S.I.R., Pretoria

FIG. 8 GEOLOGICAL MAP OF SWAZILAND AND SURROUNDINGS



SYMBOL	SYSTEM	SERIES	STAGE	SOME ROCK TYPES
	TERTIARY–QUATERNARY	——	——	UNCONSOLIDATED SUPERFICIAL DEPOSITS
	CRETACEOUS	UP.+LR.	——	SANDSTONE, SHALE, LIMESTONE
	KARCO	STORMBERG	DRAKENSBERG	RHYOLITE, DACITE, PYROCLASTS
	" " " "	" " " "	" " "	BASALTS, PYROCLASTS MINOR SANDSTONE
	" " " "	STORMBERG (SEDIMENTS) + BEAUFORT	——	SHALE, SANDSTONE
	" " " "	ECCA	——	SHALE, SANDSTONE
	PRE-TRANSVAAL	——	——	GRANITE, GNEISS
	" " " "	——	——	ALL OTHER
	SEA + WATER			BASED ON GEOLOGICAL MAP OF
	INTERNATIONAL OR PROVINCIAL BOUNDARIES			SOUTH AFRICA 1 : 1 MILLION, 1970

above the Lowveld. Wachendorf (1973) describes the relevant uppermost 100m or so of these rhyolites as poorly laminated, slightly banded, and uniform, with a granophyric groundmass and phenocrysts of felspar and occasional quartz. This differentiation into varying textural zones reflects on changing rates of cooling and crystallization at the time of extrusion. The present cave has an estimated volume of 10,000 cu.m; the opening of such a large cavity presumably required much of the Pleistocene, in view of the slow rate of change implied by the total absence of seepage water through the roof or walls and supported by the chronology deduced from the floor sediments (Appendix 54). This evidence does not allow for rapid undermining and active backwearing of the escarpment face during the later Quaternary (see also Cooke in Archaeological Survey file B20/1/2). Monoclinal tilting of the Karoo System rocks, basic entrenchment of the major rivers and removal of the bulk of the sediments derived from erosion of the Lowveld, would seem in fact to date well back into the Late Tertiary.

Climatically, the Border Cave area belongs to the summer-hot, mesothermal, winter-dry Cwa type of Köppen, with a tropical savanna climate (Aw) extending down from Mozambique to the adjacent Coastal Plain. By the Thornthwaite system, the drier Lowveld is warm-mesothermal, semiarid, with no water surplus at any season (DB_4d), whereas the crest of the Lebombo Mountains would qualify as subhumid $C_1 B_4 d$)(Schulze,1958). In terms of actual statistics, local rainfall varies from 500mm in the lowlands to 900mm in the highlands, with 75-80% of the precipitation amount being received during the summer half of the year (Climate of South Africa, 1965a and 1965b). Rainfall is not as effective as these figures would suggest, due to high evaporation, of the order of three times average annual precipitation, and rapid runoff, partly due to the precipitation being mainly in the form of high-intensity thunderstorms, although low-pressure cyclonic conditions do occur, especially in late summer (Masson, 1975). Long-term yearly receipts have been found to be oscillatory, with a pseudo wavelength of the same order as that of the double sunspot series, namely 20 years (Dyer, 1975 and 1976), while the annual budget tends to be unreliable, as indicated by V values of about 20% (Onesta and Verhoef, 1976). The Nsoko temperature record (7 years) and that of other Lowveld stations indicates a warmest monthly mean (January) of 25-26°C, a coldest monthly mean (June) of 16-18°C, and a mean annual range of 7,5-10,0°C, compared with a mean diurnal amplitude of 12-15°C (Climate of South

Africa, 1954). A mean daily range greater than the annual range is often considered to be characteristic of tropical climates, and frost today is sporadic in the Lowveld, occurring only every few years in low-lying areas with cold air drainage and strong inversions. The mean annual low at 5 stations is +0,5 to +5,7°C. Analogs for the Lebombo Mountains are provided by Stegi, Swaziland, at 653m and Melmoth, Natal at 770m. At the former the mean annual low is 6,2°C, the record low 3,3°C (52 year record), while at the latter these values are 5,0°C and 2,0°C (30 year record). This indicates that a ridge site such as Border Cave would be frost-free.

The native vegetation of the region is subtropical, mainly deciduous savanna and bush, edaphically conditioned by bedrock lithology and slope, and now much degraded over large areas by livestock over-grazing, grass burning, and wood cutting. Lowveld plant cover (Acocks,1973; also 1 : 1,5 million map accompanying original 1951 edition) on the basalts is typified by open stands of Acacia nigrescens and Sclerocarya, with a grass cover dominated by Themeda triandra but with Acacia spp. and Digitaria more abundant south of Nsoko. This give way to dense bush and thickets (Euclea, Spirostachys) on rocky slopes and low-order valleys, or open Acacia-Ficus forest along riverbanks. The Lebombo Mountains, on the other hand, maintain a cover of open bush savanna and acacia savanna although the climax vegetation there was probably scrub forest and forest in the recent past (Acocks, 1975). The broken country under 450m includes vestiges of a former mantle of humid-tropical, arboreal genera (Trichilia, Combretum) with Aloe and Euphorbia on slopes and Acacia on level ground. The high ridges and extensive rolling uplands seemingly had an original cover of sub-humid, subtropical scrub forest (Turraea, Commiphora), now partly replaced by more open veld types with a ground cover of Themeda and Eragrostis. A detailed checklist of the 226 woody plant species identified in the Border Cave area is given in Appendix 1.

Historical evidence (Reilly,1976) confirms expectations (Nel,1975) that the Lowveld and Lebombo regions of Swaziland sustained vast and varied wildlife populations up until and after the rinderpest epidemics of 1896-7 and 1902 (Daniel,1962). However, increasingly intensive and extensive cattle ranching and fencing, as also largely unrestricted hunting and trapping, at least partly fuelled by human numbers which increased from about 85,000 in 1904 to 221,000 in 1960 (Daniel,1962), reduced this to remnants occupying remote or inhospitable areas by about 1960. Considerably the largest of these last refuges is now the Hlane Game Sanctuary, located some 90 km north of Border Cave, for which a faunal list is provided in Appendix 2. A major factor limiting past ungulate biomass densities in this part of the bushveld is likely to have been the availability of running water at the end of winter. At that lean time local seasonal pans and pools dry up, while even rivers as large as the Ngwavuma are known to cease flowing during very dry years (Daniel, 1962). Pertinent in this connection is a temporal coincidence which suggests that a particularly deep and protracted trough (1926-34) in the Lowveld rainfall record (Masson, 1975) triggered the wildebeest movements which peaked in 1931-33 (Reilly, 1976). An account of the avian species which presently occupy Border Cave is given in Appendix 3. Panthera pardus is recorded in this vicinity as recently as 1942 (Archaeological Survey file B 20/1/2).

A good soils map is available for Swaziland (Murdoch, 1968), but those in the KwaZulu sector of the Lebombo have not been mapped or classified in any detail. The basic regional type is a brown, clayey soil with limited horizonation (Murdoch, 1968; Van der Merwe, 1962). On the basaltic terrain of the Lowveld, brown (Munsell hue 7,5YR), crumb-structured clays can commonly be seen in 60-100cm profiles, with black or dark grey (Munsell hue 10YR) clays with coarse blocky to prismatic structure, sometimes with calcareous concretions, localized in flat, low-lying areas. All slope soils are thin and stony, particularly so on rhyolite.

Altogether, this bio-physical mosaic represents the diversified three-dimensional catchment accessible to the prehistoric occupants of Border Cave under contemporary climatic conditions. The cave sediments serve to document a fourth temporal dimension, bearing evidence of repeated and substantial changes in the regional environment. It is within this complex contextual framework that the Border Cave archaeological record must be interpreted (Butzer et al., 1978).

1.3 Excavation History

Border Cave has been excavated on three occasions spanning almost half a century by persons either employed by or associated with the University of the Witwatersrand, Johannesburg. Pre-1970 information is, unless otherwise stated, based on details recorded in Archaeological Survey file B 20/1/2.

The first investigation of the site was carried out in July 1934 by a Department of Anatomy party under the direction of R.A. Dart, and at the instance of A. Purcocks, then in the service of the Swaziland

Administration. Dart, together with A. Galloway, J.H. Gear and G.F. Berry, spent a fortnight systematically removing a strip of 10 yard (0,91m) squares down to bedrock at a maximum depth of 168 cm (see Exc.1 of Fig.3). This trench yielded M.S.A. throughout bar superficial I.A. (Cooke et al., 1945), but it is noteworthy that a handaxe of 'Fauresmith' type was subsequently found in the wall of square E4 at a depth of 53 cm. The excavation was regarded as merely preliminary to further work and in consequence no account of it was ever published.

During 1940 W.E. Horton of Nsoko commenced digging in the central portion of the cave with the object of extracting the finer ash-rich fraction of the sediments for sale as 'agricultural fertilizer'. Fossil animal and human remains (limb-bones; a nearly complete frontal) found in the course of these operations came, by way of the District Engineer's Department, into the possession of D. Drew, at that time Principal Medical Officer in Swaziland, who forwarded them to Dart in January, 1941. At his request T.R. Jones, then on the staff of the Hlatikulu Hospital, visited the site and found, in the rubble dump left by Horton, a parietal fragment which articulated with the skull portion previously obtained. This information clearly indicated the possibility of recovering further human remains, and more precise data as to their cultural associations, by way of the orderly exploration of the site. Dart therefore approached the University Principal (H. Raikes) with a proposal for an official party to investigate the cave during July 1941. This was agreed to and the approval and support of the former Bureau of Archaeology was obtained through its penultimate Director (C. van Riet Lowe).

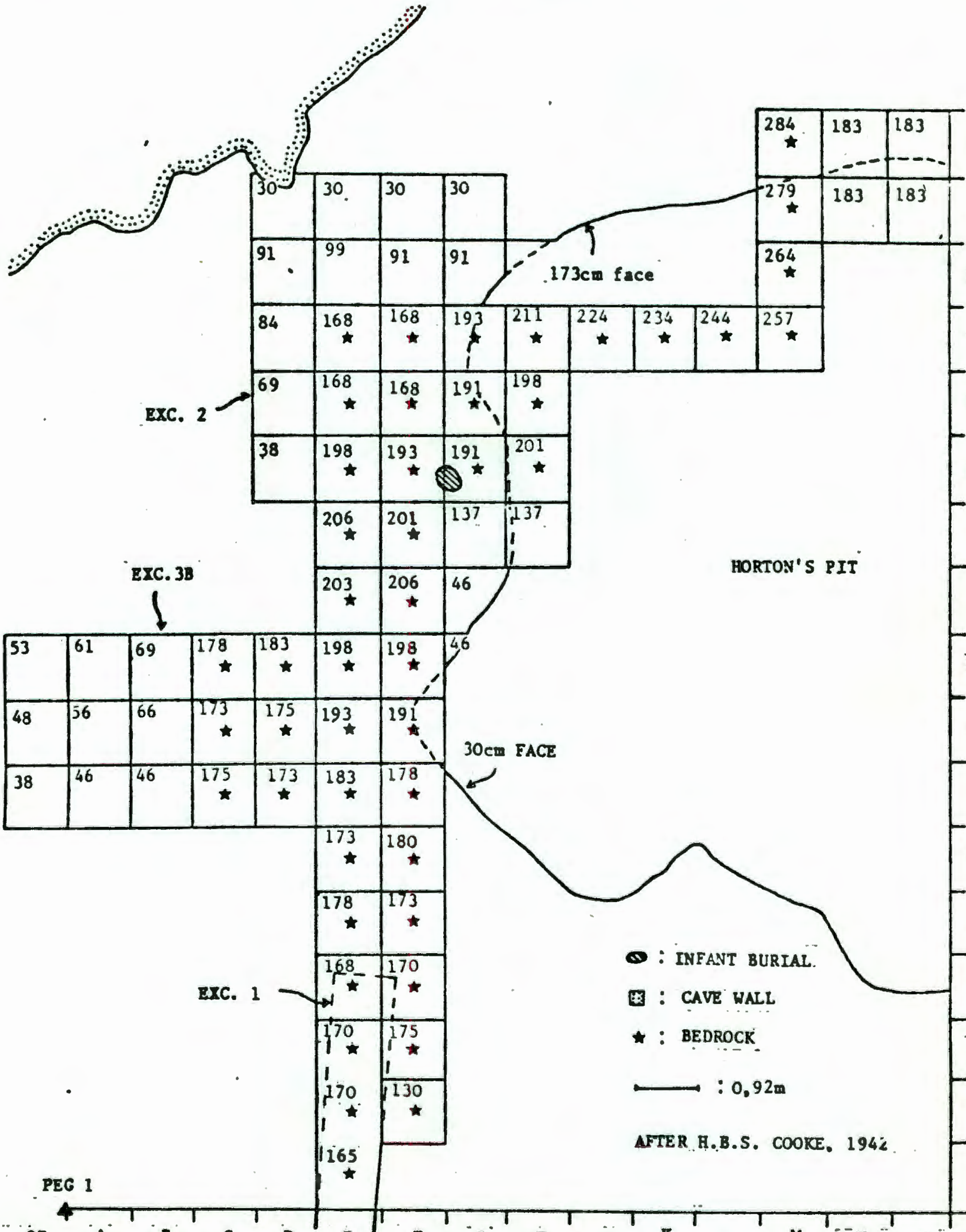
This second expedition comprised H.B.S. Cooke, B.D. Malan, L.H. Wells and E.W. Williams, as also senior students in the Departments of Anatomy and Geology. Work in the cave was carried out for 18 days in July 1941 and for a further 17 days in July 1942, during which time:

(a) The position of the cave relative to the international boundary was determined.

(b) The cave was mapped and contoured, and three base points were marked by chiselled crosses on the cave roof vertically above each (see Fig. 3, Pegs 1-3).

(c) The disturbed deposit in Horton's Pit was removed and sieved. It was found that this digging varied in depth from 173 cm at the back to about 30 cm towards the front (Fig. 9).

FIG. 9 BORDER CAVE. PLAN OF GRID SHOWING DEPTHS REACHED IN EXCS. 2 and 3B.



(d) The heap of debris constituting Horton's Pit was removed and sieved (Fig. 10). This yielded a number of additional hominid remains, namely a series of cranial vault pieces joining up with those on hand, a nearly complete lower jaw, and a right zygomatic, as also various skull trunk and limb portions belonging to at least two individuals which were dubiously regarded, on the basis of their physical condition, as being more recent in date.

(e) A grid, in yard squares, was laid out in an area adjacent to and finally cutting into Horton's Pit, in the region in which the human remains were reportedly found (Fig. 11). This was subsequently extended towards the cave mouth, to connect with the 1934 trench. Removal of the deposit was by way of 7,5 cm spits parallel to deposit surface. Full details of the final depths reached in various squares is given in Figure 9.

(f) During these operations an infant burial was encountered at a depth of 114-137 cm in squares F12 and G12 during the 1941 season.

(g) Sections along the east and north walls of the completed excavation were drawn by H.B.S. Cooke. Slightly modified versions of these are detailed in Figures 13 and 14.

(h) The cultural succession within the investigated deposits, from bedrock upwards, was established as being: an 'extremely simple' M.S.A. industry (Cooke <u>et al</u>., 1945); a 'normal' Pietersburg (Cooke <u>et al</u>., 1945), subsequently ascribed to the 'Upper' Pietersburg (Malan, 1950); a 'refined' Pietersburg (Cooke <u>et al</u>., 1945), later termed the 'Epi-Pietersburg' (Malan, 1949a), and regarded as either predating (Malan, 1949a and 1955) or equating with (Malan,1952) the 'Magosian'; material of 'indeterminate character'(Early L.S.A.) restricted to the unexcavated area in the south of Horton's Pit (Strip Q); superficial I.A. represented by occasional sherds and associated with maize cobs, localized layers of cow dung, and an abundance of goat droppings.

Almost thirty years later the author decided to investigate the site again, as part of the Swaziland Project, under the general direction of Dart. Permission to excavate Border Cave and to enter Reserve 16 (7638) was obtained from:the National Monuments Council; the Department of Bantu Administration and Development; the Bantu Affairs Commissioner at Ingwavuma; and Chief Ntunja Mngomezulu, Dinabanye Royal Kraal. Subsequent

Fig. 10 Horton's Dump, just prior to being removed and sieved in July, 1941.
Photograph by courtesy of the Archaeological Research Unit, University of the Witwatersrand, Johannesburg.

Fig. 11 Excavation gets under way in 1941
Photograph by courtesy of the Archaeological Unit,
University of the Witwatersrand, Johannesburg

investigations were carried out during seven weeks in December 1970 and January 1971, and for a further month on various occasions between then and mid-1975, during which time:

(a) The chiselled crosses on the cave rood marking Pegs 1-3 were located and the 1941-2 grid was then re-established.

(b) E+F 6-12 was cleared to bedrock in order to check on the accuracy of the grid reconstruction by comparisons along lines D/E and F/G. Sieving of the slumped debris within this trench yielded a number of items attributable to the 1942 party (Fig. 12).

(c) S+T 16-17 was sunk, by way of 7,5 cm spits, to bedrock at up to 250 cm. The upper levels of this test pit, down to a maximum depth of 135 cm, was found to be disturbed by slumping into Horton's Pit.

(d) T 4-15 was removed by means of natural levels, down to the surface of the M.S.A., in order to evaluate the precise extent of post-1942 disturbance in areas immediately north and west of lines T/U and 15/16 respectively. These uppermost strata were found to be only largely intact west of square T6, and probing in that region was therefore enlarged by the addition of squares S 4+5.

(e) OZ-D 7-9 was excavated in order to check on the stratigraphy as outlined by Cooke et al. (1945). Strips C and D, partly truncated by slumping, were taken down in 7,5 cm spits to bedrock at up to 180 cm. OZ-B was then removed in terms of natural levels down to the base of the 'Epi-Pietersburg' at a maximum depth of about 70 cm.

(f) Q-T 16-24, bar the test pit enclave, was entirely removed by stratum, with a further 7,5 cm spit interval subdivision in the case of the relatively thick and mainly unstratified superficial horizon. Details relating to spatial variations in depth and thickness of each of the levels identified here is given in Appendix 4. The values in this are all based on the mean of the readings obtained on the corners of each square. That data was then used to calculate the excavated volume of every stratum. The results, as shown in Appendix 5, are estimated to be 80-90% accurate.

(g) The back wall of the 1941-2 excavation was cleared of slumped debris in order to facilitate correlation of the stratigraphic sequences in Exc. 2 and Exc. 3A Rear.

Fig. 12 Remnants of a lunch in 1942. Some items from a re-opened portion of Exc. 2 (E+F 6-12)

Row 1: Bakers Biscuits Ginger Snaps wrapping
Row 2, left: Fragment of newspaper apparently post-dating Pearl Harbour
Row 2, right, top: Nestle's cheddar cheese sticker
Row 2, right, bottom: Piece of white toilet paper

Photograph by D. Rokos

The actual or estimated original deposit surface, as documented by the contour data, was used as a datum for all depth measurements. In subsequent discussion trench (f) is referred to as Exc. 3A Rear, trenches (c) and (d) are referred to as Exc. 3A Front, and trench (e) is referred to as Exc. 3B (Fig. 3).

1.4 The Lithostratigraphy

Figures 13-15 outline much of the cave-fill sequence along the outside faces of Exc. 3A Rear and Exc. 2. Sections relating to the latter are based on unpublished profiles by Cooke (Archaeological Survey file B 20/1/2), modified slightly in terms of a further examination by the author in 1973. Ten major units, with an accumulative thickness of close on 4m have been identified in that portion of the cave. These were sometimes found to be susceptible to further subdivision, on the basis of often remarkably extensive marker lenses of ash and/or vegetation. The full designation and the acronym of each unit is given below, but the latter only is referred to elsewhere in this dissertation.

The following account of the lithological succession, beginning from the present surface, details the spatial distribution of and relationships between the various identified strata, with comment relating, unless otherwise stated, to Exc. 3A Rear. A comprehensive and complementary description of these same levels from a strictly sedimentological viewpoint may be found in Appendix 54.

1.4.1 First Brown Sand (1BS)

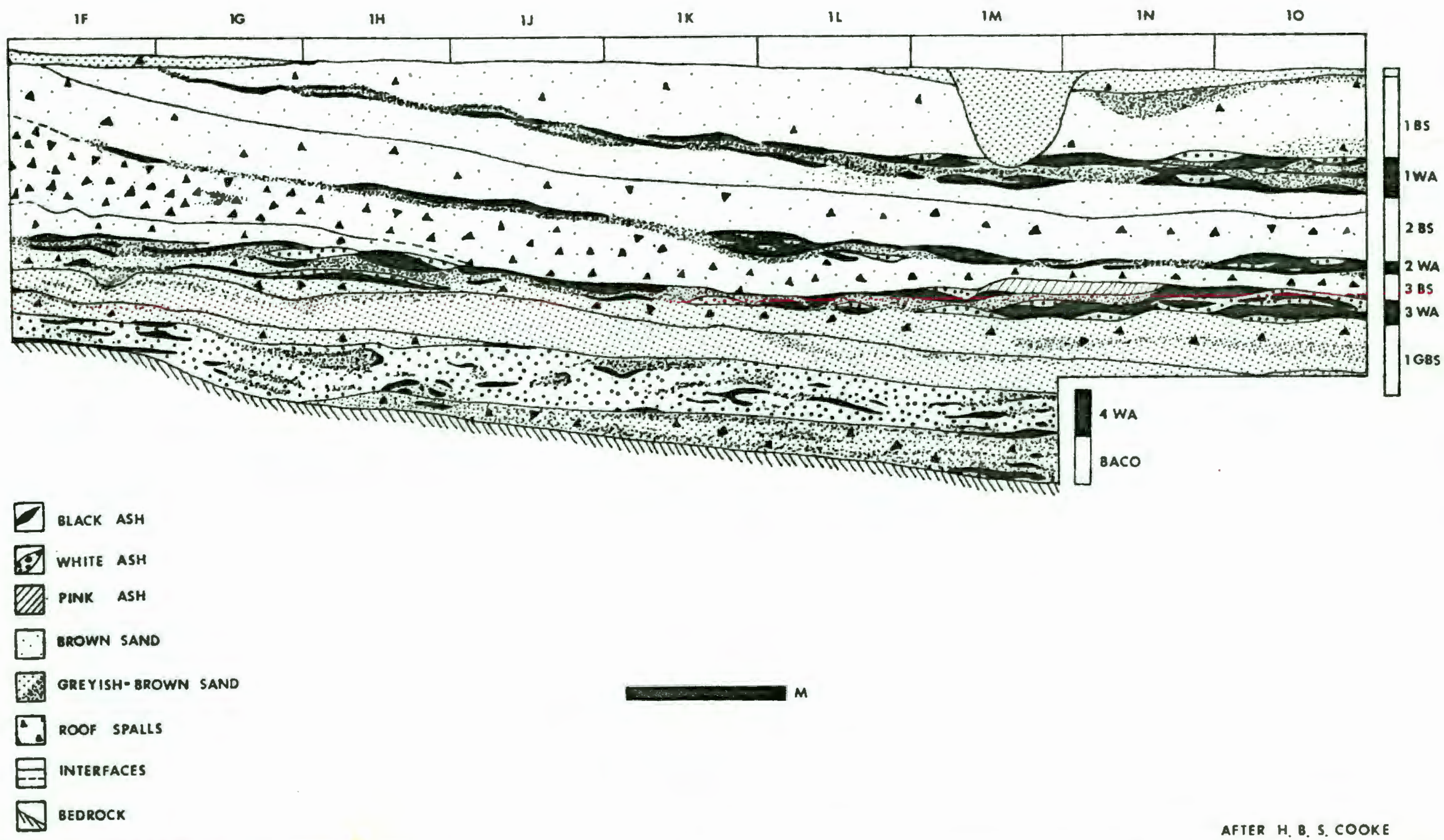
This unit was found to be consistently separable into two major sublevels, namely:

1.4.1.1 First Brown Sand Upper (1BS.UP)

Brown sand with an often moderate but very variable spall content. Lenses of ash and vegetation were usually localized and sporadic. Its surface was absent forward of Q-T22 due to increasingly severe northward and westward slumping into Horton's Pit (Fig. 3). Thickness increased markedly backwards (~ 51 cm in Q-T 19 to ~ 80 cm in Q-T 24). In S+T 4-5 it was about 12-14 cm deep and a somewhat lighter brown than the underlying sublevel, but the two were not found to be rigorously distinguishable.

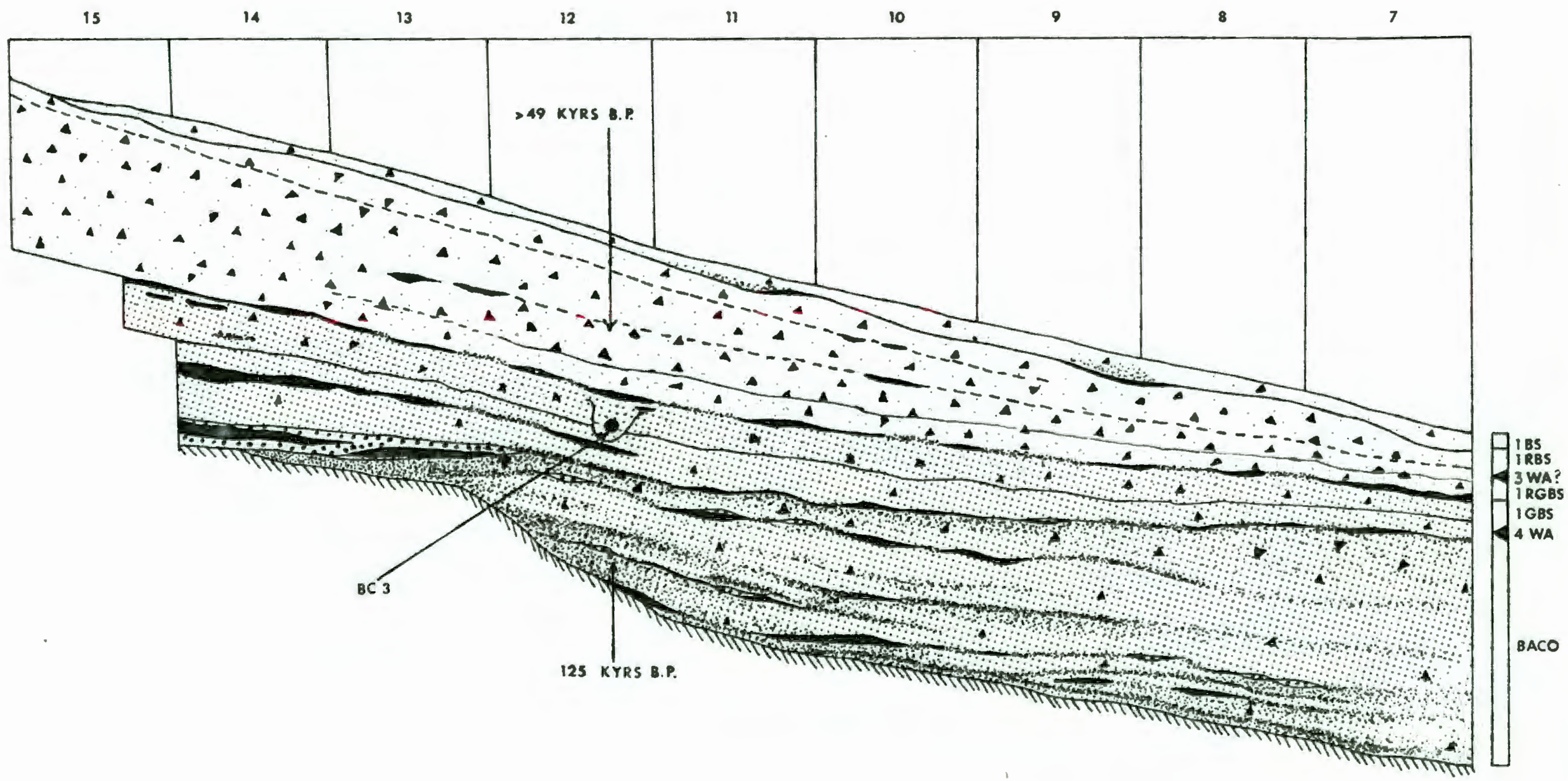
Subsequent laboratory analysis of the derived debris suggested that

FIG. 13 BORDER CAVE : SECTION MAINLY FOLLOWING EAST WALL OF STRIP 16



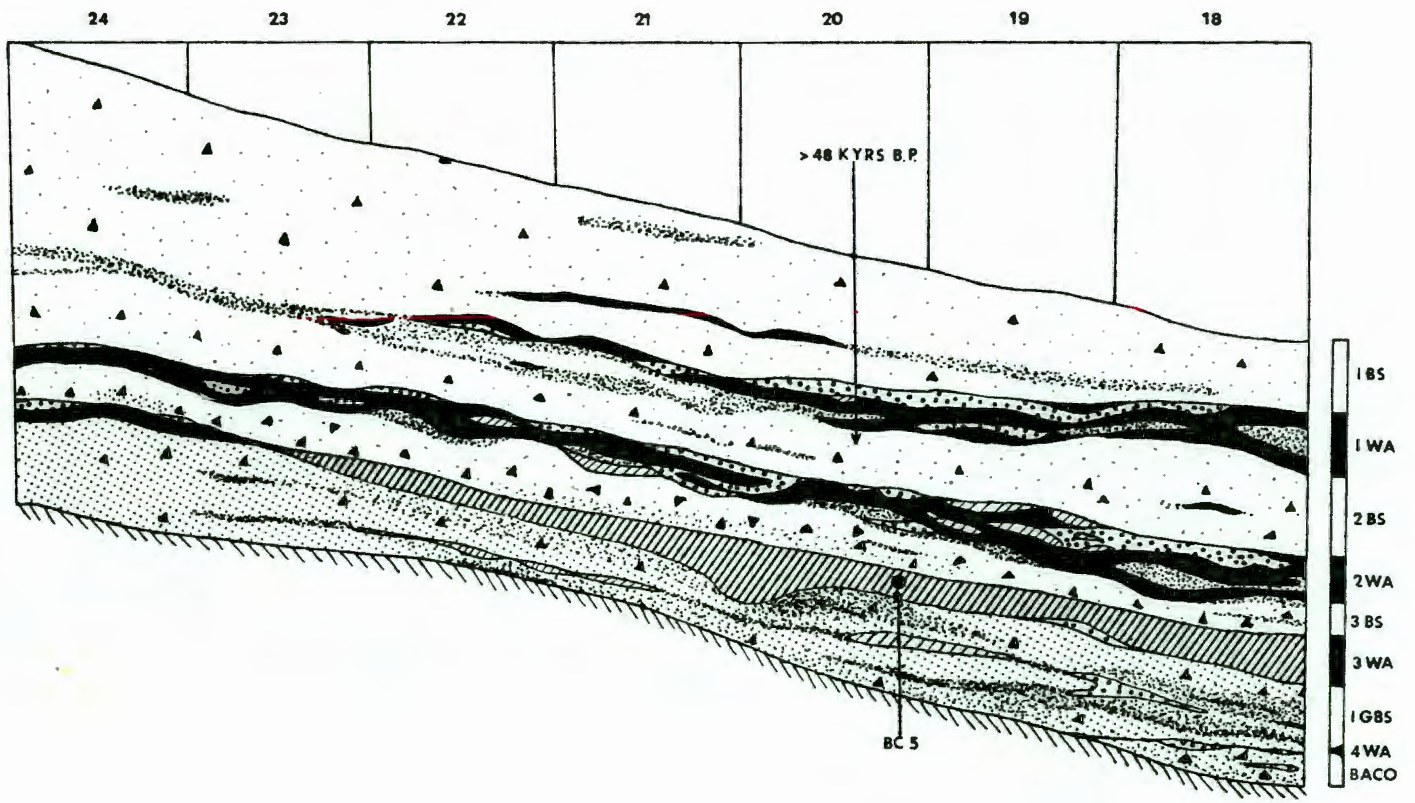
AFTER H. B. S. COOKE

FIG.14 BORDER CAVE : SECTION ALONG NORTH WALL OF STRIP E



AFTER H. B. S. COOKE

FIG. 15 BORDER CAVE : SECTION ALONG SOUTH WALLS OF STRIPS S AND T



the 1BS.UP could on cultural grounds be separated into two fractions, namely:

a. First Brown Sand. Upper Iron Age (1BS.UP.IA) : Brown sand thickening slightly backwards (~ 41 cm in Q-T 19 to ~ 53 cm in Q-T 24). It is typified by a low but consistent occurrence of IA debris. Relatively speaking, microfaunal values are low, while charcoal nodule and macrofaunal values are high.

b. First Brown Sand. Upper. Sterile (1BS.UP.S) : Brown sand thickening markedly backwards (~ 9 cm in Q-T 19 to ~ 27 cm in Q-T 24). It is typified by an absence of IA debris. Relatively speaking microfaunal values are high, while charcoal nodule and macrofaunal values are low.

Of particular note are the number of large infilled pits associated with the 1BS.UP.IA. Lips, although usually poorly defined, due to lack of resolution in a preponderantly brown sand, seemingly in all cases originated close to the modern surface (5-10 cm). One of these features contained a finely made basket lid, suggesting that they were sometimes sealed . A number seem to have been coarsely lined with grass (Deacon, Deacon and Brooker, 1976). They yielded nothing but a mass of preponderantly non-edible floral debris (mainly leaves and grass). No effort has as yet been made, by way of C-14 readings, to establish if these occurrences refer to one or more temporal event. Details concerning pit locations and dimensions, in areas excavated by the author, are as follows:

I.	S.W. portion of Q16.	Max. diameter 61 cm.	Max. observed depth 109 cm.
II.	E. of R21, W. of R22.	Max. diameter 76 cm.	Max. observed depth 110 cm.
III.	N. of S18, S. of R18.	Max. diameter 46 cm.	Max. observed depth 71 cm.
IV.	Centre of T5.	Max. diameter 71 cm.	Max. observed depth 46 cm.
V.	S.W. portion of T7.	Max. diameter 91 cm.	Max. observed depth 81 cm.
VI.	E. of T14, W. of T15.	Max. diameter 76 cm.	Max. observed depth 51 cm.
VII.	N.E. of T19, N.W. of T20.	Max. diameter 61 cm.	Max. observed depth 56 cm.

1.4.1.2 First Brown Sand. Lower (1BS.LR)

Deep brown or greyish-brown sand. Spall content usually low but increasing at base. Vegetation and ash lenses were common. Thickness decreased somewhat backwards (~ 13 cm in Q-T 18 to ~ 9 cm in Q-T 24). In S+T 4-5 it was about 12-14 cm thick and differed from 1BS.UP in being a deeper grey, having less vegetation, and in spall content (larger and ~ 4 x more abundant). It rises towards the modern surface northwards along strip 16 and is confined there to areas south of square F (Fig. 13).

1.4.2 First White Ash (1WA)

Surface comprised of an almost continuous sheet of fairly compact white ash grading downwards into soft black ash (Fig. 16). Below this was a deep brown sand with a fair spall content which interdigitated with black, orange and white ash lenses. Vegetation was abundant and mainly confined to the black ash and brown sands. A very extensive horizon of it marked the base of this stratum over large areas, but this thinned out and became discontinuous towards the back, where it was replaced by deep brown sand. Thickness decreased markedly backwards (~ 18 cm in Q-T 18 to ~ 5 cm in Q-T 24). It rises towards the modern surface northwards along strip 16 and is confined there to areas south of square F (Fig. 13).

In Exc. 3A Front this stratum was lost in T 10-15 (Horton's Pit) but it re-appeared in T9 as a thin lense which thickened towards the dripline to a maximum of ~ 45 cm in S+T 4-5, where it was clearly separable into two sublevels, namely:

1.4.2.1 First Beige Sand Upper (1BES.UP)

Beige-brown sand with spalls still larger and more abundant than in 1BS.LR. It was up to 20 cm thick in S+T 4-5 but thinned backwards and did not occur east of T7.

1.4.2.2 First Beige Sand Lower (1BES.LR)

Beige-whate sand grading eastward to pale orange, with much less spall. It was up to 25 cm thick in S+T 4-5 but thinned backwards and did not occur east of T9.

All 1BES charcoal and faunal fragments were heavily mineralized, seemingly as a result of impregnation by gypsum. Mobilization of this was presumably made possible by minor moisture drawn in by capillary action from the nearby dripline, as is suggested by the presence of fine rootlets in the lower sublevel. A few probably artificial features were noted in Exc. 3A Rear. These were all poorly defined and confined to the compact surface of the stratum. Some were largely ash-free and could possibly represent sleeping hollows. Details are as follows:

I.	N.W. portion of R19.	Max. diameter 46 cm. Max. depth 10 cm.
II.	Centre of R21?	Max. diameter >30 cm. Max. depth 6 cm
III.	Centre of S23	Max. diameter 51 cm. Max. depth 8 cm.

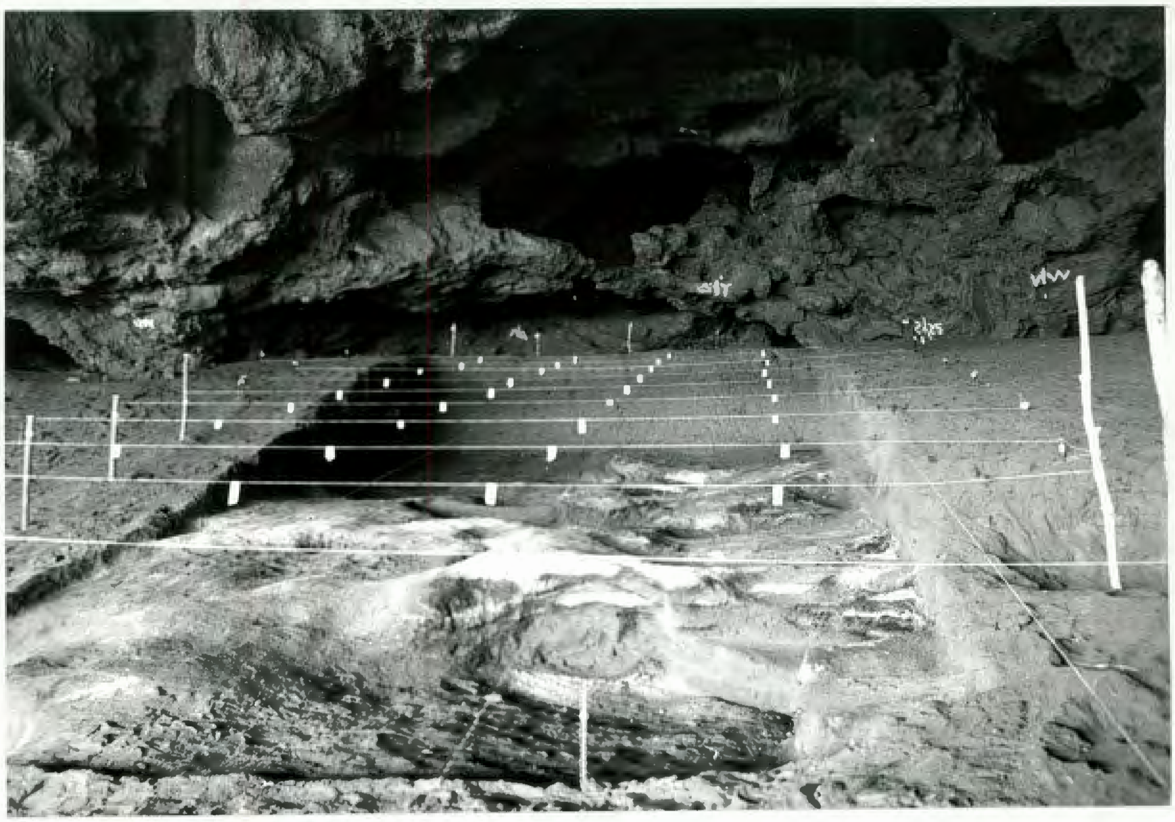


Fig. 16 Exc. 3A Rear : 1WA surface exposed
Photograph by courtesy of A. Boshier

IV.	W. of S24	Max. diameter 61 cm.	Max. depth 10 cm
V.	N. of T20	Max. diameter 38 cm.	Max. depth 20 cm
VI.	N.W. portion of T22	Max. diameter 30 cm.	Max. depth 15 cm

1.4.3 Second Brown Sand (2BS)

This unit was found to be consistently separable into two major sublevels, namely:

1.4.3.1 Second Brown Sand. Upper (2BS.UP)

Brown sand with only minor grit which did however become more abundant in the back few strips. Most of the artefacts, macrofauna and charcoal was noted to come from its lower levels. Base was defined by a thin and somewhat discontinuous vegetation-black ash horizon. Thickness decreased backwards (~ 23 cm in Q-T 18 to ~15 cm in Q-T 24) and southwards (~ 22 cm in Q20 to ~ 10 cm in T20). Extent forward of Q-T 16 is not known. It slopes up towards the modern surface northwards along strip 16 and is confined there to areas south of square E (Fig. 13). A basin-like depression, 25 cm in maximum diameter and 10 cm in maximum depth was noted on the south-east side of S19.

1.4.3.2 Second Brown Sand. Lower (2BS.LR)

This sublevel was, over much of the main trench, found to be further divisible, as follows:

a. Second Brown Sand Lower A (2BS.LR.A): Brown sand with a fair amount of spall and sporadic ash lenses. Base defined by a thin and discontinuous horizon of black ash and vegetation. Thickness increased somewhat backwards (~ 9cm in Q-T 20 to ~ 12 cm in Q-T 24).

b. Second Brown Sand Lower B (2BS.LR.B): Brown sand with a very high spall content. Fragments became larger towards the back wall and also showed an upward increase in abundance. Charcoal was mainly confined to the base, which was defined by a thin and discontinuous horizon of black ash and vegetation. Thickness increased markedly backwards (~ 8 cm in Q-T 20 to ~ 13 cm in Q-T 24).

c. Second Brown Sand Lower C (2BS.LR.C): Deep brown sand with sporadic ash lenses and a moderate spall content, mainly in the upper levels (intrusive from above?). Cultural debris was noted to be most frequent in the lower levels. Thickness decreased somewhat backwards (~ 8 cm in Q-T 20 to ~ 5 cm in Q-T 24).

All or part (perhaps only A+B) of the 2BS.LR grades, within the unexcavated area Q-T 12-15, into a very marked orange horizon, the 'red earth band' of Cooke et al. (1945). That distinctive stratum is, forward of S+T12, buried by slumped deposit and/or truncated by Horton's Pit, but may correlate with the First Orange Sand (1ORS) found underlying 1BES in S+T 4-5. Only the upper levels of this, sufficient to reveal that it did contain M.S.A., were removed in those squares (maximum depth ~ 90 cm). The 2BS.LR rises towards the modern surface northwards along strip 16, and is confined there to areas south of square D (Fig. 13).

1.4.4 Second White Ash (2WA)

A fairly compact and continuous sheet of white ash overlying black ash with intercalated lenses of orange and white ash and deep brown sand (Fig. 17). Spalls occurred in fair abundance and increased towards the back wall. A well-defined vegetation horizon marked the base over an extensive area. Thickness decreased markedly backwards (~ 21 cm in R+S 18 to ~ 12 cm in R+S 24) and southwards (~ 26 cm in Q 19 to ~ 15 cm in T 19). Forward extent beyond S+T 15 is unknown (as are all of the following levels in Exc. 3A Rear). It rises and thins markedly northwards along strip 16, being only a faint streak in the face of square F (Fig. 13). Correlation beyond this point is uncertain but it may be represented by discontinuous ash streaks backwards of square 9 in the profile along strip E (Fig. 14). Cooke et al. (Archaeological Survey file B 20/1/2) record that it occurred at 25 cm in E15 and then reached the present surface in D15.

Two possible features are represented by a faint depression with a maximum diameter of 50 cm and a maximum depth of 7 cm in the centre of T20 and by some grouped large slabs (hearthstones?) in S19. Of interest is a localized salt-consolidated zone up to 18 cm thick and located at the base of the 2WA. This appeared to be centred on S+T 16, thinned out backwards to about the west edge of strip 19, and was truncated westward by Horton's Pit.

1.4.5 Third Brown Sand (3BS)

This unit was found to be separable backward of R+S 21 into two sublevels, namely:

Fig. 17 Exc. 3A Rear: 2WA surface exposed.
Photograph by courtesy of A. Boshier

1.4.5.1 Third Brown Sand Upper (3BS.UP)

Brown sand with little cultural debris and a moderate spall content. Base was represented by a discontinuous level of vegetation and ash. It rises towards the modern surface northwards along strip 16 and is possibly represented by some fraction of the superficial First Rubbly Brown Sand (1RBS) in Exc. 3B (base at 15-35 cm).

1.4.5.2 Third Brown Sand Lower (3BS.LR)

This sublevel was, in strips 23 and 24, found to be further divisible as follows:

(a) Third Brown Sand Lower A (3BS.LR.A) : Brown sand with very abundant spall which included large slabs. A thin streak of black ash and vegetation marked its base. Thickness increased markedly backwards.

(b) Third Brown Sand Lower B (3BS.LR.B) : Deep brown sand with somewhat less spall. A thin horizon of friable vegetation overlies the following stratum in places. Thickness increased somewhat backwards.

The 3BS.LR had a mean thickness of ~ 22 cm in Exc. 3A Rear. Northwards it rises somewhat and thickens very markedly towards the northeast corner of the cave where it reaches a maximum development of ~ 60 cm (Fig. 13). This accumulation is the 'roof collapse' that was correctly interpreted as predating the 2BS.LR 'red earth band' by Cooke et al. (1945).

1.4.6 Third White Ash (3WA)

Fairly compact black and white ash with a moderate spall content, grading southwards in strip R into orange ashy sand, and backwards of R+S 21 into greenish grey gritty sand. Thickness decreased markedly backwards (~ 10 cm in Q-T 18 to ~ 3 cm in Q-T 24) and northwards (~ 16 cm in T 18 to ~ 8 cm in R 18). Along strip 16 it is near-horizontal but thins out to a streak in the north-east corner of the cave (D.17). The stratum is very weakly represented in the section along strip E and correlates either with the surface or with the base of the First Rubbly Grey-Brown Sand. A of Exc. 3B. Only one feature was noted, namely a poorly-defined elongated depression with a maximum depth of ~ 25 cm in T20, which ran into the profile wall and was associated with a human mandible (B.C.5)

1.4.7 First Rubbly Grey-Brown Sand (1RGBS)

This unit is partly or entirely confined to Exc.2/3B and was consistently separable into two sublevels. These were originally believed to equate with the upper portion of the First Grey-Brown Sand of Exc. 3A Rear (see below)

(Beaumont, 1973). However, subsequent field inspection of the cleared profiles along strips 16 and E failed to corroborate this interpretation. Details are as follows:

1.4.7.1 First Rubbly Grey-Brown Sand A. (lRGBS.A)

Grey to deep brown sand with an abundance of small spall. Base demarcated by a thin white-grey ash horizons. Base deepened (~ 30 cm in OZ - B7 to ~ 48 in OZ - B9) and stratum thickened (~ 12 cm in OZ - B7 to ~ 25 in E10) rearwards, but was not certainly traceable further back than E11. Attenuated streaks of the 3WA of Exc. 3A Rear were followed along strip E to the east side of square 11, while extrapolation beyond this to square 9 of Exc. 3B suggested that it correlated either with the surface or with the base of the IRGBS.A. One feature was noted, namely a shallow pit with vertical walls ~ 25 cm high and originating at or just below the sublevel surface in the south side of A9 and the north side of B9.

1.4.7.2 First Rubbly Grey-Brown Sand B. (lRGBS.B)

Grey to deep brown sand with an abundance of small spall. Base demarcated by a compact grey-white ash horizon. Thickness is fairly constant (~ 12-15 cm), but base deepens rearwards (~ 43 cm in OZ-B7 to ~61 cm in OZ-B9). It was found impossible by mere inspection to establish certainly the backward limits of this sublevel in Exc. 2.

1.4.8 First Grey-Brown Sand (lGBS)

This unit was found to be consistently separable into two sublevels, namely:

1.4.8.1 First Grey-Brown Sand Upper (lGBS.UP)

Deep brown sand with intercalated brown sand and grey ash lenses and with fairly abundant coarse spall which decreased in frequency with depth. Base was defined in terms of an orange ash horizon which graded towards the back into a greyish-greenish ash. Thickness increased somewhat rearwards (~ 28 cm in R+S 18 to ~ 39 cm in R+S 24). This sublevel, characterized by a high and consistent molluscan content, parallels bedrock northwards and maintains a fairly constant thickness along much of strip 16, but tends to thin towards the cave mouth along strip E. It equates with the upper portion of the 'dark earth' of the 'Normal Pietersburg' mentioned by Cooke *et al.* (1945).

1.4.8.2 First Grey-Brown Sand Lower (1GBS.LR)

Deep grey sand with intercalated grey and white ash lenses. A soft brown sand with a very low spall content was noted to lie immediately above a very compact and marked white ash band which served as an arbitrary base. Thickness varied markedly as a result of thinning in areas backward of R+S 21, where the stratum rested directly on bedrock (~ 27 cm in R-T 18 to ~ 2 cm in R+S 24). It maintains a fairly constant thickness of 20-25 cm and roughly parallels bedrock along strip 16, but thins out markedly down-slope along strip E to ~ 9 cm in E7. An almost entirely spall-free 'chocolate-coloured earth band', corresponding to the basal portion of the 1GBS.LR in Exc. 3A Rear, was considered by Cooke et al. (1945) to equate most closely with the matrix adhering to B.C.1. Features noted comprise:

I. A basin-like depression, 30 cm in maximum diameter, and 12 cm in maximum depth, in S22.

II. A basin-like depression, 25 cm in maximum diameter, and 8 cm in maximum depth, in T19.

1.4.9 Fourth White Ash (4WA)

Subsequent to excavation and during the clearing and inspection of profiles along the 1941-2 excavations it was found that the thin (3-5 cm) compact and marked white ash horizon which was taken as the base of 1GBS.LR, seemed almost certainly to correlate with a thick (~30 cm) level of white ash with intercalated black and grey ash lenses which runs just above and then intersects bedrock in square G along strip 16 (Fig. 13). It can be clearly traced over the full length of strip E, where it thins markedly towards the dripline (~ 15 cm in E14 to < 1 cm in E7), and is represented by a faint streak ~ 15 cm below the 1RGBS in Exc. 3B (Fig. 14). The intact surface of this stratum was noted by Cooke et al. to constitute the base of the back sector of Horton's Pit (Archaeological Survey file B 20/1/2).

1.4.10 Basal Complex (BACO)

Deposits underlying the 4WA had a thickness of up to 140 cm in E + F7 and comprised a complex succession of grey, black, and white ash and brown sand lenses which were found impossible to subdivide meaningfully in test trench C+D 7-9 (Exc. 3B). It was subsequently broken down into four fairly arbitrary fractions, namely:

1.4.10.1 Basal Complex A (BACO.A) (previously 1GBS.LR.B)

A sequence of interdigitating white grey and black ash and brown sand lenses with a moderate abundance of spall (particularly overlying the cave floor) (Fig. 18). It rested directly on bedrock in Exc. 3A Rear forward of R+S 22 and thickened to the west (~ 0 cm at back of R+S 21 to ~ 28 cm in R 18) and to the north (~11 cm in T 18 to~28 cm in R 18). Along strip 16 it directly overlies bedrock but pinches out in square H (Fig. 13). It thickens downslope in strip E with base apparently being a discontinuous ash horizon beginning in E13 but not clearly traceable forward of E9. (Fig.14).

1.4.10.2 Basal Complex B (BACO.B)

Grey and deep brown gritty sand with ash streaks and a moderate spall content. Present only in Exc. 3B and in Exc.2 forward of E13. In Exc. 3B it was about 25 cm thick with a base that dips markedly towards the drip-line (~ 145 cm in C9 to ~ 114 cm in C7).

1.4.10.3 Basal Complex C (BACO.C)

Dark brown sand with some ash lenses and a fair spall content. Present only in Exc. 3B and in Exc. 2 forward of E13. In Exc. 3B it was about 25 cm thick with a base that dips markedly towards the dripline (~ 168 cm in C9 to ~ 145 cm in C7).

1.4.10.4 Basal Complex D (BACO.D)

Compact deep brown sand with ash lenses and some spall, mainly on bedrock. Present only in Exc. 3B and in Exc. 2 forward of E12. Bedrock represented base in both areas and mean thickness was about 18 cm. In C+D7 the sediments were noted to be slightly damp with a few rootlets and no typical salt content.

1.4.11 General remarks

Table 1 outlines the correlations between the various trenches as discussed above. The following additional remarks and details are pertinent:

(a) The broad disposition of the deposits at this site were primarily determined by the fact that bedrock slopes down towards the cave mouth at an angle of 13-15^{o}. This has resulted in successive levels being banked upon each other in rearward order of decreasing age (Fig. 13; Archaeological Survey file B 20/1/2). The floor also deepens away from the north wall at an 8-10^{o} angle, leading to a further tendency for the immediately overlying strata to have a concordant slope in that direction.

Fig. 18 A view of Exc. 3A Rear at the end of January, 1971
Photograph by courtesy of A. Boshier

TABLE 1. Litho-stratigraphic correlations between various excavations at Border Cave

EXC 3A Front	EXC 3A Rear	EXC 2 + 3 B	
Present acronyms	Present acronyms	Present acronyms	Cooke et al (1945) & File B20/1/2
1BS UP	1BS UP IA + S	1BS UP	Bantu
1BS LR	1BS LR		
1BES UP & LR	1WA		
	2BS UP		
1ORS ?	2BS LR A-C		Red earth band
	2WA		
	3BS UP	1RBS?	
	3BS LR A + B	1RBS	Roof collapse
	3WA	1RGBS.A?	
		1RGBS.B	Ash band overlying BC3
	1GBS UP	1GBS UP	
	1GBS LR	1GBS LR	Soft dark band - BC1 ?
	4WA ?	4WA	
	BACO A	BACO A	
	BEDROCK	BACO B	
		BACO C	
		BACO D	
		BEDROCK	

Abbreviations

? = uncertain correlation

(b) Levels with a low cultural content usually thicken towards the cave walls where weathering was and is presumably most active. Artefact-rich strata, on the other hand, invariably thin out towards the back, probably as a result of the gravitational effects of trampling.

(c) The deposits in Exc. 2 can be roughly divided into two groups, namely:

I. A pre-3WA suite which is relatively rich in artefacts and poor in spall.

II. A post-3WA suite which is relatively rich in spall and poor in artefacts.

Consistent occupation seems to have been largely confined to the cave centre during and after the formation of the spall-cone in the north-east corner of the site (post-3WA times). Subsequent accumulations in that area, as represented by our Exc. 3A Rear, tend as a result to lense out very markedly northwards. Illustrating this is the finding that some 200 cm of 3BS and later sediments in S+T 22 are represented by only about 30 cm of superficial sand and rubble in Exc. 3B.

(d) The slightly damp sediments and the presence of rootlets in BACO.D from squares C+D7 are regarded as representing the approximate inner limit of moisture penetration by capillary action at this site. The preservation of organic matter in those squares is consequently rather poor but improves very perceptibly a short distance further inwards. Cooke et al. (Archaeological file B 20/1/2) record that the entire BACO complex downslope of their 'transitional zone' in C+D7 was comprised of compact reddish-brown earths, rich in roof spall of often moderate size, which were practically devoid of ash and bone, but extensively traversed by termite burrowing, and with a large ant-heap being recorded in D+E 5-6.

(e) Post-1969 observations suggest that the caves roof is entirely impervious to seepage and there is no tangible evidence that moisture has entered by this means since the excavated sediments began to accumulate. Confirming the extreme and persistent desiccation of the deposits are the well preserved floral remains from levels down to the 2WA with an inferred age of ~80 Kyrs. B.P. (Butzer et al., 1978). Possible evidence for slight deviations from total aridity is provided by the presence in all strata of easily mobilized chlorides, which could conceivably, at least to some extent, derive from saline aerosols, brought in by sea mists which are not uncommon in this area during summer, subsequent to their formation by means of the mechanism outlined by MacIntyre (1974).

(f) The sediments are, generally speaking, all largely or entirely unconsolidated with the major exception of the lower BACO levels forward of about strip 7. Yet despite this interfaces are remarkably well defined (usually $<$ 2 cm), conceivably as a result of often low human numbers and the rhythmic alternation of periods of occupation and absence. Observed disturbance due to other animal agencies was negligible, perhaps in part due to the low visibility of collapsed holes in the uncompacted sediments. However, small infilled depressions (diameter $\sim$15 cm ; depth $\sim$8 cm) and cavities (diameter $\sim$5 cm ; traceable length $\sim$5-15 cm), both sometimes associated with vegetation, were occasionally encountered during excavation and interpreted as rodent nests and burrows respectively. Details are as follows :

I.	1BS.UP.S	In S23 53-61 cm and S24 76-84 cm.
II.	1BS.LR	In R18 46 cm-1WA and R19 69 cm-1WA.
III.	1WA	In Q17, Q19-21 and S18 ?
IV.	2BS.UP	In R19.
V.	2BS.LR.A	In Q20.
VI.	3BS.LR.B	In S24.
VII.	1RGBS.	In C9 61-69 cm.
VIII.	1GBS.LR	In R20 and S20 (from Horton's Pit).
IX.	BACO.A	In T17 and S18 (from Horton's Pit).

1.5 Recovery and Processing

Actual excavation was, as a matter of policy, limited to the author and one other person, working usually in adjacent squares and with 15 cm trowels. Removed deposit was taken directly by bucket to one of the two to three 3 mm mesh sieves it was found possible to keep in continuous use. Each of these was manned by a team of four or five local labourers and one supervisor (Fig. 19). Each member of this group, bar the last-mentioned, was given the task of collecting all items larger than 3-4 mm in one particular fraction of the preserved debris. The following categories were used for this purpose: artefacts, bone, charcoal nodules, vegetation; and miscellaneous (feathers etc.). Impelements were packed in linen bags and the other groups in plastic packets, and a label was placed in and stapled onto each of these containers. Relevant stratigraphic data from the dig and frequency information (artefacts, spalls, etc.) from the sieves was verbally relayed by the persons in charge to the recorder for entry into the field notes.
The extreme scarcity of water locally and the hydrophobic nature of the

Fig. 19 Sorting through a sieve in 1970/1
Photograph by courtesy of A. Boshier

sediments precluded any on-site attempt at flotation analysis.

On returning from the field the collection was initially resorted and repacked in cardboard boxes and in 1972 processing was commenced with the help of 8-10 casually employed black women working under constant supervision at the Museums of Man and Science according to the following procedures:

(a) The primary data categories (listed above) were checked and mis-identifications were correctly placed.

(b) Flaked artefacts were separated from other groups (e.g. sherds) and then sorted into silicate and non-silicate fractions.

(c) 'Bone' fragments were separated into macrofauna, microfauna, ostrich eggshell and mollusc classes.

(d) Vegetation was separated into 'modified', seeds, and 'other'.

(e) Miscellaneous was separated into feathers, coprolites and 'other'.

(f) Absolute numbers for each group in (a)-(e) were totalled by means of tally counters and this information was recorded on the appropriate data sheets.

(g) All categories, bar vegetation, were cleaned, either by rinsing only, or when necessary, by scrubbing with a wire shoebrush in water.

(h) The artefacts and larger bones were all marked, except when size or surface precluded this. Details on each comprise square number, level acronym (some since changed) and the site catalogue number (MM1.71).

From 1973 onwards the entire collection was gradually moved for final analysis to the Bernard Price Institute for Palaeontological Research where:

(a) The microfauna and shell categories were analysed to establish percentage charring;

(b) The macrofauna, vegetation and charcoal nodules samples were weighed, mainly on a torsion balance and to the nearest gram.

(c) The macrofauna and microfauna was sorted, largely by various zoology vacation students, into 'identifiable' and 'unidentifiable' fractions.

On completion (in most cases) of these processing procedures the various categories were submitted to the following specialists for their detailed analysis and/or identification:

(a) Hominid samples to H. de Villiers.

(b) Macrofaunal samples to J. Kitching and R.G. Klein.

(c) Microfaunal samples to G. de Graaff.

(d) Land mollusc samples to I. Plug.

(e) Feather samples to R. Savile-Davis.

(f) Hair samples to G. de Beer.

(g) Coprolite samples to J. Kitching and J. Maguire.

(h) Floral samples to J. Anderson.

(i) Pollen samples to E.M. van Zinderen Bakker and A. Horowitz

(j) C-14 samples to J.L. Bada, R.R. Protsch and J.C. Vogel.

(k) TL samples to J.H. Fremlin.

(l) Fission track samples to K. Stammers.

(m) Amino acid samples to J.L. Bada.

(n) F.U.N. samples to T. Molleson, K.P. Oakley and R. Protsch.

(o) $^{13}C/^{12}C$ samples (vegetation and bone) to J.C. Vogel.

(p) NaCl samples to W.S. Rapson.

(q) Sediment samples to K.W. Butzer.

(r) Notched artefact samples to A. Marshack.

2. THE ARTEFACTS

2.1 Sample Derivations

The 65,387 items analysed comprise:

(a) All the specimens from Exc. 3A Rear.

(b) All the specimens from 1BES in Exc. 3A Front.

(c) All the specimens from 1RBS and 1RGBS in Exc. 3B.

(d) All the specimens from spits C7 91-114 cm, C8 107-130 cm, and C9 114-145 cm, taken to define BACO.B.

(e) All the specimens from spits C7 114-145 cm, C8 130-152 cm, and C9 145-168 cm, taken to define BACO.C.

(f) All the specimens from spits C7 145 cm - Bedrock, C8 152 cm - Bedrock, C9 168 cm - Bedrock, D7 160 cm - Bedrock, D8 150 cm - Bedrock, and D9 168 cm - Bedrock, taken to define BACO.D

In addition it was found desirable to study:

(a) All the specimens from S16 160-175 cm, S17 160-175 cm, T16 160-175 cm, and T17 160-183 cm, in order to supplement the 1GBS.UP sample from Exc. 3A Rear.

(b) All the specimens from S16 221 cm - Bedrock, S17 213 cm - Bedrock, T16 221 cm - Bedrock, and T17 213 cm - Bedrock, in order to supplement the BACO.A sample from Exc. 3A Rear.

2.2 Technological Analysis : Procedures

Primary grouping was on the basis of the broadly defined technological processes through which man effected the transformation of available naturally-occurring raw materials with selected characteristics (e.g. good flaking capability) into preconceived functionally desirable forms by way of some form of energy input (muscle, heat). This scheme (Schoonraad and Beaumont, 1968) enables shifts with time in the relative emphasis on the various identified processes to be readily quantified and achieves a separation of forms which are functionally similar or identical but which were produced by very different approaches (e.g. ostrich eggshell and glass beads).

The major processes identified at this site, believed to represent a developmental hierarchy in the order given, are : flaking; cutting and/or grinding; fusion and/or smelting; Artefacts were always assessed, in the few relevant instances, on the basis of the most advanced method used in their manufacture. It was found that:

(a) An overwhelming 99.4% of the artefacts derive from the flaking process.

(b) A miniscule 0,6% of the artefacts relate to the other 'non-flaking' processes.

2.3. Typological Analysis : Procedures

Secondary sorting was on the basis of various intuitively recognised typological categories, which are believed to approximate to those actually produced in functional response to aspects of the external world, within limits ultimately imposed by the then prevailing level of technological development. According to this scheme the relative abundances of some tool types would reflect the varying extents to which certain activities were induced by the interaction of local cultural and environmental parameters during the timespan represented by the aggregate under consideration. A definition is offered for each indentified class amongst the stone artefacts but not for the 'non-flaked' forms which accord in all cases with accepted usage. In formulating the former the author has tried as far as possible to rely on 'all or nothing' criteria which facilitate reproducible results and minimize marginal cases.

2.3,1 Tools 1

This group comprises all absolutely unbroken retouched artefacts and constitutes the 'formal tool' category of most workers. It is divisible into the following classes :

2.3.1.1 Scrapers

Forms in which steep and deep retouch is focussed on a margin abutting on a flat surface, usually a flake ventral. Edge plan-form permits the following subclasses to be isolated:

(a) Straight-edged. One or more straight retouched edge.

(b) Convex-edged. One or more convex retouched edge.

(c) Irregular-edged. One or more discontinuous retouched edge.

(d) Compound. A combination of any of the previous categories.

2.3.1.2 Trimmed points 1

Forms in which steep and abrupt retouch was directed at obtaining or enhancing a point. The following subclasses can be isolated:

(a) Defining. Retouch usually limited to the tip or to portion of one or both margins in order to improve point symmetry.

(b) Convergent. Two retouched margins converging at the flake distal end to produce a point.

(c) Oblique. One retouched edge running obliquely to the flake percussion axis to form a point where it intersects the other, untrimmed margin.

2.3.1.3 Trimmed points 2

Forms in which shallow invasive retouch was directed at obtaining or enhancing a point. The following subclasses can be isolated:

(a) Unifacial. Retouch limited to either the ventral or the dorsal.

(b) Bifacial. Retouch occurs on both the ventral and the dorsal.

2.3.1.4 Backed pieces 1

Forms in which steep and abrupt retouch is asymmetrically disposed along a margin opposite a usually straight cutting edge. The following subclasses can be isolated:

(a) Curve-backed. Retouch on the distal end of that margin.

(b) Irregular-backed. Retouch along discontinuous portions of that margin.

2.3.1.5 Backed pieces 2

Forms in which steep and abrupt retouch is symmetrically disposed along a margin opposite a usually straight cutting edge. The following subclasses can be isolated:

(a) Segment. Retouch along all or part of one margin to form an arc which intersects the cutting edge.

(b) Trapeze. Retouch absent or straight along one margin bar the ends where it is oblique to the cutting edge.

2.3.1.6 Modified butts

Forms in which the butt has been altered or reduced largely or entirely by steep abrupt retouch. The following subclasses can be isolated:

(a) Point. Butt modification based on a plain or trimmed point.

(b) Miscellaneous. Butt modification on any other shape.

2.3.1.7 Denticulates

Forms in which deliberately discontinuous retouch was applied to produce a serrated edge.

2.3.1.8 Other

Forms not ascribable to any of the previously mentioned categories.

2.3.2 Tools 2

This group comprises all absolutely unbroken artefacts largely shaped by secondary flaking which is not retouch. The first class is rare and the second is anomalous and often difficult to distinguish from bipolar cores.

2.3.2.1 Burins

Forms with secondary flaking from some trimmed, snapped or natural margin to produce a narrow chisel-like edge having a breadth usually determined by artefact thickness.

2.3.2.2 Scaled pieces

Forms typically show a fairly broad, stout, bruised and concave gouge-like edge at the intersection of two often step-flaked faces on a flake or slab. It equates with the more widely used terms outils écaillés or pièces èsquillées (cf. Deacon 1972). The following subclasses can be isolated:

(a) Single-edged. One edge on the flake or slab.
(b) Double-edged. Two edges on the flake or slab. Usually but not always on opposite ends.

2.3.3 Untrimmed flakes

This group comprises all unretouched flakes (s.l.) with maximum dimensions (see 2.7) entirely unaffected by breakage. No primary separation was effected on the basis of either size (e.g. Kleindienst 1961) or macroscopic utilization state (e.g. Sampson 1972).

Terminology is as follows:

(a) A straight line following the crest of a flake ventral surface usually intersects the present or former edge of the striking platform at an approximate right-angle and is here termed the positive percussion axis (+ Pe).
(b) A straight line following the base of a flake scar-bed usually intersects the present or former edge of the striking platform at an approximate right-angle and is here termed the negative percussion axis (- Pe).

Flake classification is as follows:

(a) A primary grouping based on a presumed technical hierarchy of the only possible basic plan-form categories.

(b) A secondary grouping based on the degree to which plan-form within each of the previous categories was predetermined by co-ordinated + Pe and -Pe relationships.

The resultant scheme is as follows:

2.3.3.1 Irregulars (I)

Forms in this series have irregular plan-forms and developed members show no set relationship between the +Pe and particular -Pe axes. The following subclasses can be isolated:

(a) Irregular 1 (a). Flakes in which all three maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(b) Irregular 1 (b). Flakes in which one or two maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(c) Irregular 2. Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded (Fig. 20).

2.3.3.2 Blades (B)

Forms in this series have quadrilateral plan-forms and developed members show -Pe axes, directed from one or more striking platforms parallel to the +Pe axis. The following subclasses can be isolated:

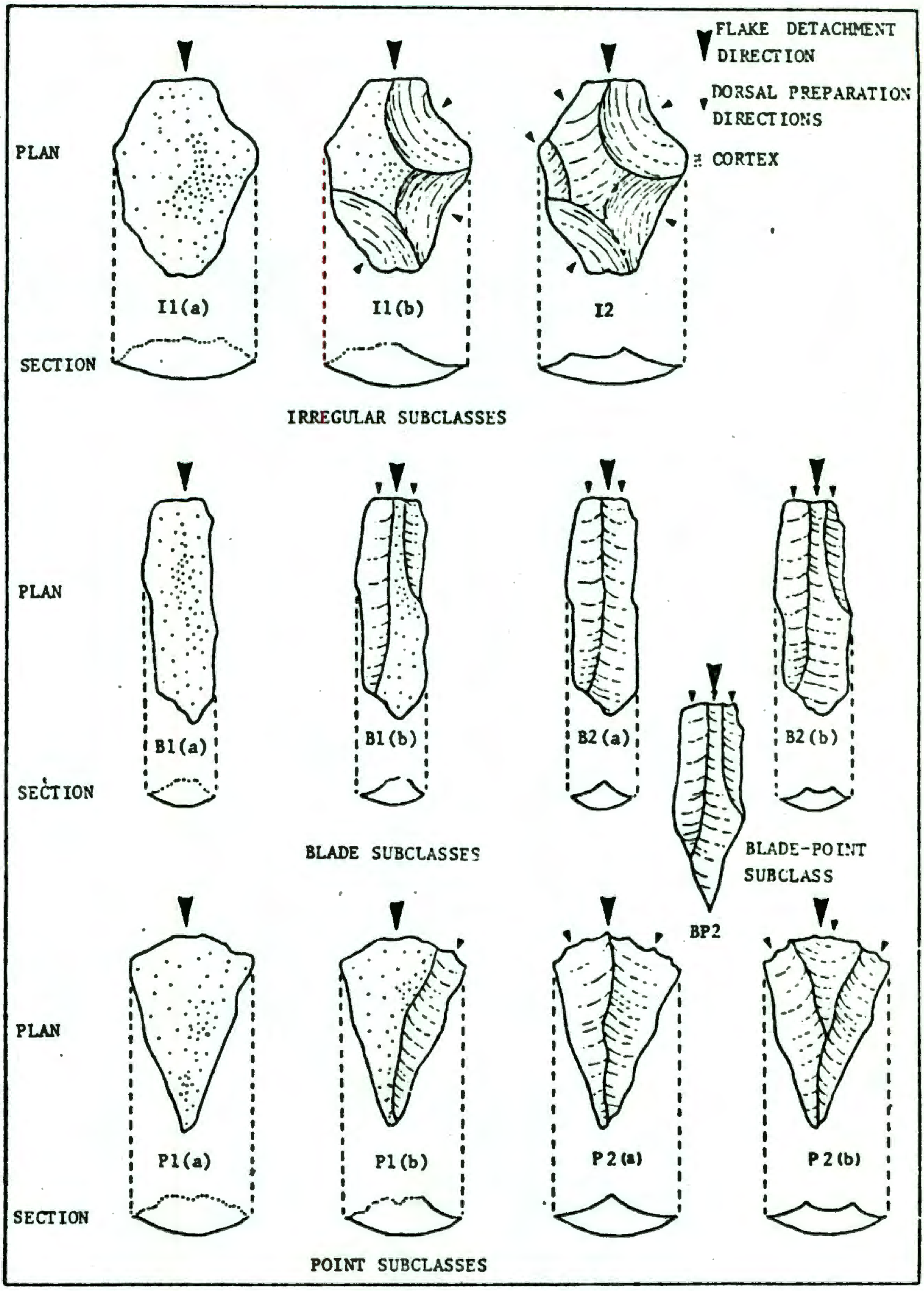
(a) Blade 1 (a). Flakes in which all three maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(b) Blade 1 (b). Flakes in which one or two maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(c) Blade 2 (a). Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded. Specific configuration is partly or entirely determined by only two scar-beds (Fig. 20).

(d) Blade 2 (b). Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded. Specific configuration is partly or entirely determined by more than two scar-beds (Fig. 20).

FIG. 20 FLAKE CLASSIFICATION



2.3.3.3 Points (P)

Forms in this series have triangular plan-forms and developed members show -Pe axes directed from a single striking platform on both sides of and convergent upon the distal end of the +Pe axis. The following subclasses can be isolated:

(a) Point 1 (a). Flakes in which all three maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(b) Point 1 (b). Flakes in which one or two maximum dimensions on the dorsal side are partly or entirely determined by cortex surfaces, the platform being excluded (Fig. 20).

(c) Point 2 (a). Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded. Specific configuration is partly or entirely determined by two scar-beds (Fig. 20).

(d) Point 2 (b). Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded. Specific configuration is partly or entirely determined by more than two scar-beds (Fig. 20).

2.3.3.4 Blade-Points (BP)

Forms in this minor series show B class -Pe axis orientations but P class type plan-forms. The following subclass was isolated:

(a) Blade-Point 2 : Flakes in which all three maximum dimensions on the dorsal side are entirely determined by flaked surfaces, the platform being excluded (Fig. 20).

Specific criteria followed during analysis were:

(a) Flakes which fulfil some but not all of the B or P class definitions were relegated to the appropriate I subclass.

(b) The terms quadrilateral and triangular in the B, P, and BP class definitions were taken to mean a tendency to approximate to those shapes rather than a precise concordance with them.

(c) The term parallel in the B and BP class definitions was taken to mean that maximum deviation between any two -Pe axes should be no more than about 20°.

(d) The term 'partly determined' in the B2 (b) and P2 (b) definitions was taken to mean that the relevant arrises traversed at least 25% of total flake length.

The following unretouched flake attributes were also analysed:

2.3.3.5 Platform state

Butts were classed on the basis of the following criteria:

(a) Class 1. Platforms show cortex and/or a flaked surface with no clear scar-bed orientation relative to the ventral edge.

(b) Class 2. Platforms show two or more facets (counted) running the full width of and at about right-angles to the ventral edge.

(c) Class 3. Platforms are absent or too small to ascribe with certainty to either of the two previous classes.

2.3.3.6 Edge state

The presence or absence at the macroscopic level of incidental modification as a result of utilization-scarring and/or post-depositional damage was used to define the following classes:

(a) Class 1. Absent

(b) Class 2a. Present. Covers 0-12,5% of total edge length.

(c) Class 2b. Present. Covers 12,5-25% of total edge length.

2.3.4 Cores

This group comprises all nuclei whose primary purpose was seemingly to provide flakes. Classification of such items was based on process rather than on form. The following categories are identifiable:

2.3.4.1 Irregular

Forms show removal of flakes from convenient edges but reveal no constant relationship between these.

2.3.4.2 Bipolar

Forms show flaking from one or more unrelated edge and spalling and/or bruising on opposite ends as a result of anvil contact damage (Cooke, 1969).

2.3.4.3 Adjacent platform

Forms show alternating detachments from one or more resultantly sinuous edge, the scar-bed of the previous removal serving as the platform for the next.

2.3.4.4 Radial prepared

Forms show preparation along part or all of the nucleus periphery and a subsequent suite of removals over one face from the platform so provided. The following subclasses can be isolated on the basis of form and scar intersection pattern:

(a) Discoidal. Irregular arrises and sub-circular plan-forms are characteristic.

(b) Blade. Parallel arrises and crudely quadrilateral plan-forms are characteristic.

(c) Triangular. Convergent arrises and crudely triangular plan-forms are characteristic.

2.3.4.5 Plain platform

Forms show multiple removals from one or more unprepared platform.

2.3.5 Waste 1

This group comprises all broken forms certainly ascribable to Tools 1 and 2. Only one class is represented, namely:

2.3.5.1 Broken tools

These items show clear traces of secondary work. This class is divisible into the subclasses listed below. Broken scaled pieces cannot normally be clearly distinguished from bipolar cores and possible instances have been included in that core class.

(a) Scraper. Items certainly ascribable to that class.

(b) Trimmed point 1. Items certainly ascribable to that class.

(c) Trimmed point 2. Items certainly ascribable to that class.

(d) Backed pieces 1. Items certainly ascribable to that class.

(e) Backed pieces 2. Items certainly ascribable to that class.

(f) Modified butt. Items certainly ascribable to that class.

(g) Miscellaneous. Items too fragmented to be confidently placed in any of the above subclasses.

2.3.6 Waste 2.

This group comprises all other broken items and aberrant forms. The following categories are identifiable:

2.3.6.1 Atypical flakes

Forms do not conform in some aspect of morphology with normal flakes. The following subclasses can be isolated:

(a) Rejuvenation. Flakes resulting from the preparation of a new striking platform on a core. Synonyms are core-crests and redirected flakes.

(b) Malforms. Flakes show distorted bulbs, ventral surfaces, or dorsal scar-beds, often as a result of raw material flaws. Included here were underhinged and overhinged items (cf. Hassan in Anon, 1972).

2.3.6.2 Broken flakes

Forms show perceptible distortion of one or more maximum dimension as a result of breakage. The following subclasses can be isolated:

(a) Proximal. Broken transversely and showing the entire bulb or longitudinally but including the major portion of the bulb/the point of percussion.

(b) Distal. Broken transversely and showing a convex ventral surface or longitudinally but excluding the major portion of the bulb/the point of percussion.

2.3.6.3. Unclassifiable

Forms which cannot be certainly ascribed to any of the previous classes in this scheme.

2.3.7 Utilized

This group comprises those primal forms which show selection for some inherent material characteristic and incidental damage resultant upon subsequent utilization. The following categories can be identified:

2.3.7.1 Hammerstones

Forms show bruising and sometimes fortuitous flaking on or from one or more surface on edge as a result of use for percussional purposes.

2.3.7.2 Grindstones

Forms show striations and/or smoothing on one or more surface as a result of grinding and/or polishing.

2.3.7.3 Pigment

Colouring matter foreign to the site and sometimes showing some evidence of use. The following subclasses can be isolated:

(a) Haematite, ground. Any grade. Striations present.

(b) Haematite, plain. Any grade. Breakage surfaces only.

(c) Miscellaneous, plain. All other. Breakage surfaces only.

2.3.7.4 Thorn

Barbs minus twig with breakage and/or damage of the tip, presumed to be as a result of their use as awls.

2.3.8 Admixture

This group comprises forms regarded as being in false or uncertain association with the aggregate from which they derive. The following exclusive categories can be identified.

2.3.8.1 Intrusive

Dubious association based on typological and/or patination differences between the specimen and contiguous artefacts.

2.3.8.2 Re-used

Dubious association based on patination differences on a given specimen which fall outside the range typical of the containing occurrence.

2.4 Raw Material Analysis : Procedures

The environment at any given time and place can be conceived of a containing a certain finite range of raw materials potentially suitable for artefactual purposes. Those which actually occur in a specific aggregate represent the surviving fraction of the then utilized portion within that spectrum. It is possible to subdivide those selected vestiges in terms of:

(a) A primary grouping based on physical criteria which may have had a meaning for the original tool-makers (e.g. chert, chalcedony, etc.).

(b) A secondary grouping based on the form in which those categories occur naturally in that area (e.g. pebbles and nodules, as opposed to slabs).

This possible structuring was in practice rather loosely applied to obtain the following categories:

2.4.1 Appendix 6 materials

Raw material classes are self-evident (wood, bone etc.), but the following details as to provenance are pertinent:

(a) Talcose schist was exclusively used for the production of bored stones and may derive from localised deposits at least 40 km to the west in the Basement granites and gneisses. However, the nearest extensive source would seem to be outcrops of the Swaziland System some 120 km and more north-west of Border Cave (Fig. 8).

(b) Seashells were exclusively used for the production of pendants and are all referred by G. Avery (pers. comm.) to Nassa kraussiana. This species is stated to be abundant in weedbeds at low tide in the muddy sand of estuaries (Day, 1968). The nearest habitat where those conditions would prevail occur about 80 km to the east, on the seaward fringes of the Tongaland Flats (Fig. 2).

(c) Tusks were exclusively used for the production of ground 'daggers' (Beaumont, 1973a) and are all referred by J. Kitching to Phacocherus aethiopicus.

2.4.2 Appendix 7 materials

Raw material classes are all well-defined and ascriptions are believed to be at least 95% accurate. Further subdivision may have been possible, but only at the expense of a major increase in imprecision. Definitions and provenances are as follows::

2.4.2.1 Rhyolite 1

Typically lightly porphyritic with small felspar insets in a microgranular groundmass and colour reddish-brown to deep grey. Outcrops locally but precise sources not located.

2.4.2.2 Rhyolite 2

Typically heavily porphyritic with large felspar insets in a medium-grained groundmass and colour dark brown to deep plum. Outcrops locally but precise sources not located.

2.4.2.3 Quartzite 1

Uniformly fine-grained with colour reddish-brown to dark grey. Comparable rocks occur as localized lenses interbedded in the lowermost levels of the lavas. One such occurrence was noted 100m east of the Canterbury Estates homestead, but most are seemingly in the Ngwavuma Poort area where the largest is recorded as being up to 8m thick, traceable for 16m along dip, and having lithological similarities to the Cave Sandstone (Archaeological Survey file B 20/1/2).

2.4.2.4 Quartz 1 + 2

Normal vein quartz and quartz crystal respectively. Presumably derived from lava amygdales, but these were not noted to occur within the general vicinity of the cave ($\sim$1 km radius).

2.4.2.5 Chalcedony

Low-grade white and grey varieties predominate, while a small fraction may in fact be chert. This class was not noted in the site area but is known to occur abundantly ~ 15 km to the east and south-east, on the lower dip slope of the Lebombo. A collection purchased from a roadside vendor in that region included a flaked (chert?) slab with a scar-bed morphology most typical of the M.S.A.

2.4.2.6 Additional

Those rocks not ascribable to the previous categories. It includes token amounts of dolerite and low-grade obsidian, a fairly large fraction of unidentified materials, but is mainly comprised of medium-grained white sandstone or quartzite showing cobble cortex. This rock was undoubtedly obtained from gravel terraces dominated by quartzites and hornfelses which are sporadically exposed immediately alongside the river in the examined stretch between Nsoko and the Ngwavuma Poort (Fig. 21). It presumably ultimately derives from the 'Rooi Rand' outcrops of the Molteno some 20 km further west (Hunter, in Explanatory notes to accompany sheet 273 1 BB Geol. Survey and Mines Dept., Swaziland).

2.4.2.7 Pigment

These fragments may be exclusively of local derivation but those which are of high quality and/or rich in specularite may well come from the M.S.A. working at Lion Cavern, Ngwenya (Beaumont, 1973b).

2.4.2.8 Thorns

All or most were probably broken from branches of Acacia karroo, a species presently confined to the lower scree slopes at the base of the escarpment (Appendix 1; Fig. 22).

2.5 Analytical Results. Raw Data

The raw data obtained by means of this threefold analytical scheme are detailed in Appendices 6 and 7. The following comments amplify aspects of that information:

(a) Notched items. A description and interpretation of these forms may be found in Appendix 8.
(b) Bored stones. One of these fragments has presumably decorative incised lines radiating out from the orifice edge on one side (Fig. 23).

Fig. 21 Gravels on south bank of the Ngwavuma River about one kilometre east of road bridge near Nsoko.
Photograph by courtesy of the Archaeological Research Unit, University of the Witwatersrand, Johannesburg

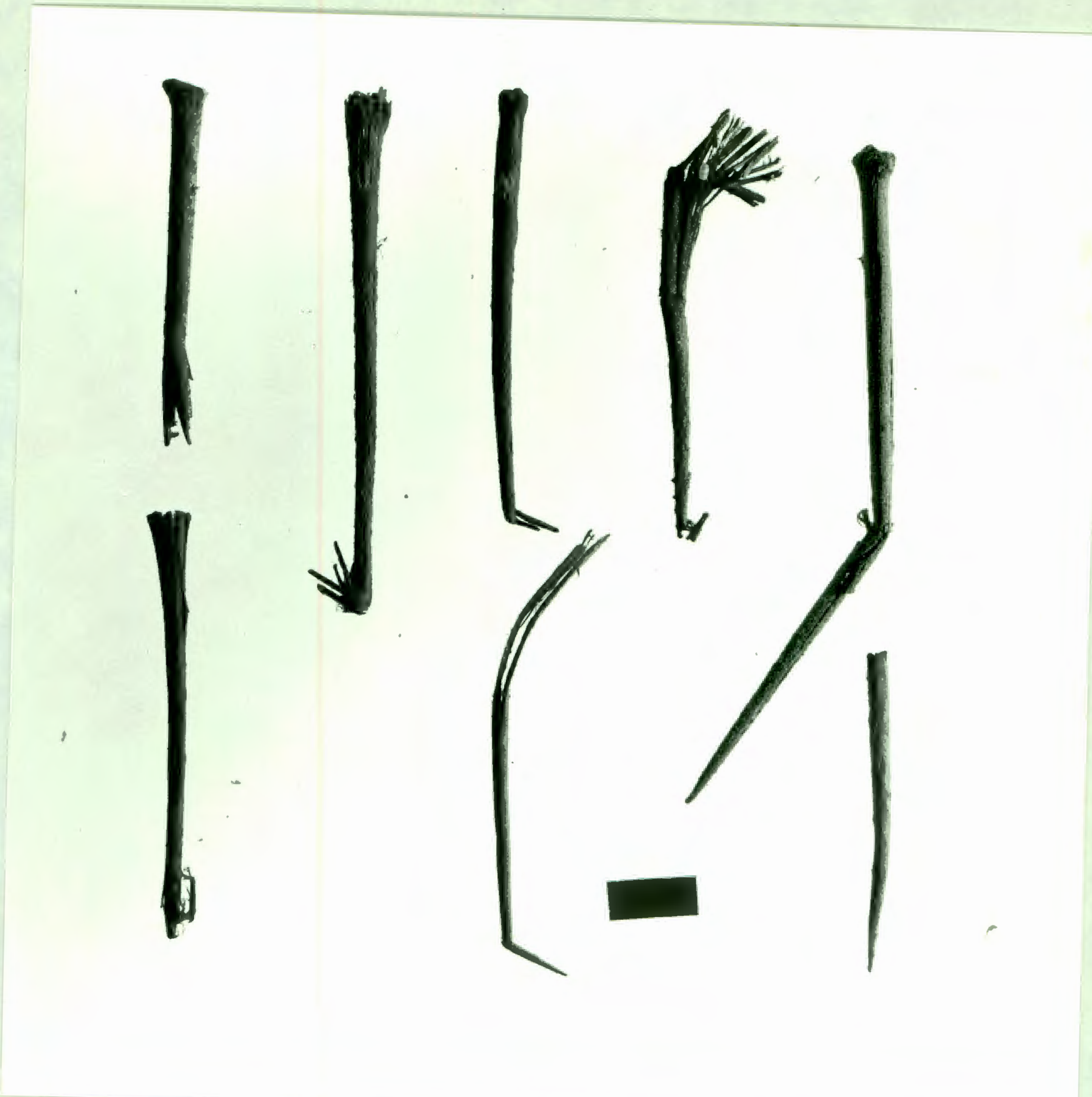


Fig. 22 Utilized cf. Acacia karroo thorns
Numbering from left to right
Top row, no. 1 : From Q19. 2BS.UP.
Top row, no. 2 : From Q19. 2BS.LR.
Top row, no. 3 : From S18. 2BS.LR.C
Top row, no. 4 : From S18. 2BS.LR.C
Top row, no. 5 : From S17. 107-114cm. 2BS.LR.
Bottom row, no.1: From Q19. 2BS.UP.
Bottom row, no.2: From S18. 2BS.LR.A+B
Bottom row, no.3: From Q19. 2BS.UP.

Photograph by D. Rokos

Fig.23 Portion of a small talcose schist bored stone with presumably decorative notches around outer edge of orifice on one side
From R16. 1WA
Photograph by P. Nagel

(c) Seashell pendants. It was not possible to establish if the perforations were in all cases purely artificial (Fig. 24).

(d) Tusk items. These were first split longitudinally and the inside face was then ground, according to J. Kitching (Fig. 25).

(e) Bone points. One of these appears to have been based on an echinoid spine, according to J. Maguire (Fig. 25).

(f) Eggshell beads. The two unfinished items suggest that piercing preceded periphery finish in the production of this sample (Wendt, 1972). Perforation was from the inside surface and is very variable in terms of size and roundness. The circumference is similarly unstandardized and specimens appear to have been ground individually without the aid of a grooved stone. Mean maximum dimension is 7,1 mm, with a range of 4,5-9,0 mm, based on a sample of 10. Figure 24 illustrates a number of the intact items and contrasts them with a relatively recent random sample from a 'Pottery L.S.A.' context. (Beaumont and Boshier, 1973).

(g) String and rope. Only short lengths were encountered and all came from the 1BS.UP.I.A.(Fig. 26).

(h) Basketry. Invariably produced by means of a combination of grass 'filler' and bark strips (Figs. 27 and 28).

(i) Sherds. Decoration was entirely by means of black burnishing, while lip profiles are plain and square or rounded. These features, based on tenuously deduced bowl and pot forms, suggest ceramics very similar to modern Swazi wares (Beaumont,1973a). Burnished rim/body proportions are high, suggesting that application was not uniformly distributed on container surfaces. Dimensional data is as follows (maximum size taken 'parallel' to face; thickness taken at sherd midpoint):

I. 1BS.UP.I.A. Sample = 149. Mean max. size = 46,1 mm. Mean thickness = 9,3 mm.

II. 1BS.UP.S. Sample = 12. Mean max. size = 41,9 mm. Mean thickness = 9,1 mm.

III. 1BS.LR. Sample = 11. Mean max. size = 40,9 mm. Mean thickness = 7,9 mm.

(j) Glass beads. The Exc. 3A Rear sample was dominated by:

I. Large opaque and often irregular pink ovates. Mean outside diameter 6,5 mm and sample size 11 (Fig. 29).

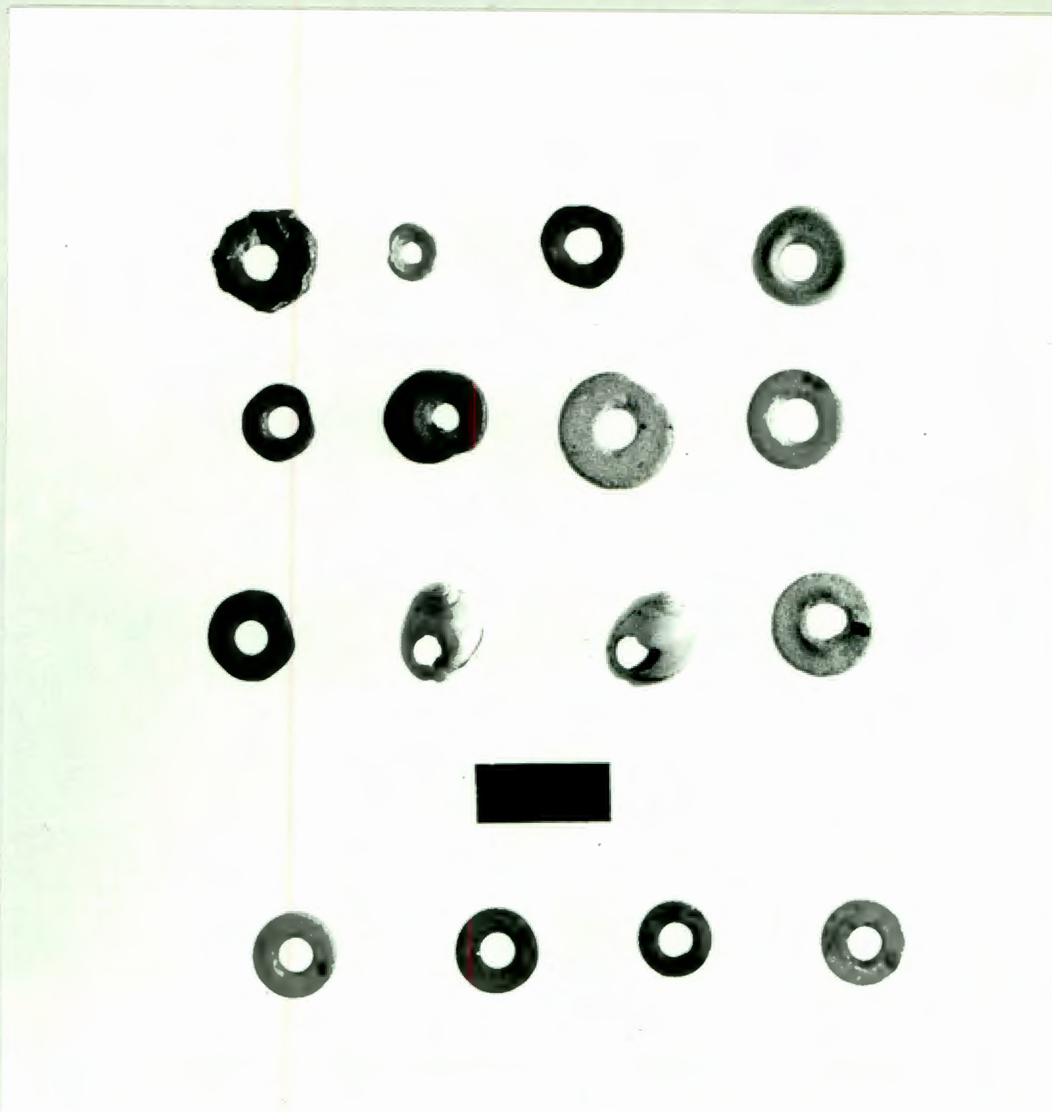


Fig. 24 Shell beads

Numbering from top to bottom and left to right

Row 1, no. 1 : From R19.1WA. Ostrich. Incomplete
Row 1, no. 2 : From R24 76cm.-1WA.1BS.LR. Ostrich. Complete
Row 1, no. 3 : From Q24.1WA. Ostrich. Complete
Row 1, no. 4 : From Q24.1WA. Ostrich. Complete
Row 2, no. 1 : From T19.1WA. Ostrich. Complete
Row 2, no. 2 : From S19.1WA. Ostrich. Complete
Row 2, no. 3 : From S23. 76cm.-1WA.1BS.LR. Ostrich. Complete
Row 2, no. 4 : From S22 76-84cm. 1BS.LR. Ostrich. Complete
Row 3, no. 1 : From T19. 1WA. Ostrich. Complete
Row 3, no. 2 : From R18. 1WA. Nassa. Perforated
Row 3, no. 3 : From S19. 53cm.-1WA.1BS.LR. Nassa. Perforated
Row 3, no. 4 : From Q24.1WA. Ostrich. Complete
Row 4, 1-4 : From 7L 46-53cm at Doornfontein M82 near Postmasburg dated to AD. 830 (Beaumont and Boshier, 1973)

Seashell identifications by G. Avery

Photograph by D. Rokos

Fig. 25 Ground bone objects
Numbering from left to right:
Top left, no. 1 : From Q23 76cm.-1WA.1BS.LR. Echinoid spine?
Top left, no. 2 : From T20 69cm.-1WA.1BS.LR. Bone point
Top right : From Q16 61cm.-1WA.1BS.LR. Warthog tusk item
Centre right : From R20. 2BS.LR.C. Warthog tusk 'dagger'
Bottom : From S23. 2BS.LR.C. Warthog tusk 'dagger'.

Assembled from seven fragments by J. Kitching

Skeletal part identifications by J. Kitching and J. Maguire

Photograph by D. Rokos

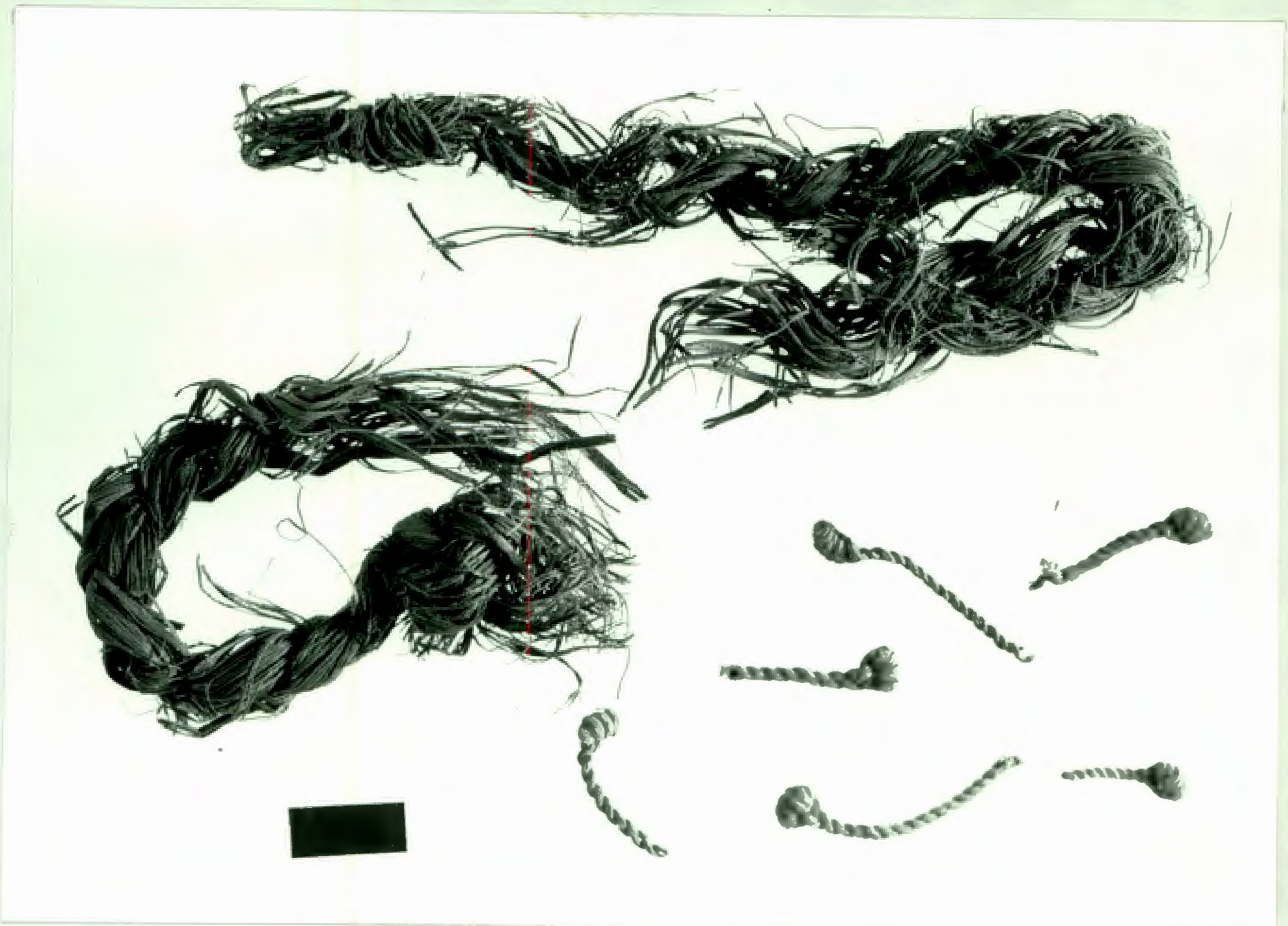


Fig. 26 Pieces of rope and string; numbering from top to bottom:

Row 1 : From R24 15-23cm. 1BS.UP. Iron Age. Rope fragment

Row 2, left : From T22 15-23cm. 1BS.UP. Iron Age. Rope fragment

Row 2, right : From R20. 23-38cm. 1BS.UP. Iron Age. Six string fragments

Photograph by D. Rokos

Fig.27 Woven grass and bark carrying ring.
From T 13-15. 1BS. Slumped. Presumably Iron Age.
Photograph by G. Smith

Fig. 28 Woven grass and bark bin lid
From R22 69-76cm. Pit.IBS.UP. Iron Age.
Photograph by D. Rokos

Fig. 29 Some smelted or fused items

Left: From 1BS.UP.Iron Age. Mainly small glass beads collected from the deposit surface in the southern part of the cave

Right, top: From T21, 7,5-15cm. 1BS.UP.Iron Age. Two strings of sequentially ordered pink, red, blue and black glass beads

Right, bottom: From R18 46cm - 1WA.1BS.LR.Disturbed. Large brass bead (outside diameter 20,5mm)

Right, bottom: From T22 0-7,5cm. 1BS.UP.Iron Age. Large brass bead (outside diameter 19,0mm)

Right, bottom: From R17 46cm - 1WA.1BS.LR.Disturbed. Aluminium NRC disc no. 1526

Right, bottom: From R26 15-30cm 1BS.UP.Iron Age. Four opaque pink glass? beads (outside diameter about 6,5mm)

Right, bottom: From T22 7,5-15cm. 1BS.UP.Iron Age. Three black and white striped glass beads (outside diameter about 3,5mm)

Photograph by D. Rokos

II. Small white and black strips on blue core ovates. Mean outside diameter 3,5 mm and sample size 8 (Fig. 29).

Almost all of the remaining sample from that trench was made up of 195 small pink, red, blue and black plain ovate glass beads which occur in patterned sequences on two string fragments recovered from square T21 in 1BS.UP.I.A. (Fig. 29). The specimens collected from the modern surface in the southern sector of the cave were mainly small and far more varied in colour, which include plain white, light and dark blue, red on white etc. (Fig. 29).

(k) Metal objects. The two items listed as copper beads are more probably brass. N.R.C. on the disc stands for National Recruitment Company (Fig. 29).

(l) Segments. Mainly based on blades and retouch exclusively from the ventral surface. Some chalcedony specimens show invasive trimming along the dorsal surface of the 'cutting edge'. Dimensions equate with those noted in other aggregates ascribed to the 'Second Intermediate' (Deacon, n.d.). Details are as follows:

I. 1RGBS.B - 3BS. Rhy. 1 + Qtzite 1. Sample = 16. Chord length mean 47,7 mm and range 29,0 - 62,5 mm. Max. height mean 17,5 mm and range 11,5 - 24,0 mm.

II. 1RGBS.B - 3BS. Chalcedony. Sample = 7. Chord length mean 30,6 mm and range 18,5 - 41,0 mm. Max. height mean 14,1 mm and range 8,5 - 19,0 mm.

2.6 Analytical Results : Relationships

The raw data for stone artefacts was variously manipulated in order to see if any serial trends with time could be established within or between the major typological classes. Only the most obtrusive of those actually isolated are discussed below. Relatively minor or inconsistent deviations from shift patterns were found to be very largely or entirely the result of inadequate sample size. Graphical extrapolations were in all cases based on a careful evaluation of this factor. In interpretative procedures, the position taken was that the explanation of a possible major and/or consistent anomaly in a given level was first to be sought in terms of non-random sampling and/or post-depositional damage. Only when these possibilities appeared inadequate was it deemed justifiable to consider the possibility of an 'intrusive' element.

In practice only the 1GBS.UP gave inconsistent readings on the basis of a number of indices. On tracing back it was found that most of the aberrant results came from an area associated with hammerstones in the rear portion of Exc. 3A Rear (Appendix 7). This is tentatively interpreted as a knapping site left by an individual whose craftmanship did not conform in many respects with the more random 'normal' sample from further foreward in the same stratum (Hill, 1978).

2.6.1 Temporal changes in formal tool class proportions

Pertinent data in this connection are listed in Appendix 9. Percentages were not calculated for samples of less than 20. Only 'All' category numbers are consistently large enough to be reasonably reliable. That information is given graphically in Figure 30. Comments are as follows:

(a) Scrapers and Backed pieces 1 are fairly evenly represented in all major raw material groupings.

(b) Trimmed points and Backed pieces 2 are seemingly largely based on Rhyolite 1 and Quartzite 1.

(c) Modified butts are entirely confined to Rhyolite 1 and Quartzite 1.

(d) Scaled pieces are almost exclusively based on Quartz and Chalcedony.

(e) Trimmed points, Backed pieces, and Modified butts are entirely absent from the 'Early L.S.A.' as represented by 1BS.LR + 1WA + 1BES.

(f) The partly concordant temporal distributions of Backed pieces 1 and 2 may indicate that the latter is a late refinement of the former.

(g) The perceptible decline of Trimmed points in precisely those levels in which Backed pieces appear, would seem to support the view that these are functionally equivalent classes (Clark, 1970).

2.6.2 Temporal changes in the proportion of formal tools relative to flake minimum numbers.

The latter grouping was calculated by combining all specimens in Tools 1, Untrimmed flakes, Waste 1, Atypical flakes and Proximal flakes. More than 99% of Tools 1 and Waste 1 items are certainly based on entire or partial flakes and no fragments show duplication. Pertinent data are fully listed in Appendix 10. Percentages were not calculated for flake minimum numbers of less than 40. Results relating to the 'All' category are given graphically in Figure 31. Comments are as follows :

(a) The proportion of formal tools varies with material, being seemingly lowest in Rhyolite 2, similar in Rhyolite 1 and Quartzite 1, and highest in Chalcedony.

FIG.30 FORMAL TOOL PROPORTION CHANGES WITH TIME

BORDER CAVE EXC 3A + 3B

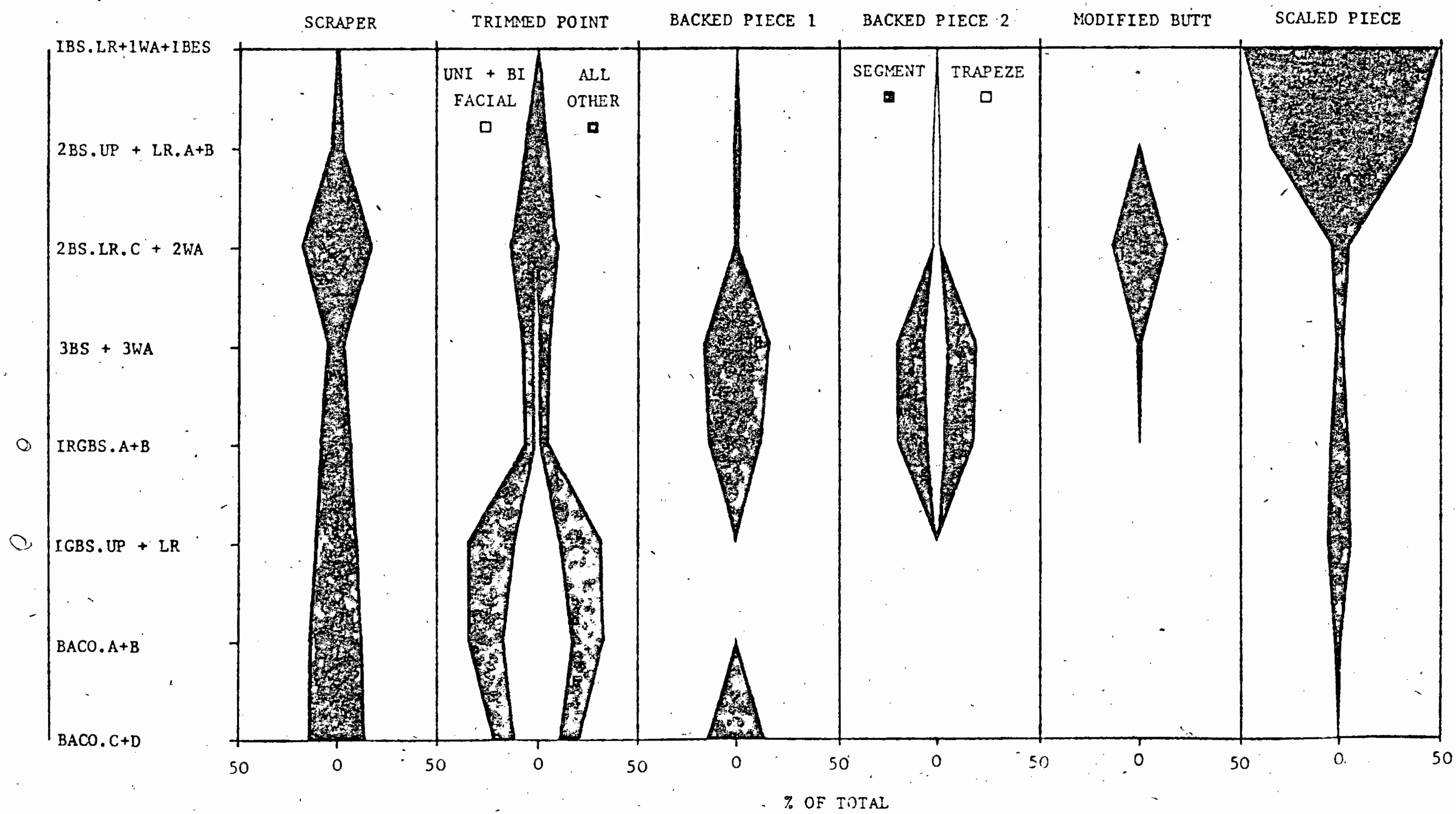
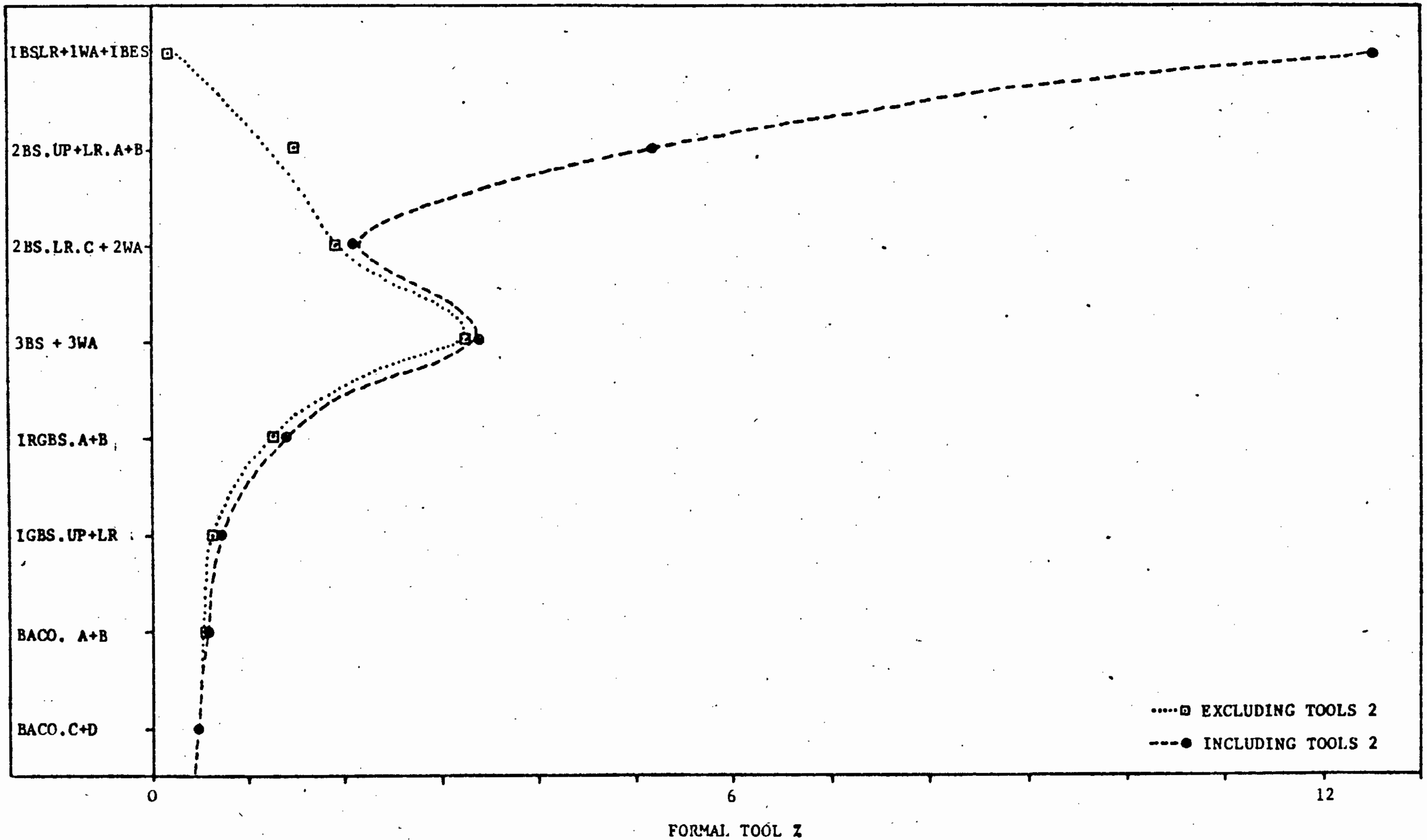


FIG.31 FORMAL TOOL/FLAKE MINIMUM NO. PROPORTION CHANGES WITH TIME IN TOTAL SAMPLES

BORDER CAVE. EXC. 3A + 3B



(b) The proportion of formal tools subsequent to 2BS.LR.C + 2WA depends on the precise status accorded to Scaled pieces (eg. van Noten, 1977:35).

2.6.3 Temporal changes in the proportion of Blade and Point classes relative to total Untrimmed flakes.

Pertinent data are fully listed in Appendix 11. Percentages were not calculated for Untrimmed flake samples of less than 40. Results relating to the Rhyolite 1 + Quartzite 1 groupings are given graphically in Figure 32. Comments are as follows:

(a) Points are markedly and consistently underrepresented in Chalcedony and this may partly explain their paucity in certain levels (Fig. 38).

(b) Rhyolite 1 + Quartzite 1 Blade proportions fluctuate markedly but there is a broad tendency for values to decrease away from 3BS+3WA.

(c) Rhyolite 1 + Quartzite 1 Point proportions fluctuate markedly but there is a broad tendency for values to decrease subsequent to BACO.D.

(d) Figure 32 suggests the presence of possibly four zones typified by concordantly low values for Blades and Points. The two of these isolated by means of stippled lines and arbitrarily taken to zero are based on an evaluation of data from individual units within those stratum groupings. Levels with 'anomalously' low readings were taken to be BACO.B, 1GBS.UP, 3BS.UP, and 1BS.LR + 1WA + 1BES. These all equate broadly with established spall horizons, suggesting that frequency shifts in Blades and Points may relate in some way to environmental changes induced by temperature (Appendix 54). It is unfortunate that the small sample associated with Eboulis 2 precluded any certainty as to whether the same relationship holds true for 2BS.LR.B.

2.6.4 Temporal changes in faceting proportions within the Irregular 2 subclass

Pertinent data are fully listed in Appendix 12. Percentages were not calculated for Platform state 1+2 samples of less than 40. Results relating to the Rhyolite 1 + Quartzite 1 grouping are given graphically in Figure 33. Comments are as follows:

(a) Faceting proportions appear to be broadly similar for all major raw material categories in any given aggregate.

(b) The broad outline of shifts between BACO.D and 2BS.UP+LR.A+B can be ascribed, in view of subsequent metrical evidence (Fig. 44), to changes in butt thickness and thereby in platform width, with consequent probability differences of intersecting a core preparation facet (Daniels, 1967).

FIG. 32 B1 + B2 AND P1 + P2/UNBROKEN FLAKE TOTAL PROPORTION CHANGES WITH TIME IN RHYOLITE 1 + QUARTZITE 1

BORDER CAVE. EXC.3A + 3B

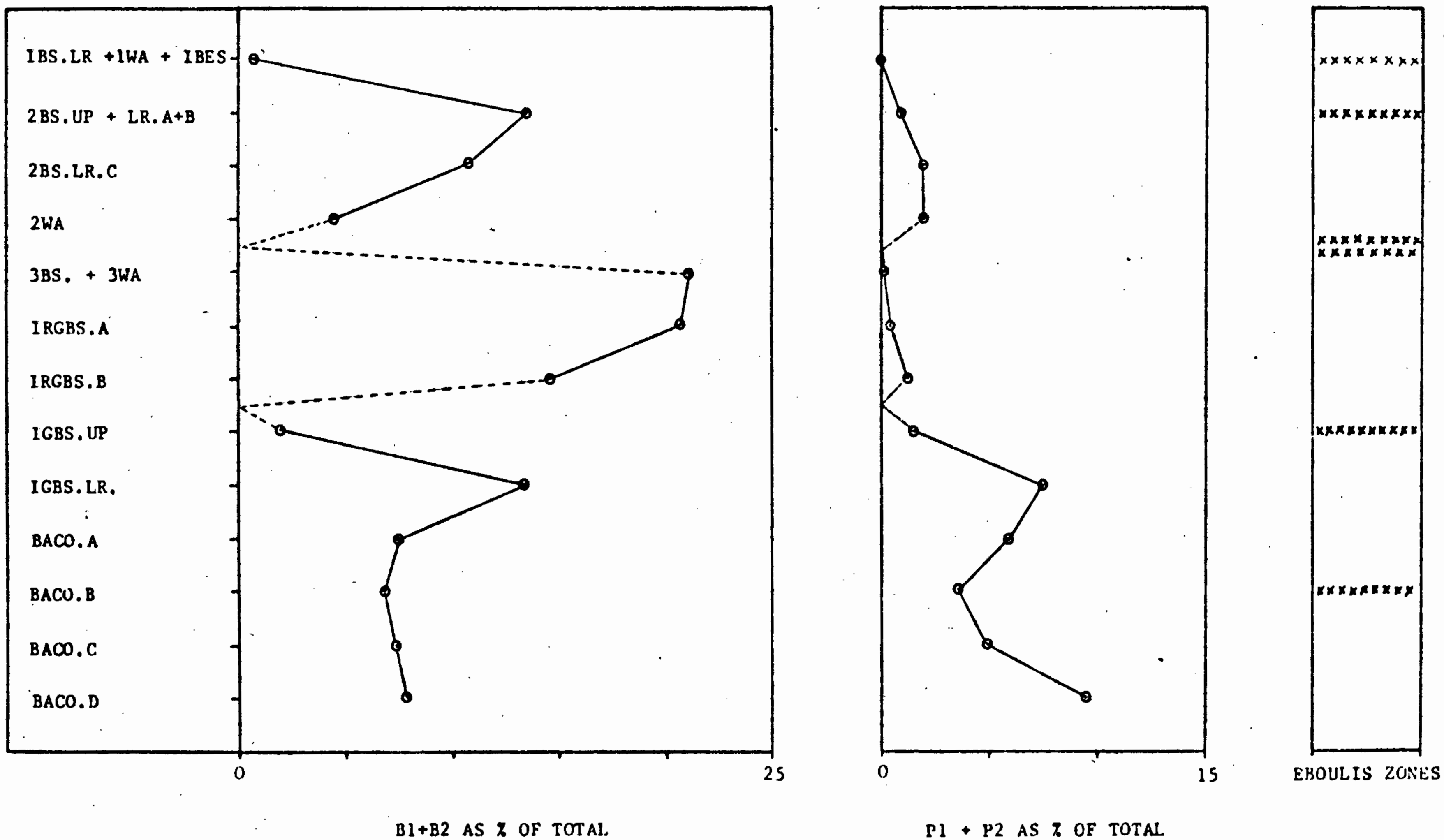
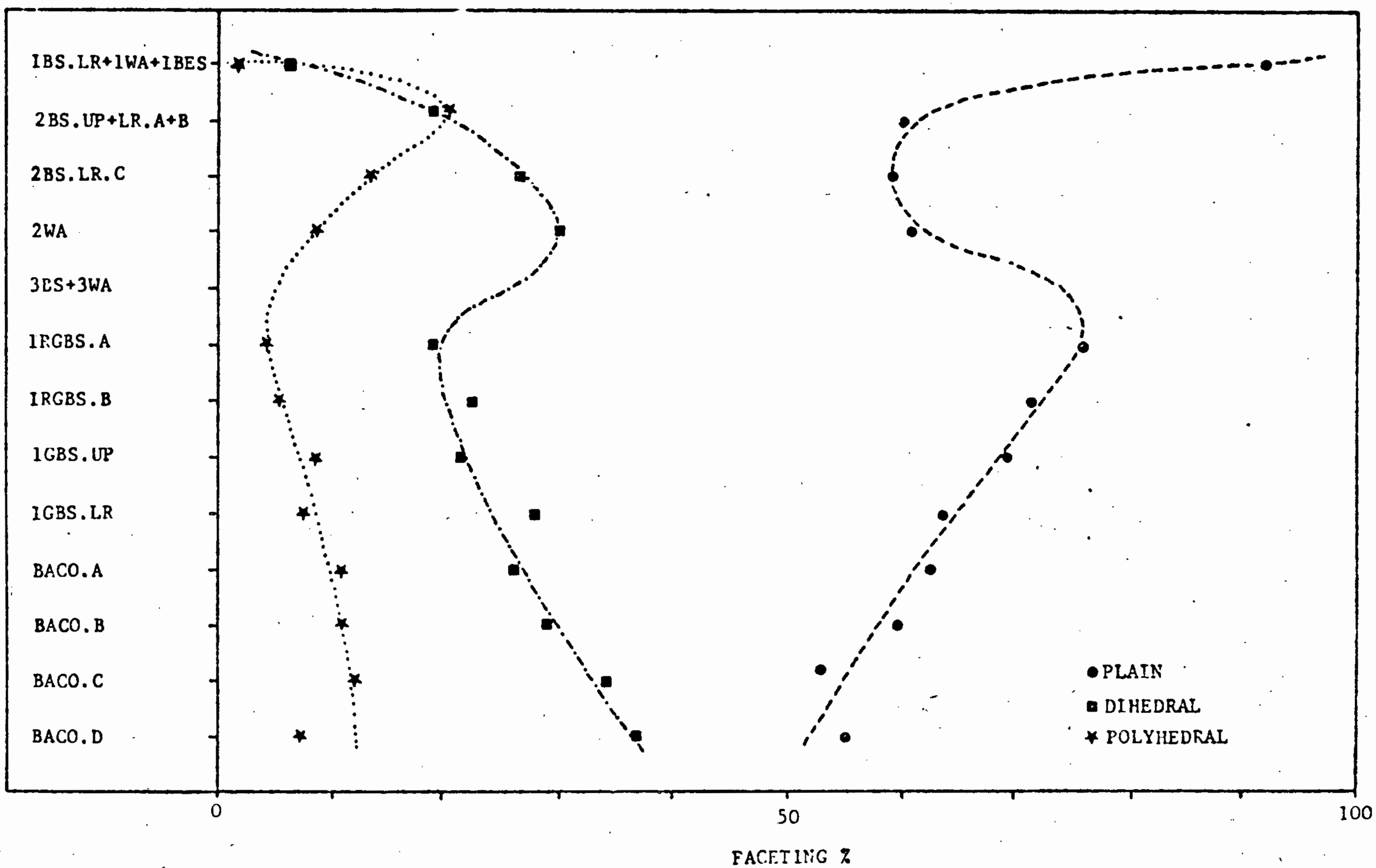


FIG.33 FACETING PROPORTION CHANGES WITH TIME IN RHYOLITE 1 + QUARTZITE 1.12 SUBCLASS

BORDER CAVE. EXC. 3A+3B



(c) An analysis was carried out to see how faceting proportions varied with artefact size in a given typological and raw material class. Data in this connection are fully set out in Table 2, and from that it can be seen that a ~46% increase in artefact breadth correlates with a ~69% increase in faceting percentage (excluding Class 3), thus corroborating the deduction in (b).

2.6.5 Temporal changes in the proportion of unretouched unbroken flakes relative to unretouched broken plus unbroken flakes

Values for the former were obtained by combining all Untrimmed flakes and Atypical flakes, and for the latter by also adding Proximal flakes. Pertinent data are fully listed in Appendix 13. Percentages were not calculated for total samples of less than 40. Results relating to the Rhyolite 1 and Chalcedony categories are given graphically in Figure 34. Comments are as follows :

(a) Breakage could have taken place during manufacture, as a result of use, or subsequent to the specimen being lost or discarded.

(b) The unbroken flake proportion is consistently lower for Rhyolite 1 relative to Quartzite 1. Yet these categories are of similar induration and flakes based on them are metrically identical (Appendix 19). A possible explanation in this case could be a statistical difference between them in inherent flaw content.

(c) There is an as yet inexplicable inverse relationship between the courses followed by Rhyolite 1 and Chalcedony. It was anticipated that values for both would vary in accordance with those of relative flake thickness (Fig. 44). But for some reason the exact opposite holds true in the case of Chalcedony.

2.6.6 Temporal changes in core class proportions

Pertinent data are fully listed in Appendix 14. Percentages were not calculated for samples of less than 20. Results relating to the Rhyolite 1 + Quartzite 1 grouping are given graphically in Figure 35. Comments are as follows :

(a) Core class proportions differ markedly between Rhyolite 1 + Quartzite 1 and Chalcedony.

(b) The M.S.A. levels between BACO.D and 2BS.UP show the culmination and decline of the Radial prepared class and the final replacement of the Adjacent platform class.

FIG.34 UNBROKEN/TOTAL FLAKE PROPORTION CHANGES WITH TIME

BORDER CAVE. EXC. 3A + 3B

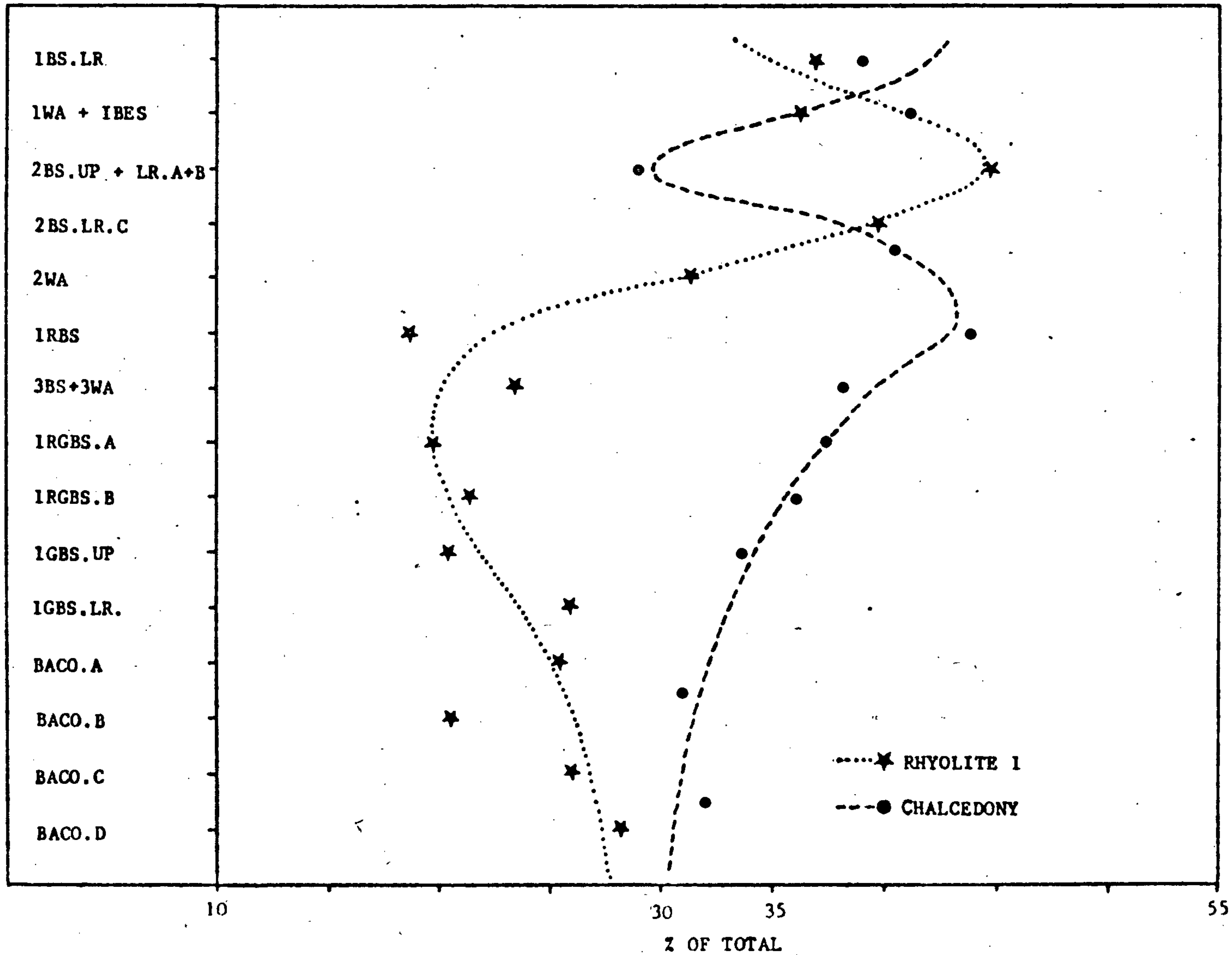


FIG. 35 CORE CLASS PROPORTION CHANGES WITH TIME IN RHYOLITE 1 + QUARTZITE 1

BORDER CAVE. EXC.3A+3B

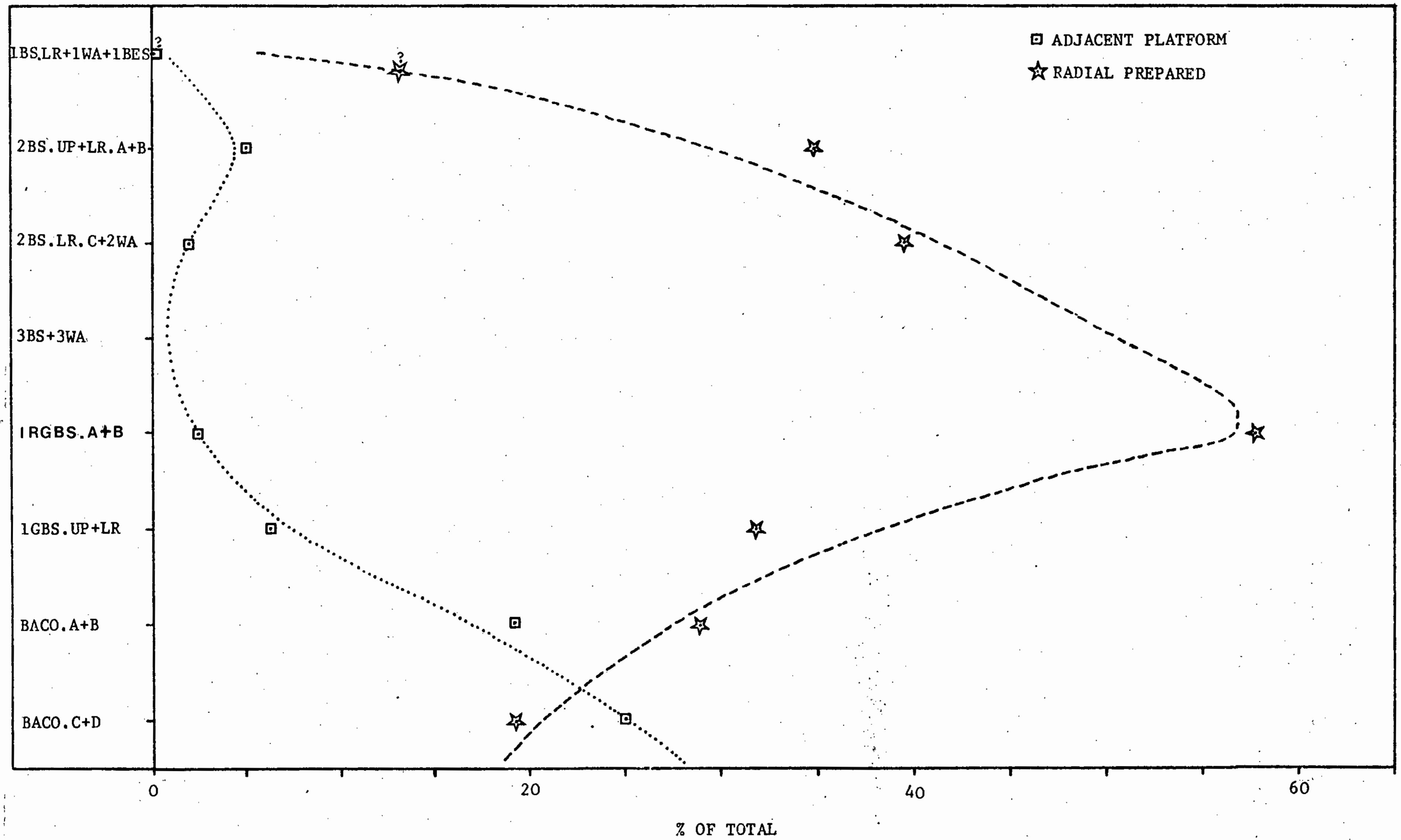


TABLE 2 An analysis of attribute relationships to artefact size

Border Cave, Exc. 3A Rear. Stratum BACO.C. Rhyolite 1. I2 subclass

Size Fraction	Sample η	Analysis	L mm	B mm	T mm	$\frac{B}{L}\%$	$\frac{T}{L}\%$	$\frac{T}{B}\%$	Rel.T	Platform Prep % Fac.	Pln.	Ind.	Util. % Pres.	Abs.
$>\bar{X}L$	235	$\bar{X}$	50,4	36,0	9,2	72,8	18,6	26,1	22,4	54,9	40,4	4,7	23,4	76,6
(37,4)		SX	-	-	-	17,40	5,40	6,85						
		$S\bar{X}$	-	-	-	1,15	0,35	0,45						
			-	-	-	23,9	29,0	26,2						
$<\bar{X}L$	263	$\bar{X}$	25,7	24,7	5,9	99,0	23,1	23,9	23,5	31,1	60,5	8,4	5,7	94,3
(37,4		SX				27,50	9,25	7,70						
		$S\bar{X}$				1,70	0,55	0,50						
						27,8	40,0	32,2						
Diff.		>/<%	196,1	145,7	155,9	73,5	80,5	109,2	94,9	176,5			410,5	

Abbreviations

Rel. = relative; Prep. = preparation; Util. = utilization; Fac. = faceted; Pln. = plain;
Ind. = indeterminate; Pres. = present; Abs. = absent; Diff. = difference

2.6.7 Temporal changes in the proportion of flake minimum numbers relative to cores

Pertinent data are fully listed in Appendix 15. Proportions were not calculated when total core sample was less than 5. Results relating to the Rhyolite 1 + Quartzite 1 and Chalcedony categories are given graphically in Figure 36. Comments are as follows :

(a) Flake minimum number per core proportions differ markedly between Rhyolite 1 + Quartzite 1 and Chalcedony.

(b) The vast value differences between these two raw material categories are believed to relate in large measure to the dissimilar forms in which they occur locally as detailed elsewhere (2.3.2).

2.6.8. Temporal changes in the proportion of Proximal flakes to total Broken flakes

Values for the latter were obtained by combining the Proximal and Distal subclasses. Pertinent data are fully listed in Appendix 16. Percentages were not calculated for Broken flake samples of less than 40. Results relating to the Rhyolite 1, Quartzite 1, and Chalcedony categories are given graphically in Figure 37. Comments are as follows :

(a) Proximal items should in theory never exceed half of the total observations, but the difficulty of certainly identifying minor Distal fragments results in that ratio being usually far exceeded.

(b) The noted shifts in all raw material categories are seen to correlate approximately with temporal variations in relative flake thickness (Fig. 44). The implications is that when flakes become stouter there is a concordant increased susceptibility to minor peripheral damage, before, during or after use, rather than outright snapping, and vica versa.

(c) 1GBS.LR and 1GBS.UP have anomalous breakage readings in terms of anticipated values, with moderate to marked deviations of ~5% and ~13% respectively (2.6)

2.6.9 Temporal changes in the proportion of unclassifiable waste relative to flake minimum number

Pertinent data are fully listed in Appendix 17. Percentages were not calculated for totals of less than 40. Comments are as follows :

(a) Unclassifiable waste proportions differ vastly amongst the various raw material categories, with values which suggest the following broad groupings, from lowest to highest : Rhyolite 2 and Additional; Rhyolite 1 and Quartzite 1; Quartz 1 + 2 and Chalcedony.

FIG.36 FLAKE MINIMUM NUMBER/CORE PROPORTION CHANGES WITH TIME

BORDER CAVE. EXC. 3A + 3B

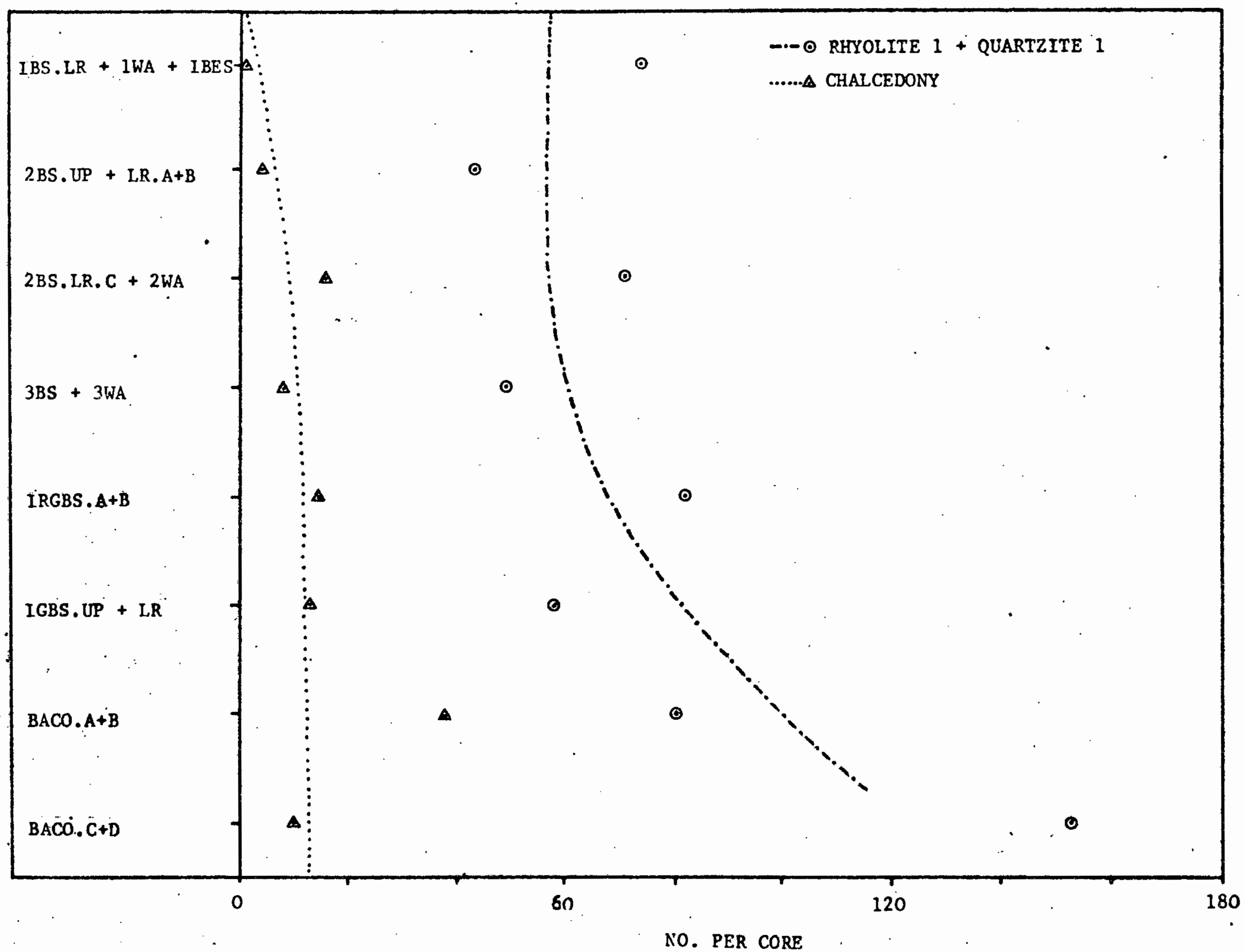
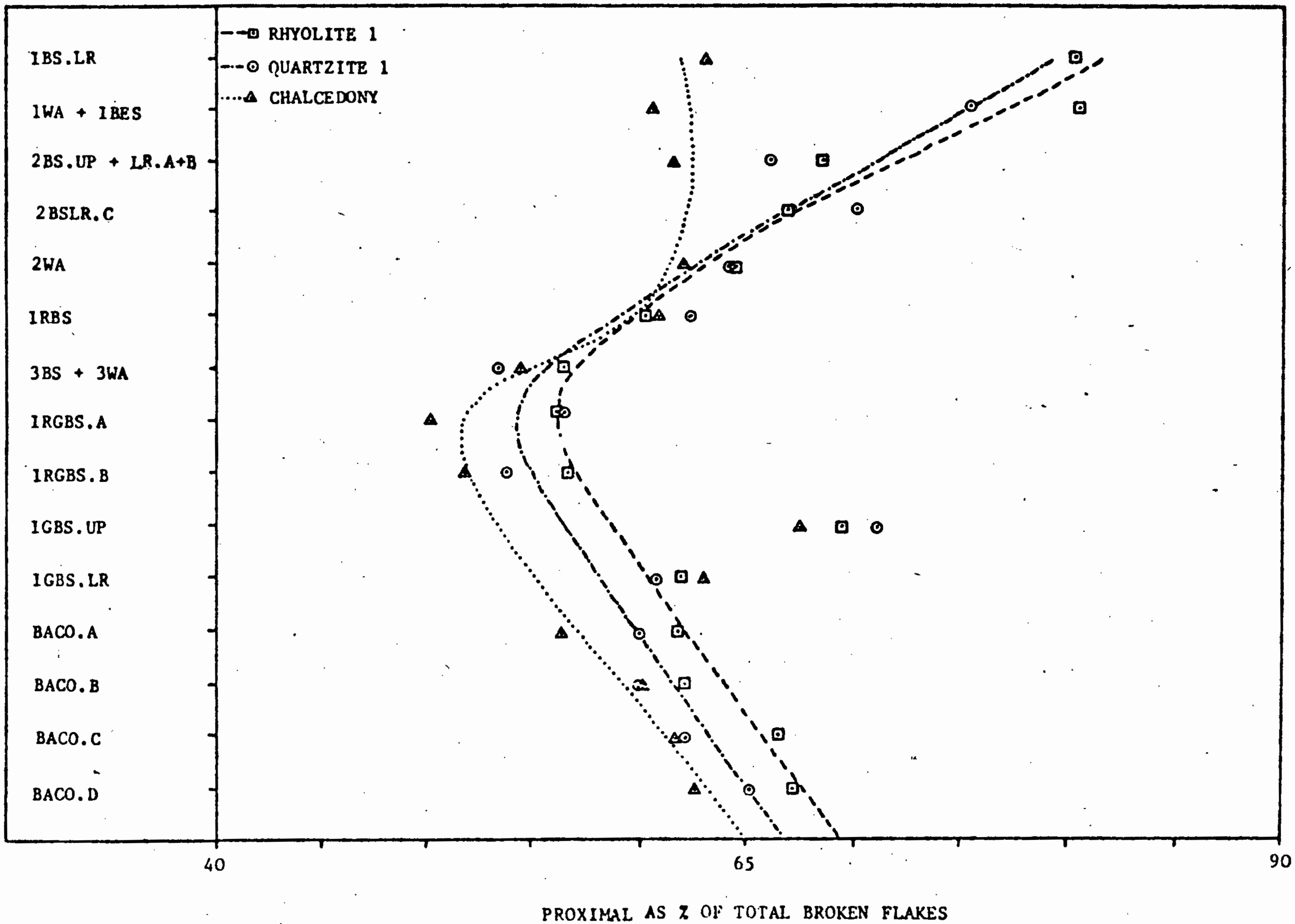


FIG. 37 PROXIMAL/TOTAL BROKEN FLAKE PROPORTION CHANGES WITH TIME

BORDER CAVE EXC. 3A + 3B



(b) The remarkable variations with time and between materials in this index can be dramatized by contrasting the values of 3% for Rhyolite 2 in 2 BS.LR.C and of 4,586% for Quartz 1 + 2 in 1WA+1BES.

(c) The broad shifts in granular raw material categories are considered to be related to temporal changes in relative flake thickness, and consequently varying proneness to breakage not certainly attributable to the Distal subclass (Fig. 44).

(d) The high Quartz 1 + 2 and Chalcedony values as a whole are regarded as being intrinsic to the nature and/or form of those materials. Marked post-2BS.LR.C shifts would however also seem to relate to the introduction and development of a new flaking technique (2.9.14.g).

(e) Comparisons between Rhyolite 1 and Quartzite 1 show that readings for the latter are in all cases lower, a fact which would seem to support the postulated difference in their inherent flaw content (2.6.5.b).

(f) Consistently 'excessive' readings for Rhyolite 1, Quartzite 1 and Chalcedony are seen to be associated with BACO.B and 1GBS.UP (2.6).

2.6.10 Temporal changes in raw material class proportions within the flake minimum number grouping

Pertinent data are fully listed in Appendix 18. Results relating to all categories other than 'Additional' are given graphically in Figure 38. Comments are as follows :

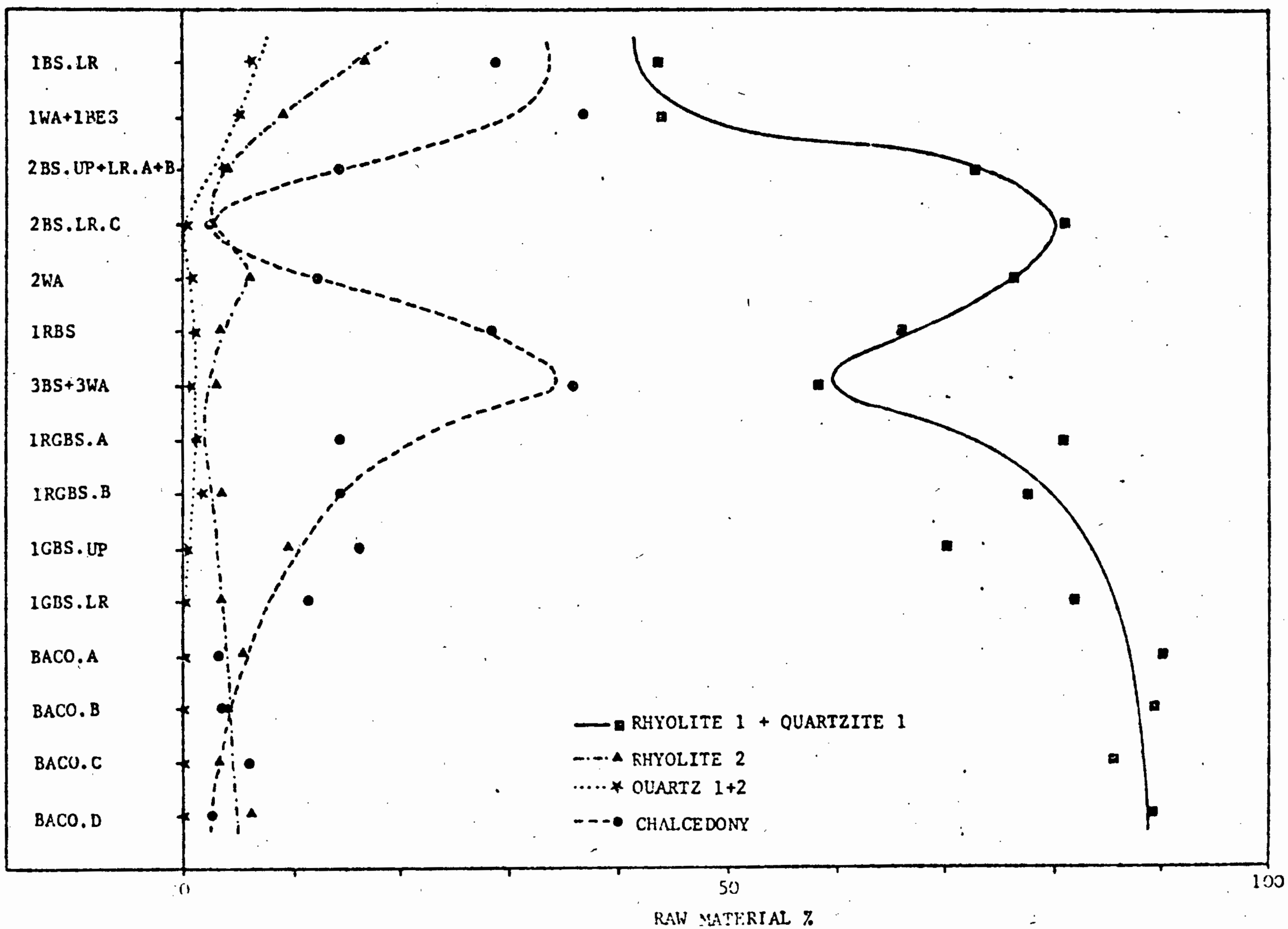
(a) Temporal shifts in utilized stone categories are usually derived by taking total observations as the denominator and this scheme has the clear advantage of simplicity. Implicit in it however, is the assumption that each fragment is of equal 'value', whether produced by intent or accident, during or after manufacture. This seems rather unlikely, as is indicated, for example, by the 2.6.9.b evidence, which shows that the production of a single flake for whatever purpose may result in up to a ~1530 x difference in the unclassifiable waste value for Quartz 1 + 2 relative to Rhyolite 2.

(b) There is clearly a marked inverse relationship between Rhyolite 1 + Quartzite 1 and Chalcedony.

(c) 1GBS.UP is isolated as showing the highest incidence of 'inconsistent' readings, with high values for Rhyolite 2 and Chalcedony at the expense of Rhyolite 1 + Quartzite 1 (2.6).

FIG.38 RAW MATERIAL PROPORTION CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B



2.7 Morphometric Analysis : Procedures

Goodwin, in Goodwin and van Riet Lowe (1929), initiated the dimensional investigation of individual artefact classes in South Africa. Mason (1957, 1962, 1967) subsequently extended such studies to total aggregates, using maximum dimension for the description of his three basic flake classes. Personal observations at the time indicated that this parameter was often very poorly correlated with the technology which had led to the creation of those fundamental groupings. The author therefore devised an entirely new approach in 1959 which is essentially identical to those subsequently published by Daniels (1967) or Isaac and Keller (1968). A modified version of this original scheme was applied to the total of 8323 specimens present in the Untrimmed flake group as documented in Appendix 7.

Definitions are as follows :

(a) Length (L) is regarded as the maximum dimension of the ventral face along a straight line parallel to the +Pe axis.

(b) Breadth (B) is regarded as the maximum dimension of the ventral face along a straight line at right-angles to the +Pe axis.

(c) Thickness (T) is regarded as the maximum dimension along a straight line at right-angles to the ventral face.

Comments are as follows :

(a) The +Pe axis as here used sometimes shows perceptible deviations from its normal right angled relationship to the platform edge (cf. Isaac and Keller, 1968). Such instances usually relate to terminal releases close to a core edge, resulting in a slight skewing of the bulb of percussion in that direction.

(b) Striking platform shoulders usually represent maximum dimension at the proximal end in terms of the above length definition.

Processing was as follows :

(a) The three dimensions were given quantitative expression by measuring each to the nearest 0,5 cm with callipers, thereby avoiding observational errors mainly caused by parallax (Freeman, 1972).

(b) The B/L, T/L and T/B bivariate indices, which together define relative proportions completely, were then calculated and given as percentages (Anon, 1972).

(c) Sample central tendency was measured by way of the mean ($\bar{X}$) (Daniels, 1967). Values for all typological and raw material classes were calculated and then double-checked.

(d) Sample dispersion was measured by means of standard deviation (SX) and error ($S\bar{X}$). Both were calculated for all I2, B2 and P2 groupings with a H.P.65.

(e) An additional 'composite' ratio which was computed is here termed the Relative Thickness (Rel. T). This was taken to be the average of the T/L and T/B means, rather than merely the thickness as a percentage of maximum dimension (Collins, 1970).

(f) A total of ~25,000 measurements and ~125,000 data inputs were involved. Presented results are considered to have an accuracy rating of ~99%. Values for (d) and (e) were only calculated when observations exceeded 40. All means were rounded off to the nearest 0,1 and standard deviations and errors to the nearest 0,05.

2,8 Analytical Results : Raw Data

A primary presentation of morphometric, platform state, and utilization state data for I1 and 2, B1 and 2 and P1 and 2 subclasses are given in Appendices 19-21. The following comments are pertinent:

(a) In some instances typologically related contiguous levels and/or sub-levels were grouped in order to increase total sample sizes.

(b) Rhyolite 1 and Quartzite 1 means in large samples were seen to fall consistently within the standard errors of each other, indicating that these two raw material classes can be regarded as metrically identical.

(c) Quartzite 1 + 2 never attained an arbitrary minimum sample size of 40 in any single stratum grouping or typological subclass and was on this basis exluded from any further dimensional attention.

(d) Irregular subclasses show low and variable utilization proportions in all raw material categories, with a tendency for values which are relatively low for Chalcedony, high for Quartzite 1, and intermediate for Rhyolite 1. A comparison of I1 and I2 subclasses in Rhyolite 1 suggests lower readings in the former, as indicated by means for all viable sample levels of ~10% and ~17% respectively.

(e) Blade subclass samples are too often inadequate to detect possible differences in utilization proportions between the various raw material categories. A comparison of I2 and B2 values in Rhyolite 1 suggests that the latter have perceptibly higher readings, with a mean for all viable sample levels of ~28%.

(f) Point subclass samples are consistently too low to detect possible differences in utilization proportions between the various raw material categories. The two viable sample readings for Rhyolite 1 in the BACO levels did however give an exceptionally high mean of ~32%.

(g) An analysis was carried out to see how utilization proportions varied with artefact size in a given typological and raw material class. The resultant data are fully set forth in Table 2, and from this it can be seen that utilization incidence is strongly correlated with artefact size, increasing fourfold at flake length doubles, which may indicate an unknown mix of two variables, namely :

I. A tendency for the preferential use of the larger flake in any given aggregate.

II. An increased probability of damage during and/or subsequent to use as edge length increases.

A final presentation of a more manageable amount of morphometric data for the I2, B2 and P2 subclasses only is given in Appendices 22-24. The following comments are pertinent :

(a) A more drastic grouping of typologically related contiguous levels was effected in order to further increase the number of viable sample sizes.

(b) Rhyolite 1 and Quartzite 1 were combined in view of their material identity as mentioned above.

(c) Rhyolite 2 and Additional were excluded in terms of the fact that our arbitrary minimum sample size was in both classes only attained in relatively few stratum grouping.

(d) Values were only calculated for four key attributes, which together fully define any Untrimmed flake subclass dimensionally, namely L, B/L, Rel. T and V.

2.9 Analytical Results : Relationships

The aforesaid parameters were subsequently graphed to see if they revealed any serial trends with time. Interpretative procedures adopted here were as discussed previously in 2.6. Presentation of information was by means of :

(a) Trend curves, smoothed with due regard to varying sample size and or reliability. Means are depicted by vertical strokes and standard error by horizontal bars.

(b) Histograms, using a log scale based on intervals suggested by J. Vogel. That approach was adopted in view of the known fact that human perception of size variations is proportional rather than absolute. This is evidenced, for example, by the visual response to differences between 20 and 40 mm as opposed to 220 and 240 mm. All data were presented by means of the same intervals in order to facilitate the evaluation of flake subclass differences in dispersion. Plots based on this scheme were found to conform more closely to a normal distribution than those using a linear scale. There is however a consistent tendency for a slight-moderate skewing to the left, as is clearly shown by the Rhyolite 1 +Quartzite 1 values in Figures 39 and 40. Comparison between these two examples further reveals that the effect becomes perceptibly less marked as mean length diminishes, and on that basis this 'distortion' is tentatively interpreted as being the result of two factors, namely :

I. That as flake size increases there is an enhanced probability of intersecting some raw material flaw with resultant breakage.

II. That as flake size increases we approach some varying limit set by the individual capacity of the toolmaker to remove ever larger specimens by means of the detachment technique then prevalent.

2.9.1 Temporal changes in L and Rel. T in I1 relative to I2

Pertinent data are fully listed in Appendix 25. Percentages were not calculated when both I1 and I2 samples fell below 40. Rhyolite 1 results are given graphically in Figure 41. Comments are as follows :

(a) The L and B values for any given level are seen to be similar and consistently lower than those of T.

(b) The T/L and T/B values for any given level are seen to be similar and consistently higher than that of B/L which tends to remain constant at ~100%.

(c) It is evident that there is a close but varying temporal relationship between these two flake subclasses, with I1 being always larger and coarser and with I2 being much more prone to morphometric fluctuations.

2.9.2 Temporal changes in I2 L mean

Pertinent data are fully listed in Appendix 22. Results are given graphically in Figure 42. Values without standard error bars are based on samples of less than 40. Comments are as follows :

FIG. 39 BORDER CAVE. 2BS.LR.C, I1 SUBCLASS. LENGTH DISTRIBUTION

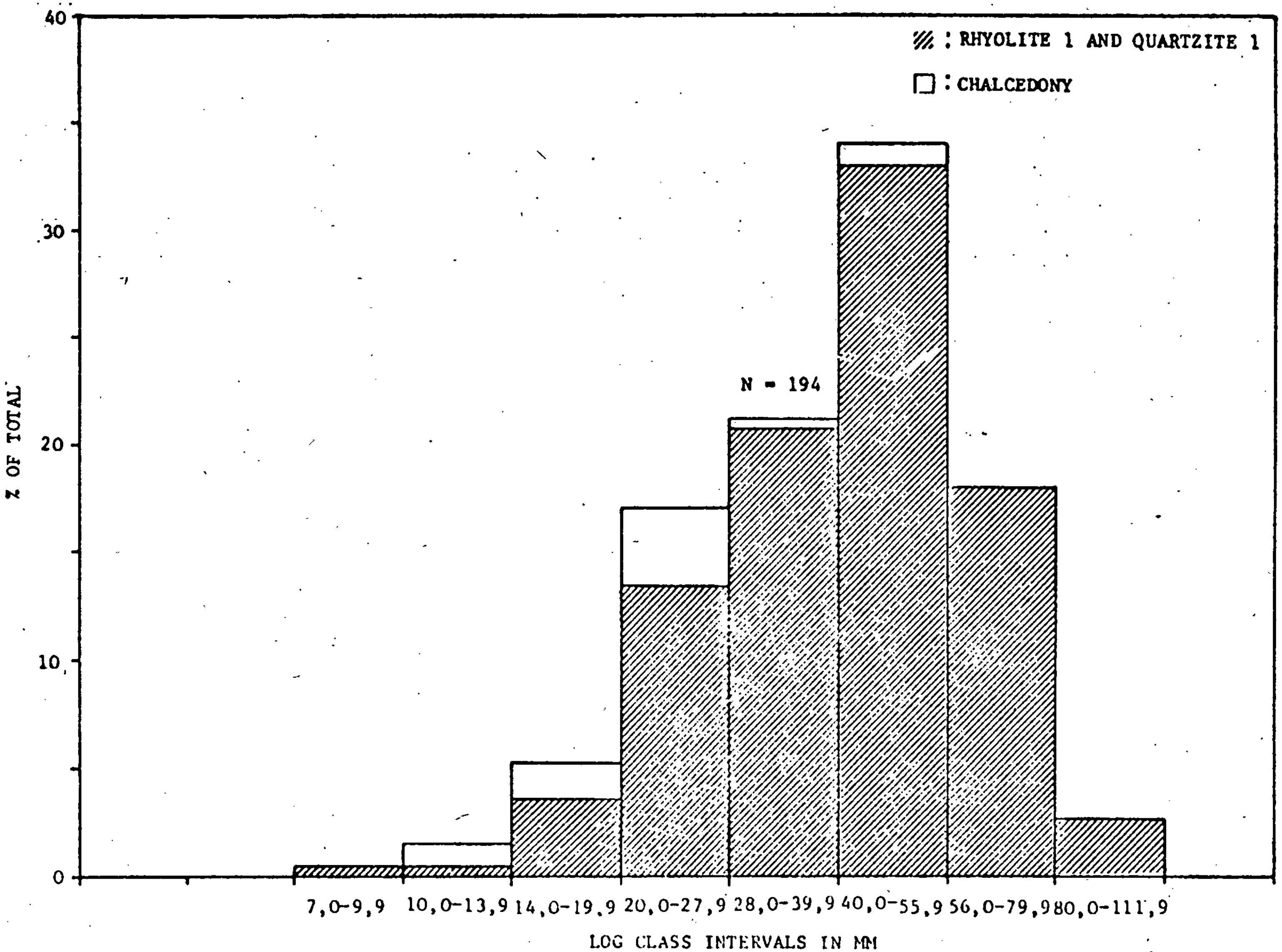


FIG. 40 BORDER CAVE. STRATUM 1RGBS. A + B . I1 SUBCLASS. LENGTH DISTRIBUTION

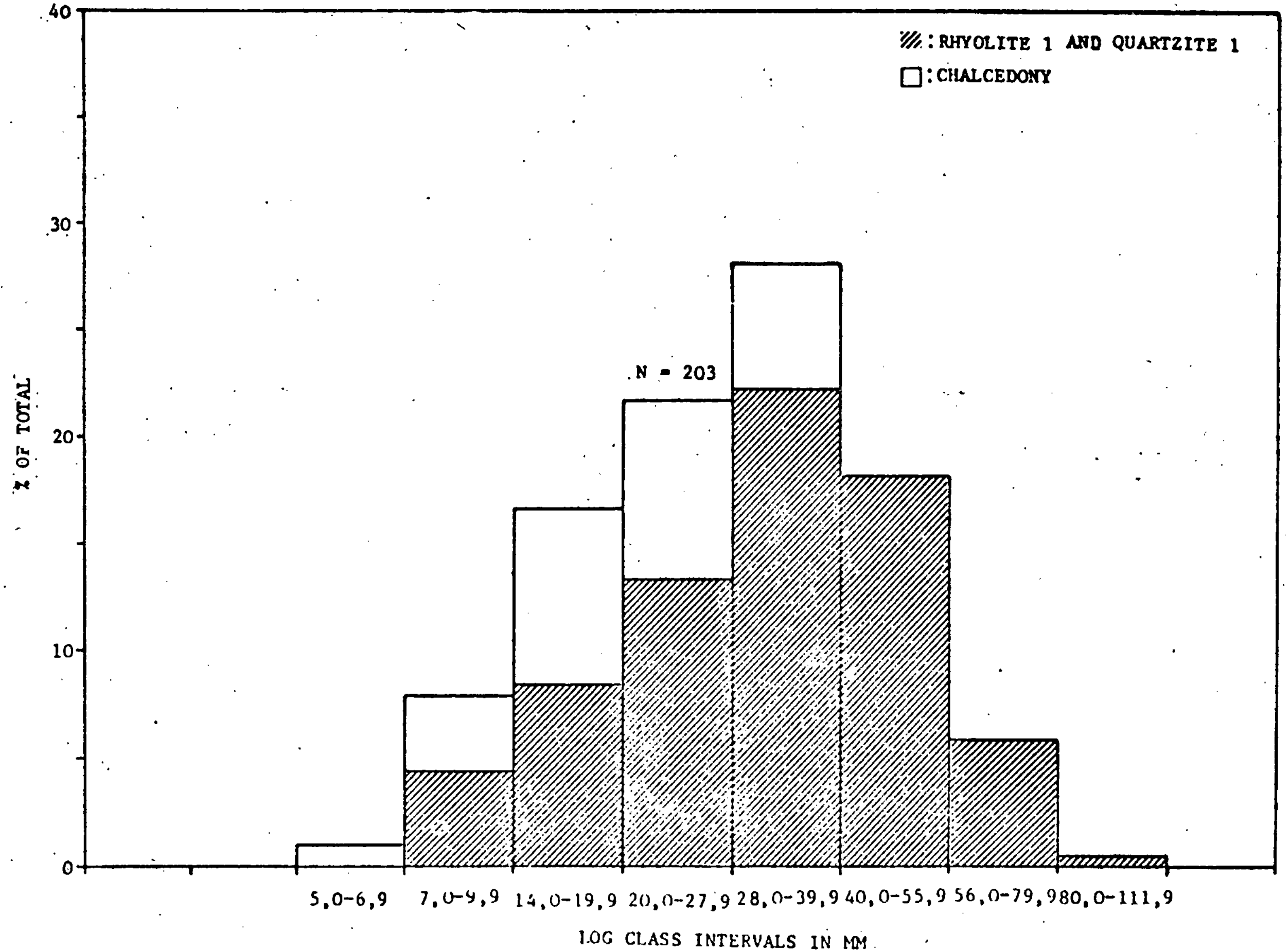


FIG.41 I1/I2 PROPORTION CHANGES WITH TIME IN RHYOLITE 1

BORDER CAVE. EXC. 3A + 3B

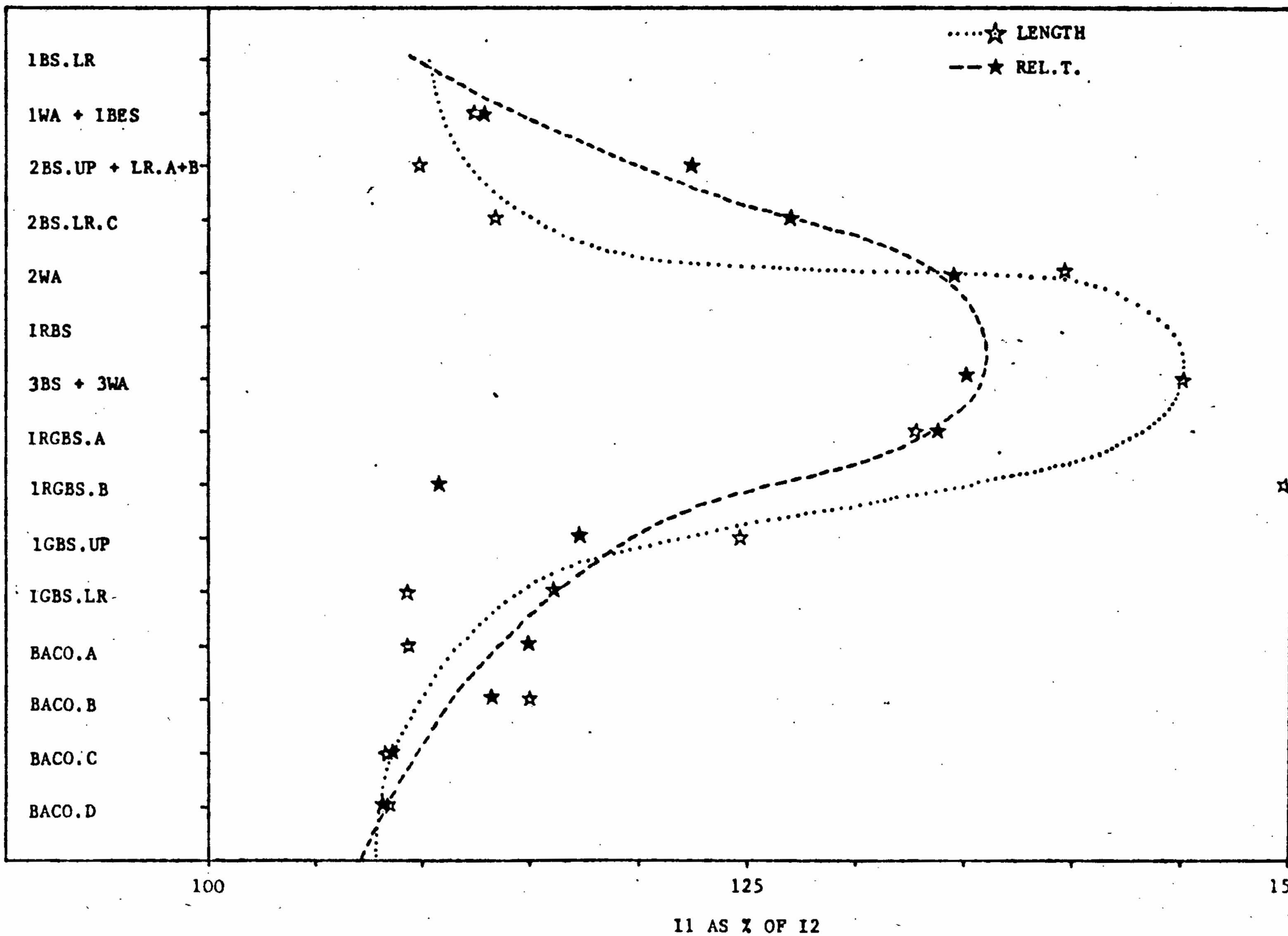
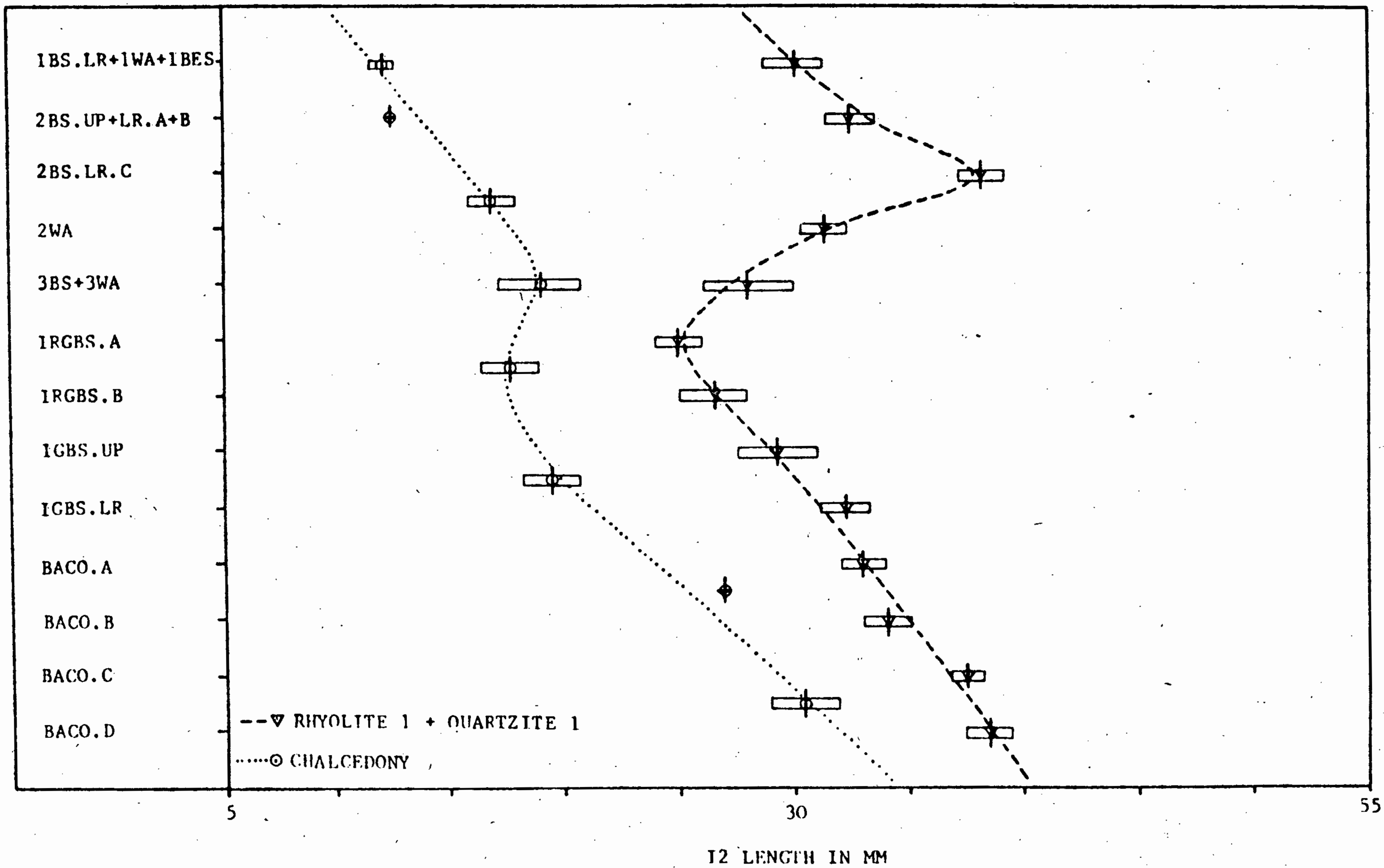


FIG. 42 I2 SUBCLASS LENGTH CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B



(a) The L mean proportion for Chalcedony relative to Rhyolite 1 + Quartzite 1 decreases markedly and consistently with time from ~80% in BACO.C+D to ~40% in 1BS.LR + 1WA + 1BES.

(b) The progressive decrease in L mean between BACO.D and 1RGBS.A in Rhyolite 1 + Quartzite 1 and Chalcedony further corroborates an obtrusive temporal trend (Mason, 1957; Sampson, 1972) in what now transpires to be only a portion of the M.S.A. (Wymer and Singer, 1972; Beaumont, 1973a).

(c) Figure 42 indicates that all I2 L means below 2BS.UP, bar only 1RGBS.A, are duplicated at two or more points, thereby precluding with that one exception, the use of this parameter alone as an effective means of placing M.S.A. aggregates in relative temporal order (e.g. Mason, 1957).

(d) A backward extrapolation of the Chalcedony L mean trend prior to 1 GBS.UP suggests that the size range of Lembombo amygdales must ultimately have placed a limit on the maximum dimensions attainable by artefacts based on this material.

(e) Figure 42 indicates a Chalcedony mean of ~30,5 mm in BACO.C+D and a Rhyolite 1 + Quartzite 1 mean of ~25 mm in 1RGBS.A+B. These data are of interest in that they suggest that environmental constraints imposed by available nodule size range in the former material cannot be the entire explanation for the persistent use of the latter rock-type for the larger artefacts in those aggregates typified by Backed pieces 2 (cf. Malan, 1942). One of a number of other possible variables relevant in this instance would be the differing availability of, and consequent energy expenditures involved in, the retrieval of those two raw material categories (2.4.2).

2.9.3 Temporal changes in I2 B/L mean

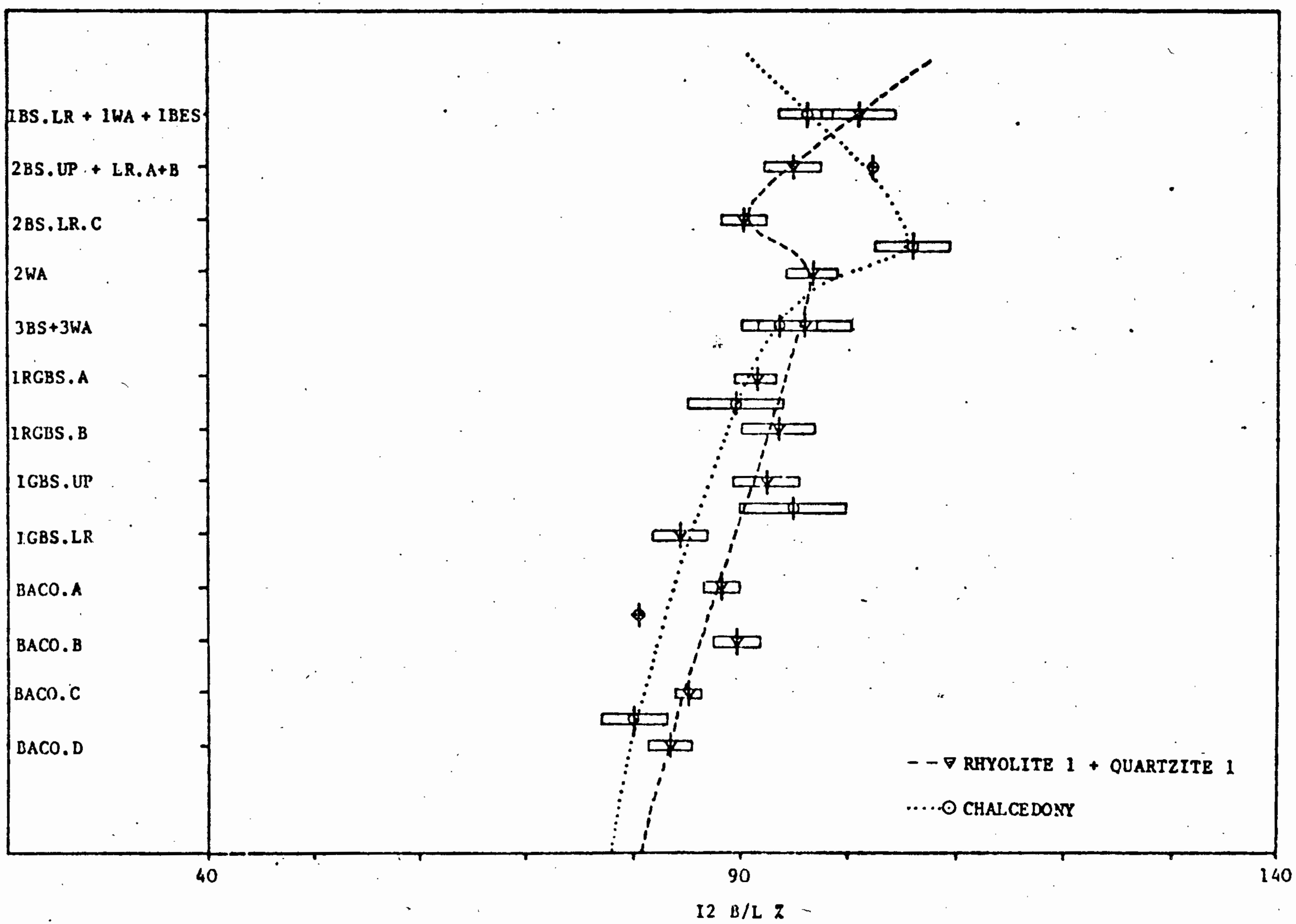
Pertinent data are fully listed in Appendix 22. Results are given graphically in Figure 43. Values without standard error bars are based on samples of less than 40. Comments are as follows :

(a) Values for Rhyolite 1 + Quartzite 1 and Chalcedony in the M.S.A. levels, i.e. those up to 2BS.UP, tend to be 'undersquare' with a mean of ~90%.

(b) Values for Chalcedony relative to Rhyolite 1 are seen to be usually very similar, but with the former being marginally lower except for the 'inversion' centred on 2BS.LR.C, where both materials differ more markedly, and the former achieves a reading more typical of the L.S.A.

FIG. 43 I2 SUBCLASS B/L PROPORTION CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B



(c) 1GBS.UP+LR are isolated as being particularly 'anomalous', with an ~8% deviation from the anticipated value in the case of Chalcedony (2.6).

2.9.4 Temporal changes in I2 Rel. T mean

Pertinent data are fully listed in Appendix 22. Results are given graphically in Figure 44. Values without standard error bars are based on samples of less than 40. Comments are as follows :

(a) Values for Chalcedony relative to Rhyolite 1 + Quartzite 1 are seen to be consistently ~1,5% lower up until the 3BS+3WA. The relatively sharp decline in Chalcedony readings in 2BS.LR.C+2WA may relate in some way to the B/L 'inversion' noted in 2.9.3.

(b) Values for the two plotted material categories subsequent to 2BS.LR A+B differ increasingly, with the Rhyolite 1 + Quartzite 1 readings being lower than any found in the M.S.A., which suggests that non-silicates were becoming peripheral to the main emphasis of the new flaking techniques then being developed (2.9.14.g).

(c) 1GBS.UP is isolated as being 'aberrant', particularly in the case of Rhyolite 1 + Quartzite 1, where there is a massive ~3% deviation from the anticipated value (2.6).

2.9.5 Temporal changes in I2 V mean

Pertinent data are fully listed in Appendix 22. Percentages were not calculated when totals fell below 40. Results are given graphically in Figure 45. Comments are as follows :

(a) The L, B and T values are rather similar for any given level, with typical readings being lowest for B, intermediate for L, and highest for T.

(b) The B/L, T/L and T/B values are rather similar for any given level, with typical readings being lowest for T/B, intermediate for B/L, and highest for T/L.

(c) Dimensional V values for both raw material categories follow similar courses, but that for cryptocrystalline rock-types is much more marked.

(d) Ratio V values for the two raw material categores are very similar and appear to follow dimensional dispersion in a very subdued way.

(e) Figures 42 and 45, when compared, suggest that there is an inverse relationship between I2 L and V values.

FIG. 44 I2 SUBCLASS REL.T. CHANGES WITH TIME

BORDER CAVE. EXC.3A + 3B

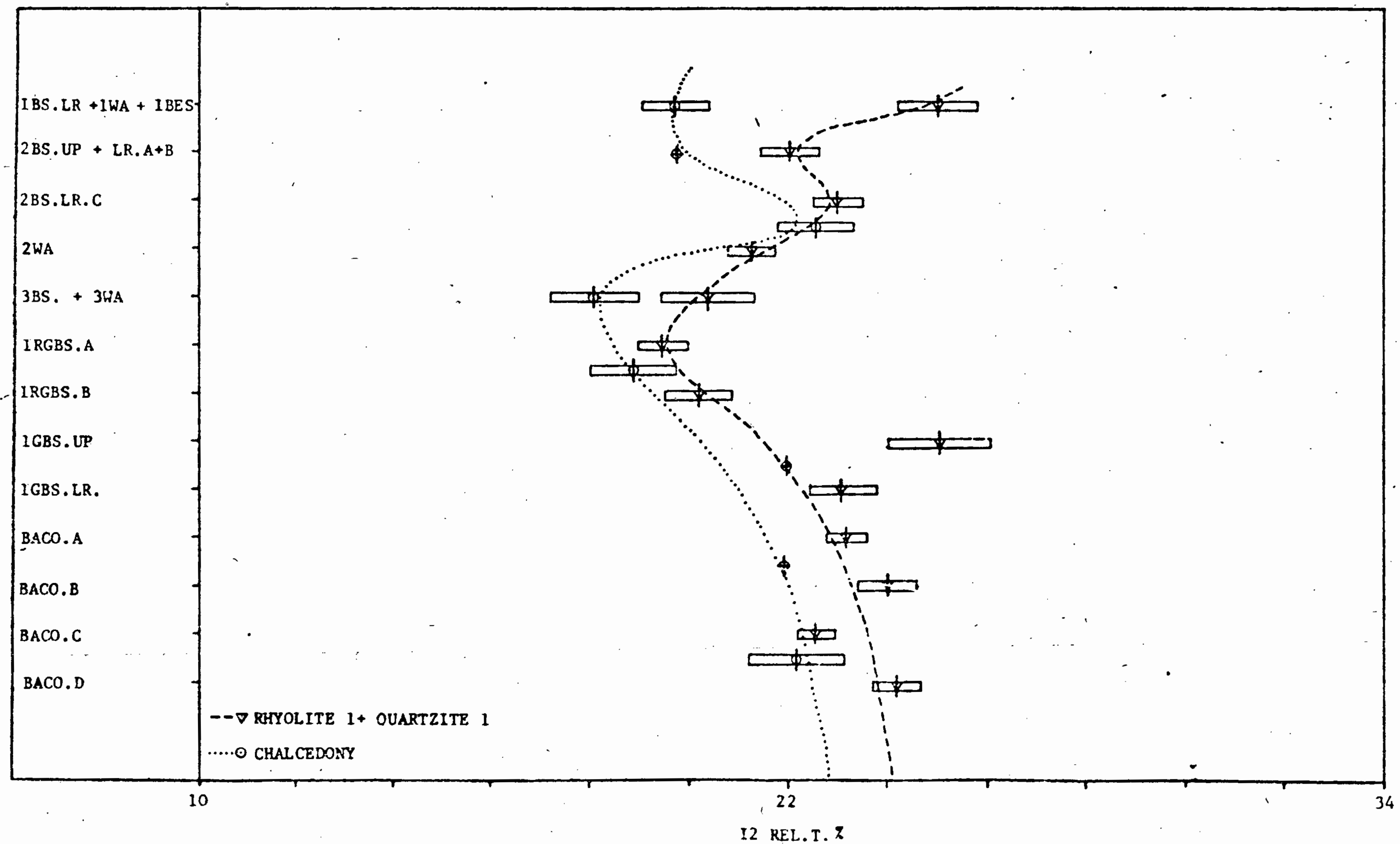
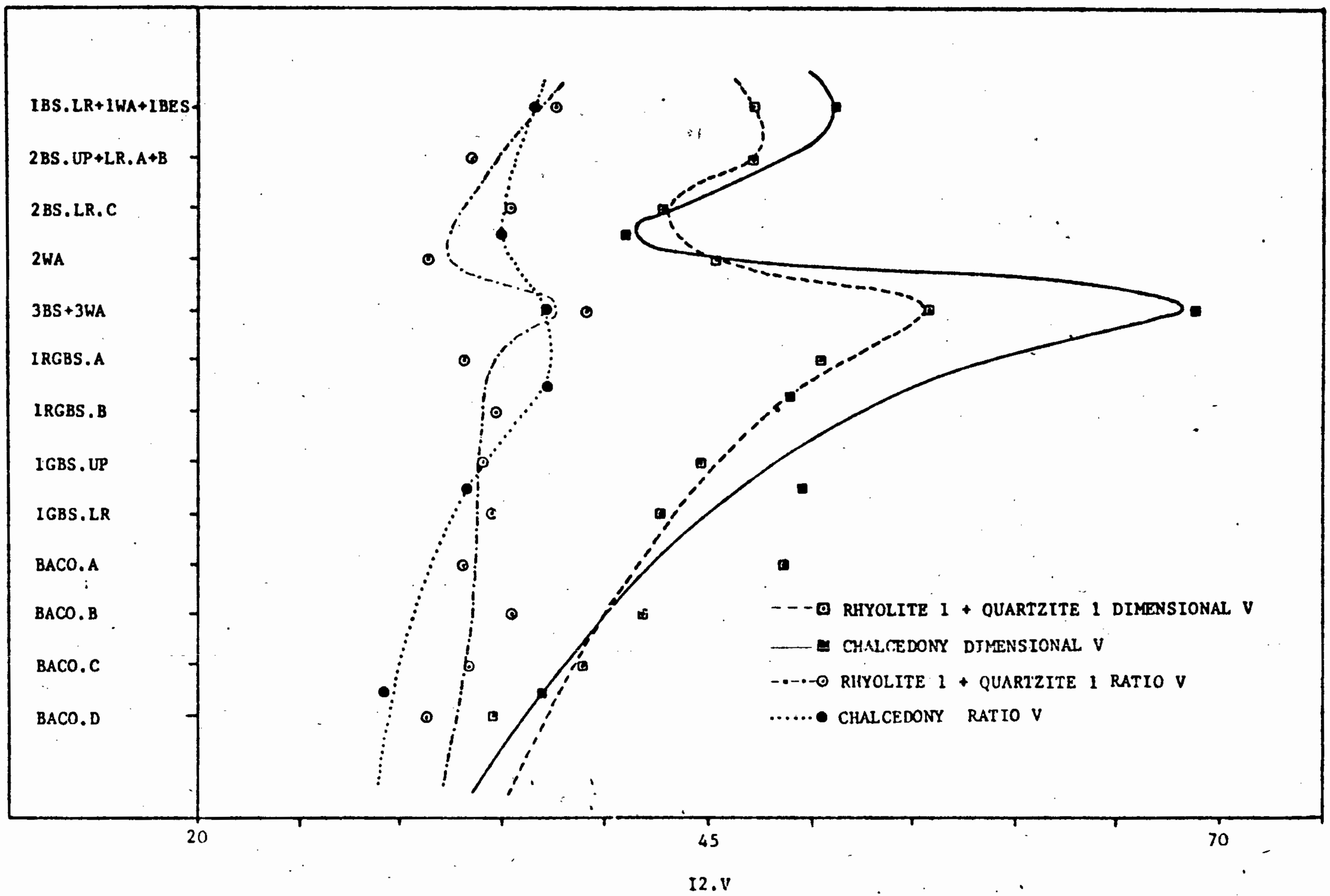


FIG.45 I2 SUBCLASS V CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B



(f) An analysis was carried out to see how Ratio V varies with L in a given typological and raw material class. Data in that connection are fully set out in Table 2, and from that it is evident that a 96% increase in L correlates with a 26% decrease in Ratio V, thereby corroborating the above deduction.

2.9.6 Temporal changes in B2 L mean

Pertinent data are fully listed in Appendix 23. Results are given graphically in Figure 46. Values without standard error bars are based on samples of less than 40. Comments are as follows :

(a) The L mean proportion for Chalcedony relative to Rhyolite 1 + Quartzite 1 varies from ~69% in 1RGBS.A+B to ~57% in 3BS+3WA.

(b) Comparisons of I2 and B2 L mean data indicate:

I. That the former are much shorter than the latter in any given level.

II. That both follow similar but somewhat differing courses with time.

III. That the Chalcedony relative to Rhyolite 1 + Quartzite 1 mean L proportion differs in 3BS+3WA (~68% versus ~57%).

2.9.7 Temporal changes in B2 B/L mean

Pertinent data are fully listed in Appendix 23. Results are given graphically in Figure 47. Values without standard error bars are based on samples of less than 40. Comments are as follows :

(a) Extrapolating the upper portion of the graphed trend indicates a potential value of ~65% for 1BS LR+1WA+1BES. With a mean of that order I2 and B2 plan-forms would tend to become indistinguishable. The low B1+2 incidence in those levels may thus have a technical rather than a possibly climatic cause (2.6.3.d).

(b) Comparisons of I2 and B2 B/L proportions indicate :

I. That the former are markedly broader than the latter in any given level (Daniels, 1967).

II. That both follow very different courses with time.

2.9.8 Temporal changes in B2 Rel. T mean

Pertinent data are fully listed in Appendix 23. Comments are as follows:

(a) I2 and B2 shifts in Rhyolite 1 + Quartzite 1 appear to parallel each other closely, but values for the latter are consistently ~ 1% lower.

FIG. 46 B2 SUBCLASS LENGTH CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B

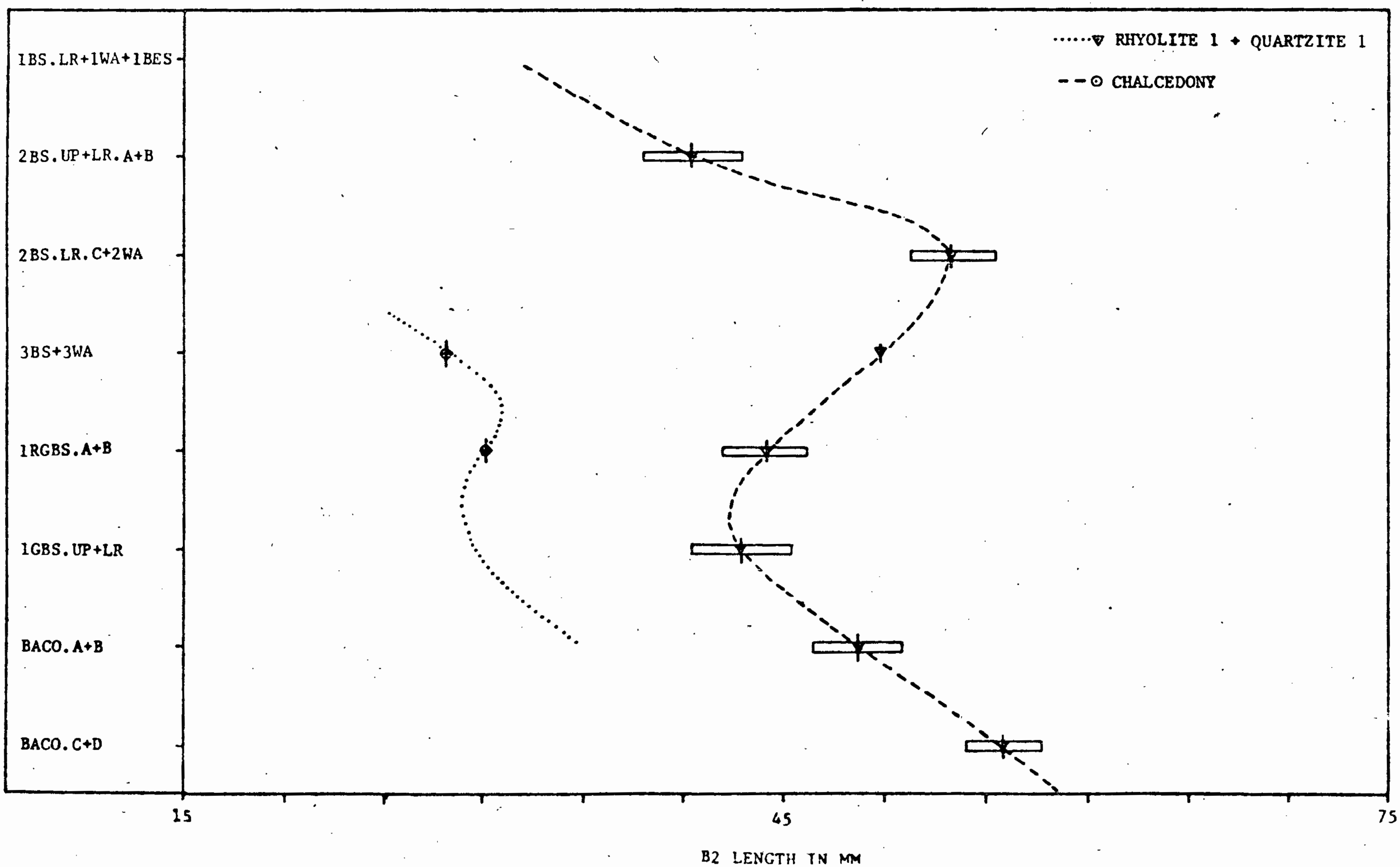
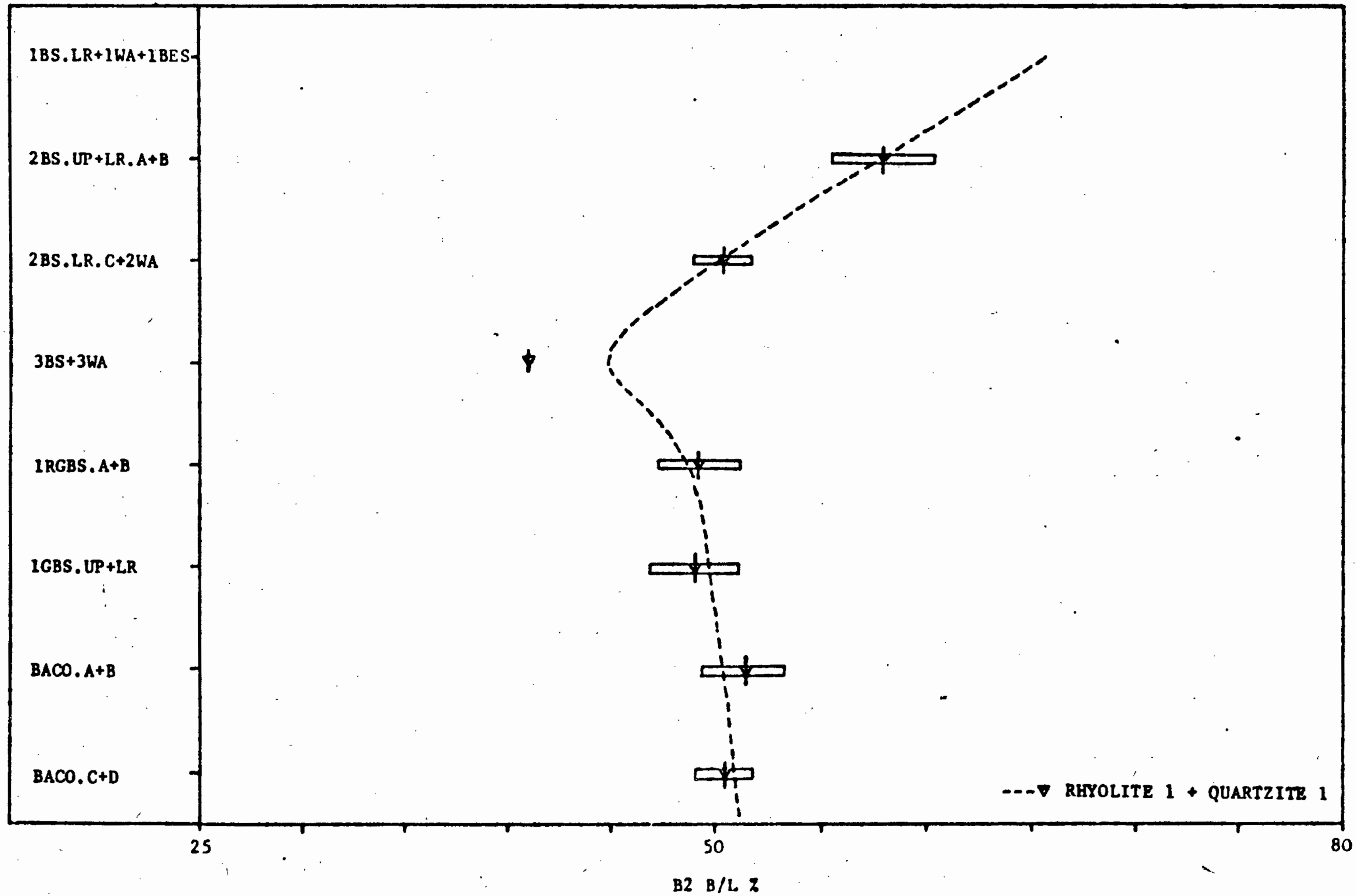


FIG. 47 B2 SUBCLASS B/L PROPORTION CHANGES WITH TIME

BORDER CAVE. EXC. 3A+3B



(b) 1GBS.UP+LR values are isolated as being aberrant, in corroboration of the I2 evidence (2.9.4.c).

2.9.9 Temporal changes in B2 V mean

Pertinent data are fully listed in Appendix 23. Percentages were not calculated when totals fell below 40. Results are given graphically in Figure 48. Comments are as follows :

(a) The L, B and T values are rather similar for any given level, with typical readings being about the same for L and B and highest for T.

(b) The B/L, T/L and T/B values are rather similar for any given level, with typical readings being about the same for B/L and T/B and highest for T/L.

(c) Figures 46 and 48, when compared, suggest that there is an inverse relationship between B2 L and V means (2.9.5.e).

(d) Comparison of V readings for I2 and B2 indicates that the latter are consistently lower, which would imply that the norms set in their production were perceptibly more rigorous.

2.9.10 Temporal changes in P2 L mean

Pertinent data are fully listed in Appendix 24. Comments are as follows :

(a) Rhyolite 1 + Quartzite 1 values decrease from ~51 mm to ~40 mm between BACO.D and 1GBS.UP.

(b) Comparison of I2.B2 and P2 L means indicate that values for the last-mentioned tend to be intermediate between the other two in any given level.

2.9.11 Temporal changes in P2 B/L mean

Pertinent data are fully listed in Appendix 24. Comments are as follows :

(a) Rhyolite 1 + Quartzite 1 values remain more or less constant at ~64%.

(b) Comparison of I2, B2 and P2 B/L means indicate that values for the last-mentioned are always intermediate between the other two in any given level.

(c) The small 2BS.LR.C+2WA sample was noted to have an abnormally low value of ~53%. Re-examination of the specimens indicated that a number were in fact misplaced BP forms.

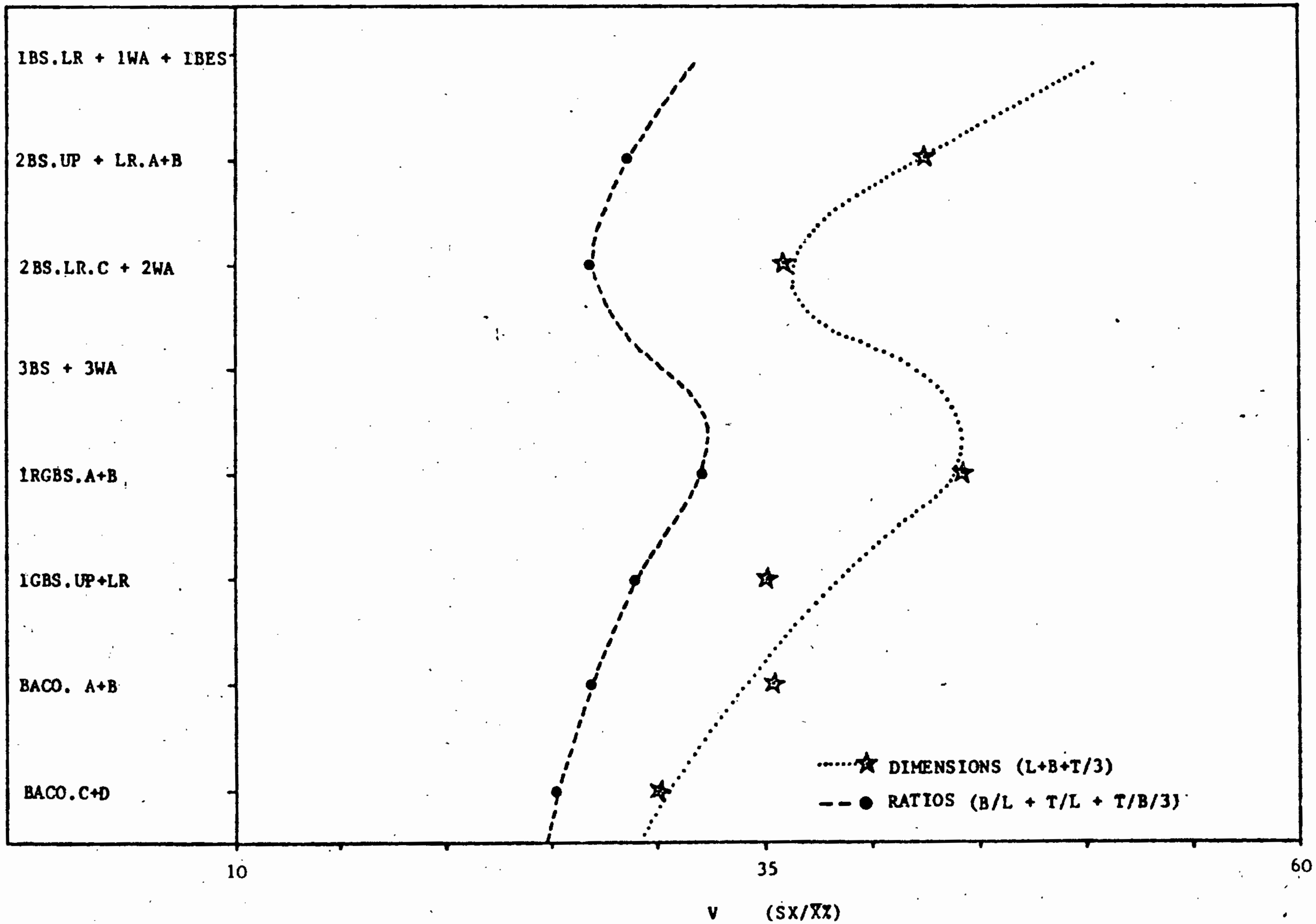
2.9.12 Temporal changes in P2 Rel. T mean

Pertinent data are fully listed in Appendix 24. Comments are as follows :

(a) Rhyolite 1 + Quartzite 1 values remain more or less constant at ~26%.

FIG.48 B2 SUBCLASS V CHANGES WITH TIME IN RHYOLITE 1 + QUARTZITE 1

BORDER CAVE. EXC. 3A + 3B



(b) Comparison of I2, B2 and P2 Rel. T means indicates that values for the last-mentioned are far higher and remain static relative to the other two in any given level.

(c) This finding suggests that the satisfactory shaping of Points may have necessitated Rel. T values of greater than about 25%, which would in turn imply that their production became increasingly more difficult to reconcile with contemporary technical trends in I2 and B2, perhaps leading for this reason to the observed decline of the P class subsequent to 1GBS.LR (Fig. 32).

2.9.13 Temporal changes in P2 V mean

Pertinent data are fully listed in Appendix 24. Comments are as follows :

(a) The L,B and T values are rather similar for any given level with typical readings being about the same for L and B and highest for T (2.9.9.a).

(b) The B/L, T/L and T/B values are rather similar for any given level with typical readings being about the same for B/L and T/B and highest for T/L (2.9.9.b).

(c) Rhyolite 1 + Quartzite 1 Dimensional and Ratio V values are rather similar with readings respectively of ~27% and ~24%.

(d) Comparison of V values for I2, B2 and P2 indicates that the last-mentioned are consistently lowest, which implies that norms set in their production were the most rigorous of any Untrimmed flake class. These would presumably have been increasingly more difficult to sustain as L decreased and V increased,thereby reinforcing the tendency postulated in 2.9.12.c

2.9.14 I2, B2 and P2 distributions

Pertinent data were amassed in terms of 2.7. Results are given graphically as specified in 2.9.6. Comments are as follows :

(a) Figures 49-56 illustrate that the distribution of any given morphometric parameter, is a particular typological and raw material category, is invariably 'normal' when plotted on a log scale.

(b) Figures 49-50 illustrate that central tendency is perceptibly greater for Rel. T relative to L in the B2 Rhyolite 1 + Quartzite 1 sample from 2BS.LR.C.

(c) Figures 51-52 illustrate the close correspondence between the B/L distributions of Rhyolite 1 + Quartzite 1 and Chalcedony in I2 and B2 samples from 1RGBS A+B (Fig. 43).

FIG. 49 BORDER CAVE. STRATUM 2BS. LR.C. B2 SUBCLASS. LENGTH DISTRIBUTION

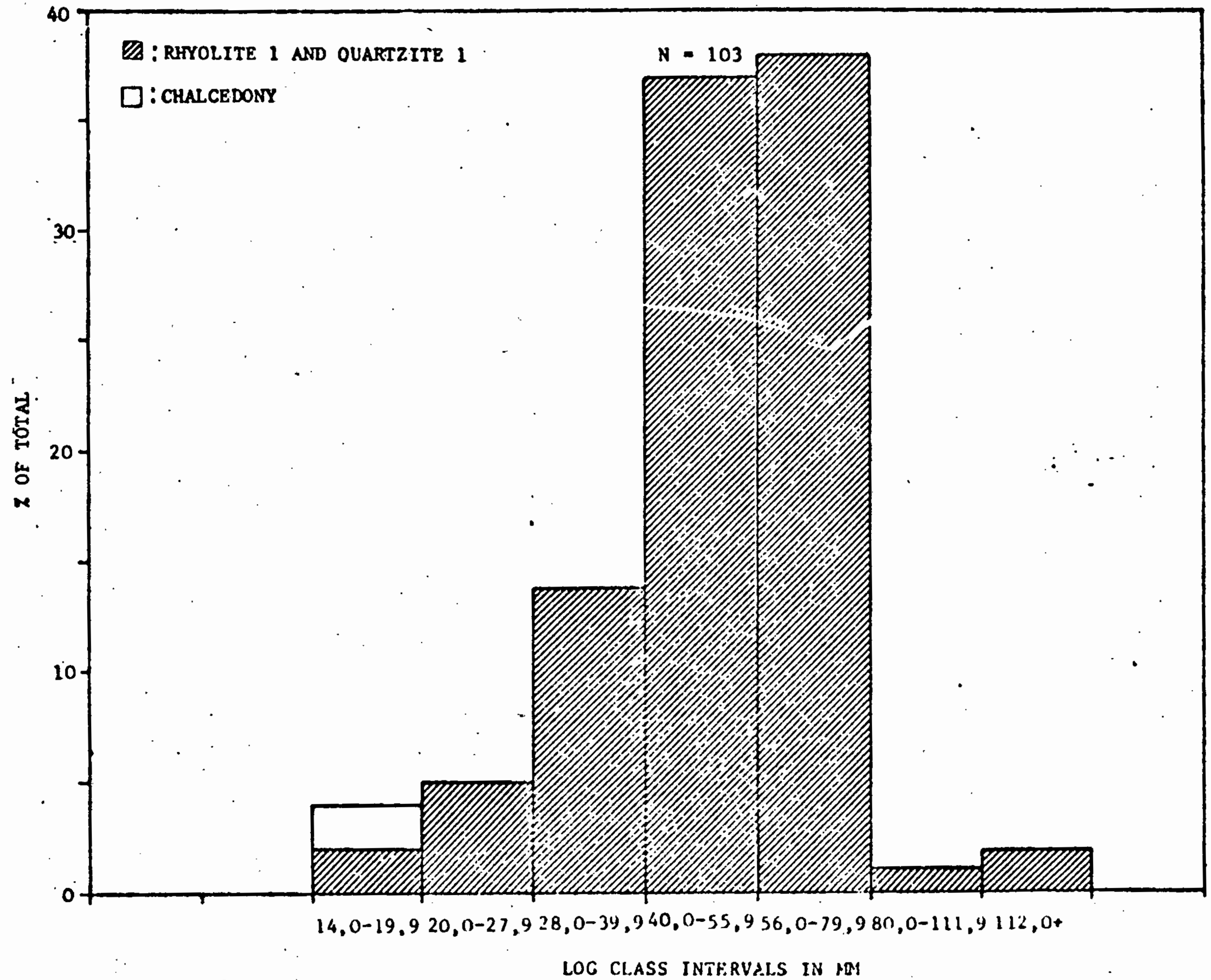


FIG. 50 BORDER CAVE. STRATUM 2BS.LR.C. B2 SUBCLASS. REL.T DISTRIBUTION

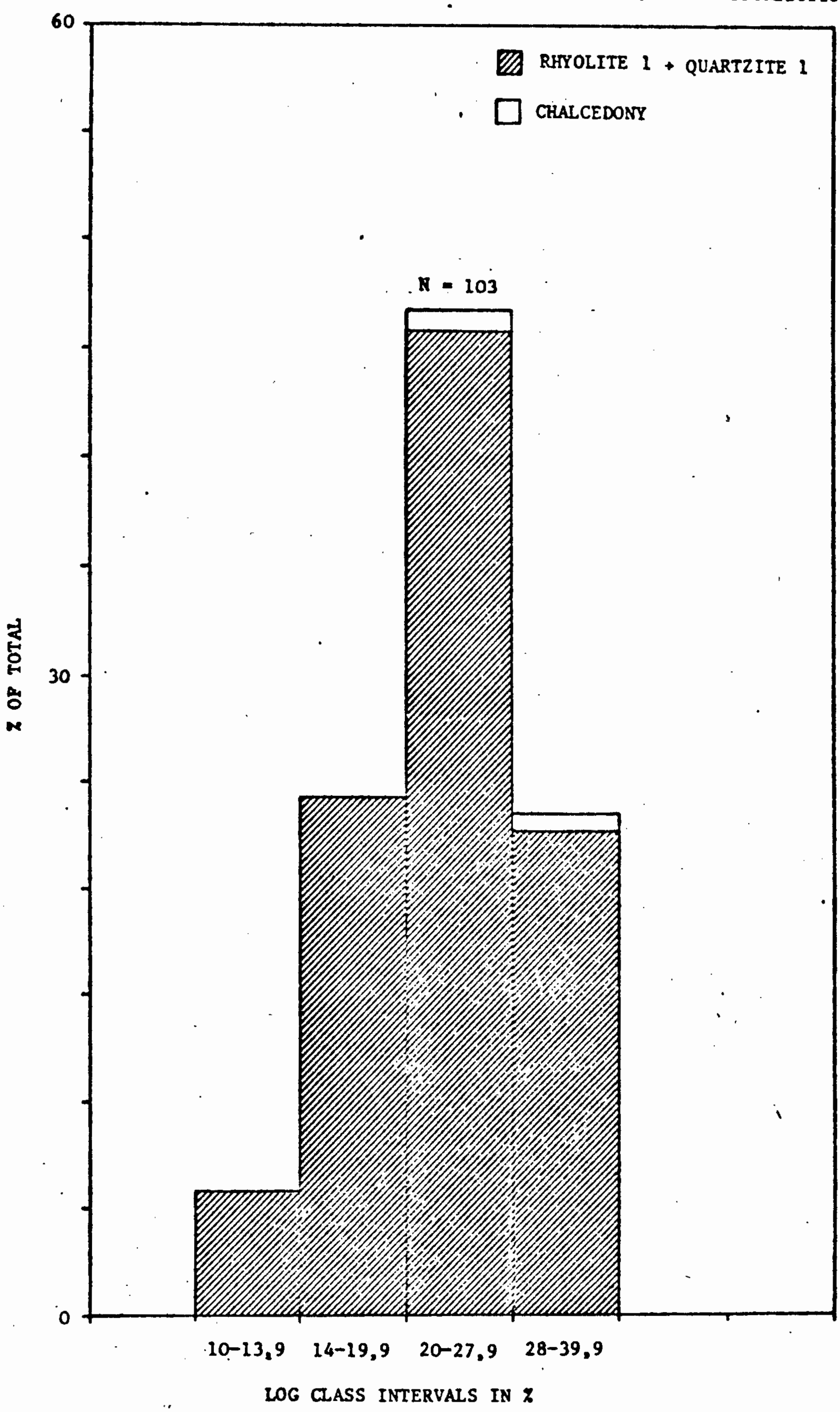


FIG.51 BORDER CAVE. STRATUM 1RGBS.A+B. I2 SUBCLASS.B/L DISTRIBUTION

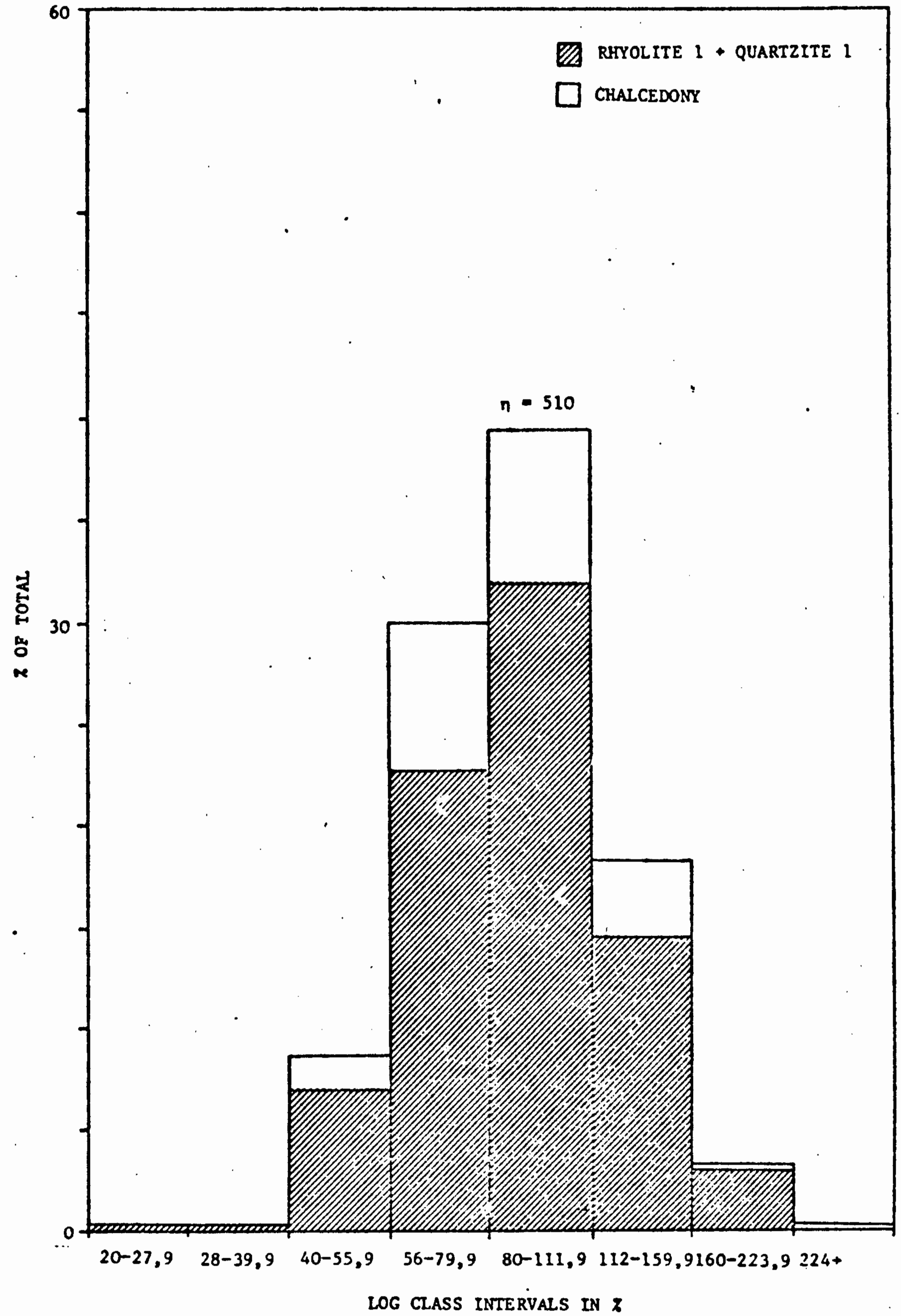


FIG. 52 BORDER CAVE. STRATUM IRGBS.A+B. B2 SUBCLASS. B/L DISTRIBUTION

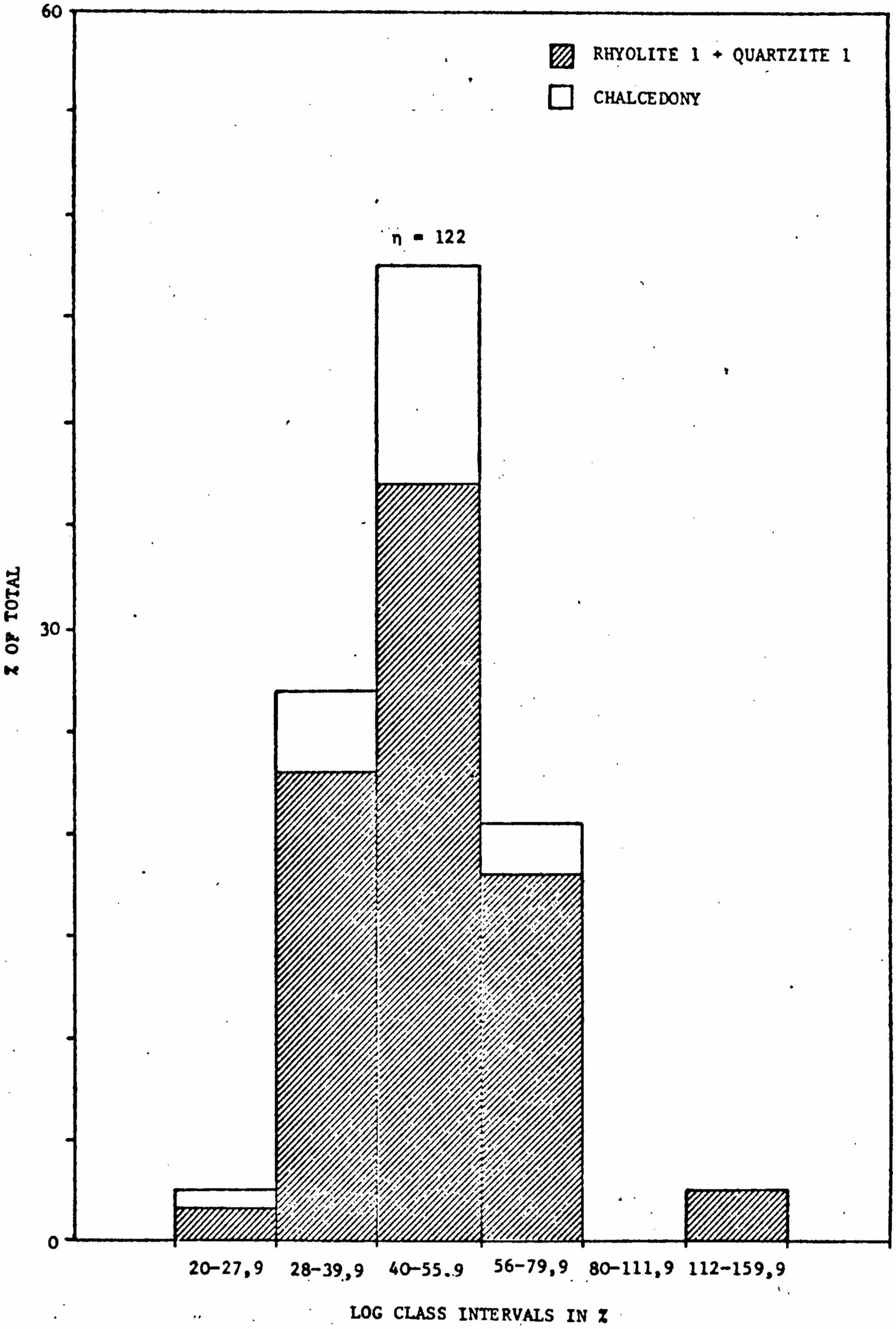
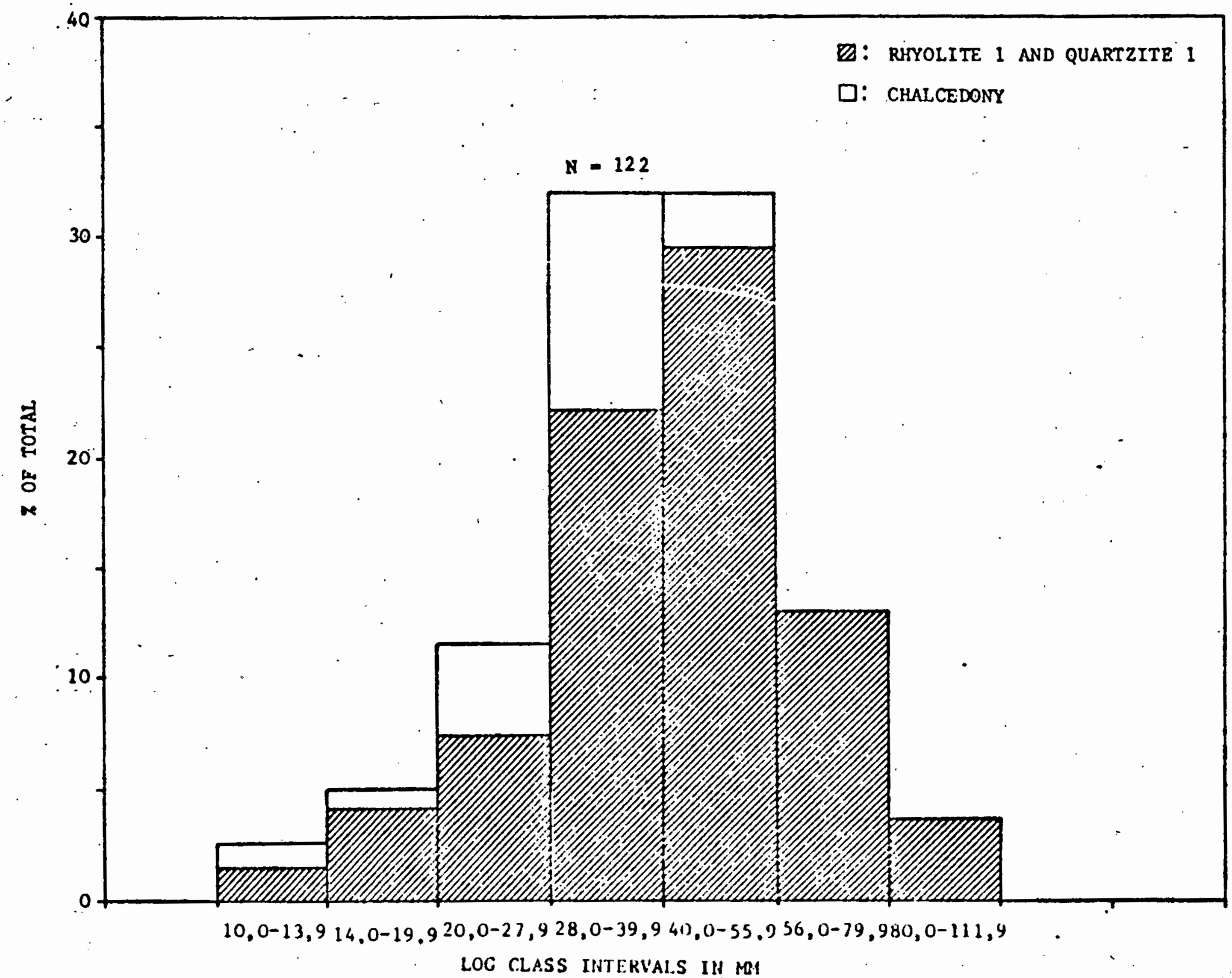


FIG. 53 BORDER CAVE. STRATUM 1RGBS A + B. B2 SUBCLASS. LENGTH DISTRIBUTION



(d) Figures 52-53 illustrate that L and B/L distributions for B2 are strictly unimodal in 1RGBS A+B. There is clearly no morphometric evidence that any fraction of the blades are 'exotic'. This is of note in view of the strong punched blade componenet in this sample.

(e) Figures 54-56 illustrate that dispersion in respect of L is very markedly less in P2 compared to I2 in the Rhyolite 1 + Quartzite 1 samples from BACO.C and D (2.9.13.d).

(f) Figures 55-56 illustrate the nature of the L mean shifts between two successive levels (BACO.D to BACO.C). It is patent that these involve subtle percentage decreases and increases in the higher and lower class intervals respectively, rather than an abrupt quantum jump affecting all class intervals equally.

(g) Figures 55-59 illustrate the temporal behaviour of L distributions in Chalcedony relative to Rhyolite 1 + Quartzite 1. It is seen that :

I. In BACO.C+D the small Chalcedony component tends merely to supplement the distribution of Rhyolite 1 + Quartzite 1.

II. In 1RGBS.A+B the large Chalcedony component serves to complement the distribution of Rhyolite 1 + Quartzite 1.

III. In 2BS.LR.C the small Chalcedony component is seen to be very much more restricted to the very left of the distribution of Rhyolite 1 + Quartzite 1.

IV. In 1WA + 1BES the Chalcendony and Rhyolite 1 + Quartzite 1 distributions still overlap but are now sufficiently distinct for the total curve to be markedly bimodal.

This emergence of distinctive L distributions for Chalcedony and Rhyolite 1 + Quartzite 1 subsequent to the 2BS.LR.C suggests that we may here be observing the emergence of flaking 'specialization' in the sense that differing detachment methods were being applied to differing materials to produce artefacts with differing metrical characteristics.

2.10 Spatial Analysis

The lateral distribution of some typological and raw material classes on a square by square basis was investigated in order to establish if this data source at that level of precision would reveal any significant associations and/or concentrations in Exc. 3A Rear. The information compiled in this connection is listed in Appendices 26 and 27.

2.10.1 Fused or smelted items

Comments are as follows :

(a) Sherds. Some marked concentrations were noted (e.g. T21 of 1BS.UP.IA).

(b) Glass beads. Some marked concentrations were noted (e.g. T21 of 1BS.UP.IA).

FIG. 54 BORDER CAVE. STRATUM BACO.C+D.P2 SUBCLASS. LENGTH DISTRIBUTION

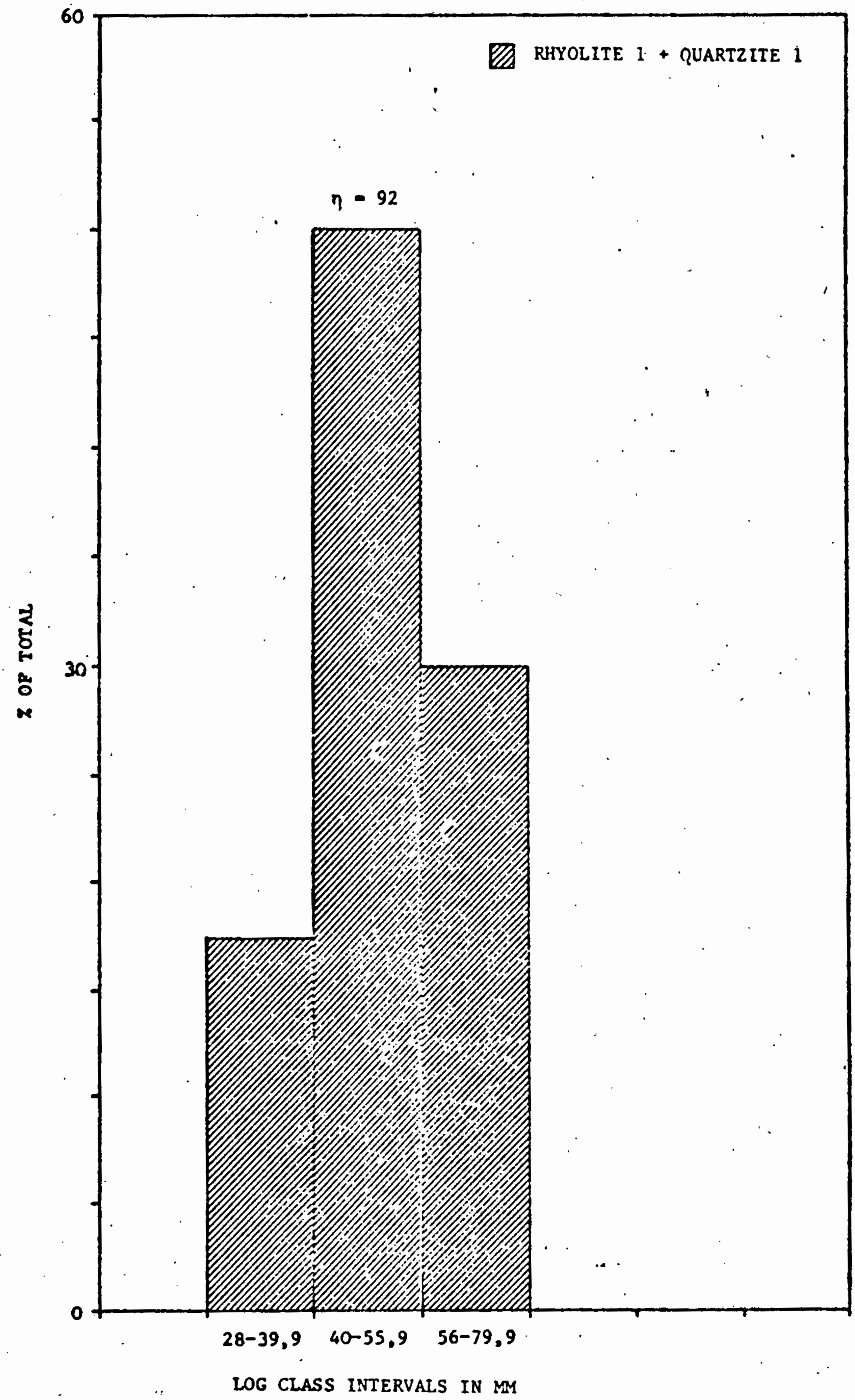


FIG. 55 BORDER CAVE. STRATUM BACO.D. I2 SUBCLASS. LENGTH DISTRIBUTION

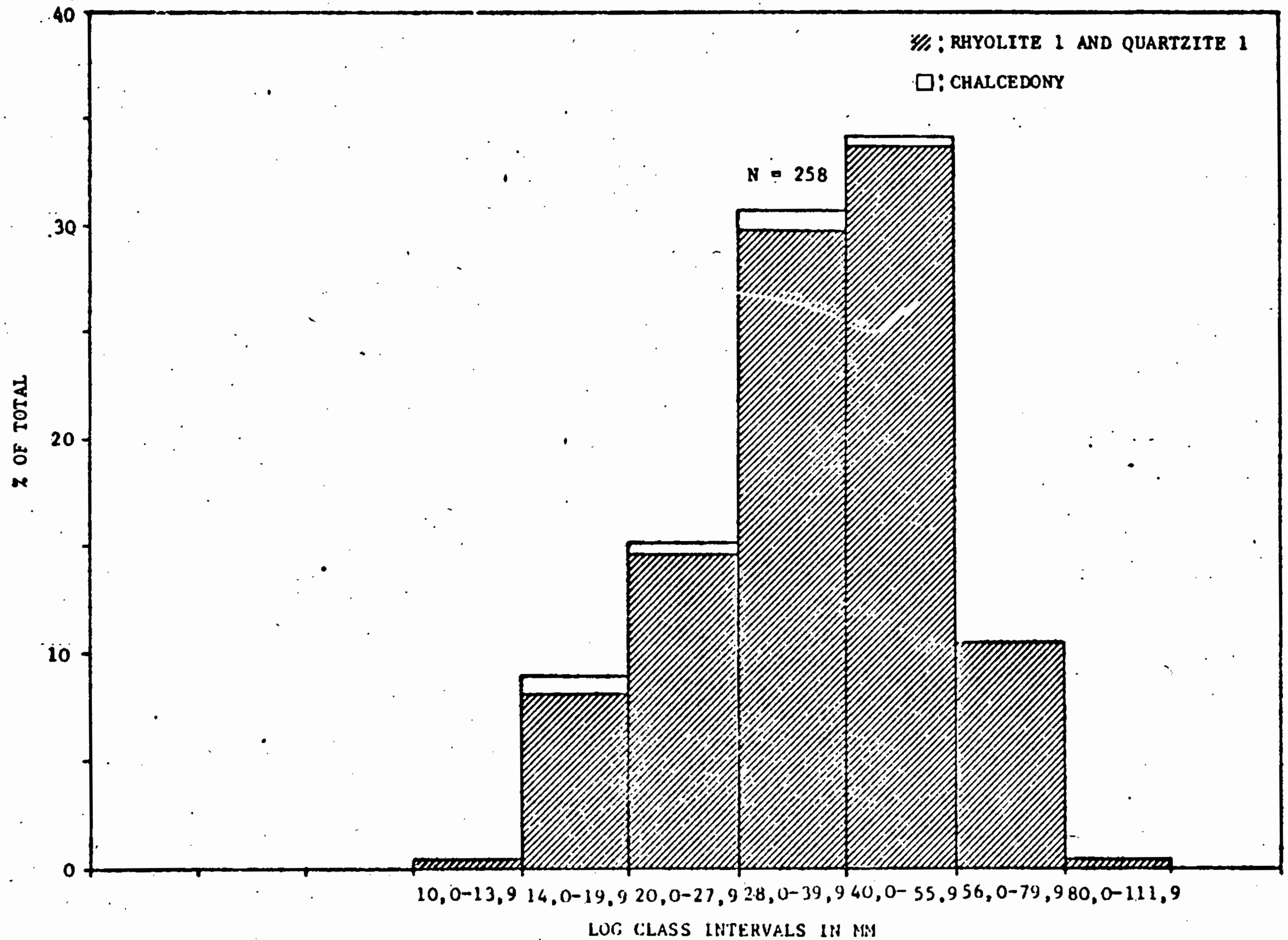


FIG. 56 BORDER CAVE. STRATUM BACO.C. I2 SUBCLASS. LENGTH DISTRIBUTION

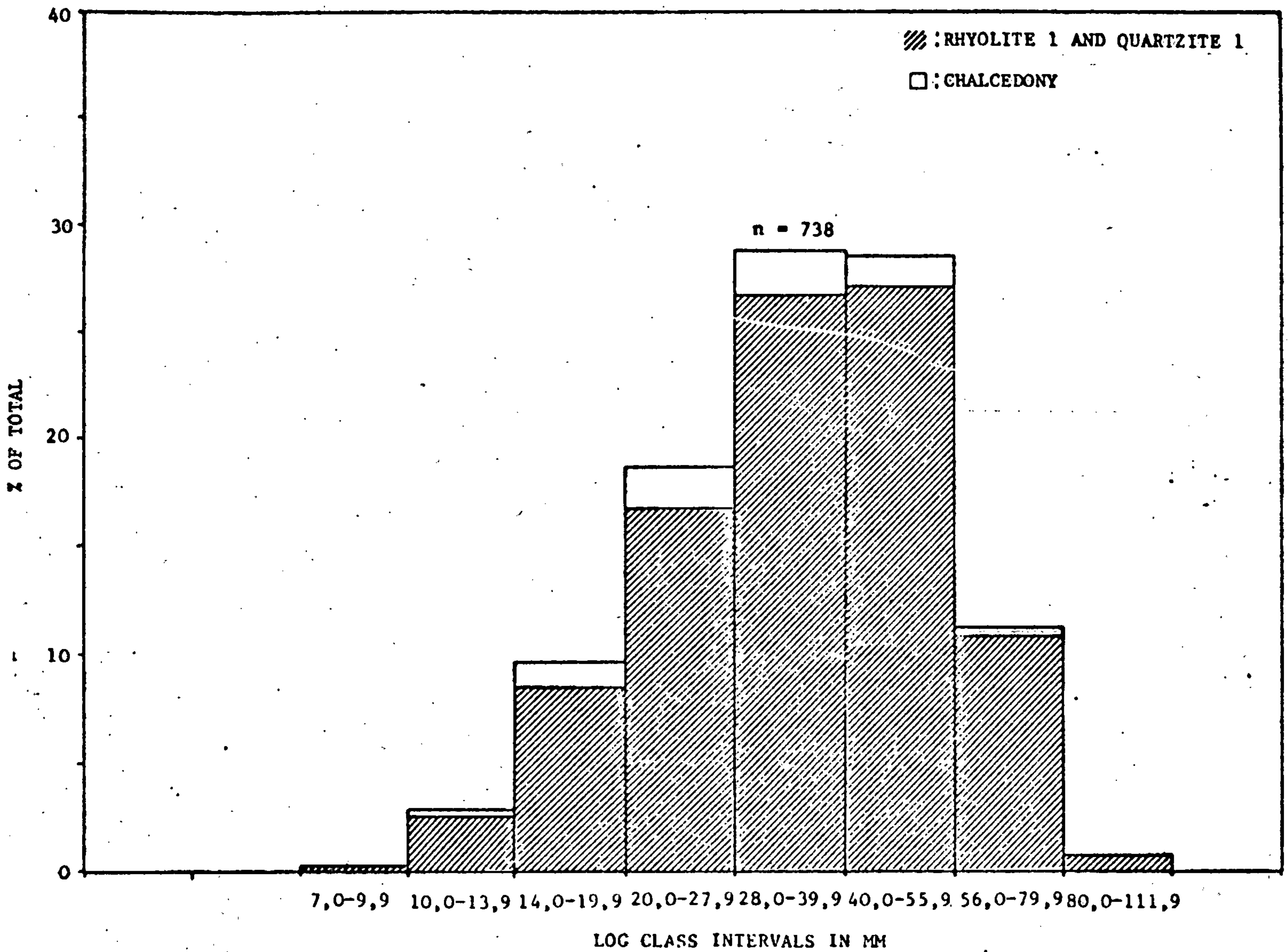


FIG. 57 BORDER CAVE. STRATUM 1RGBS A + B. I2 SUBCLASS. LENGTH DISTRIBUTION

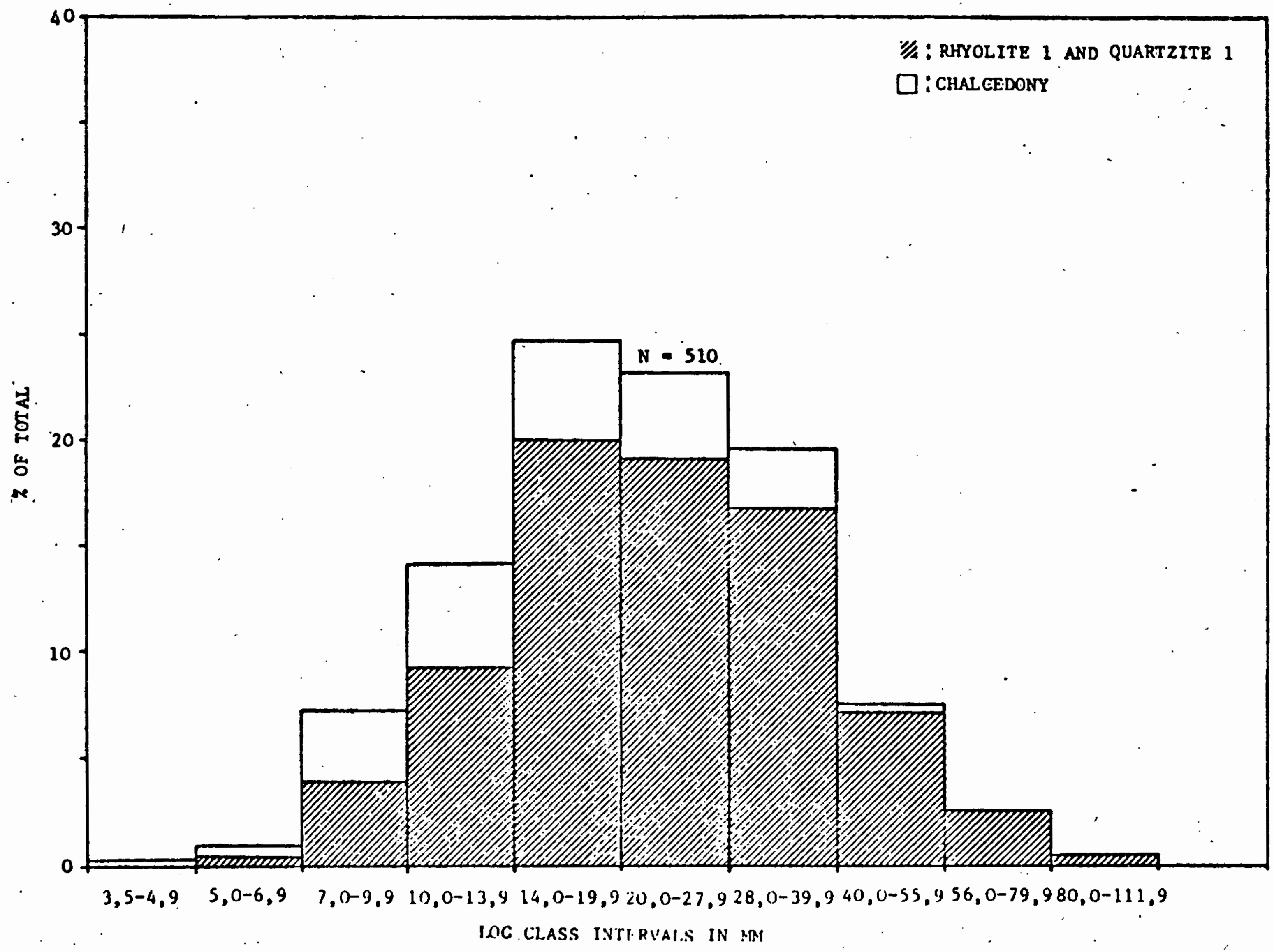


FIG. 58 BORDER CAVE STRATUM 2BS.LR.C I2 SUBCLASS. LENGTH DISTRIBUTION

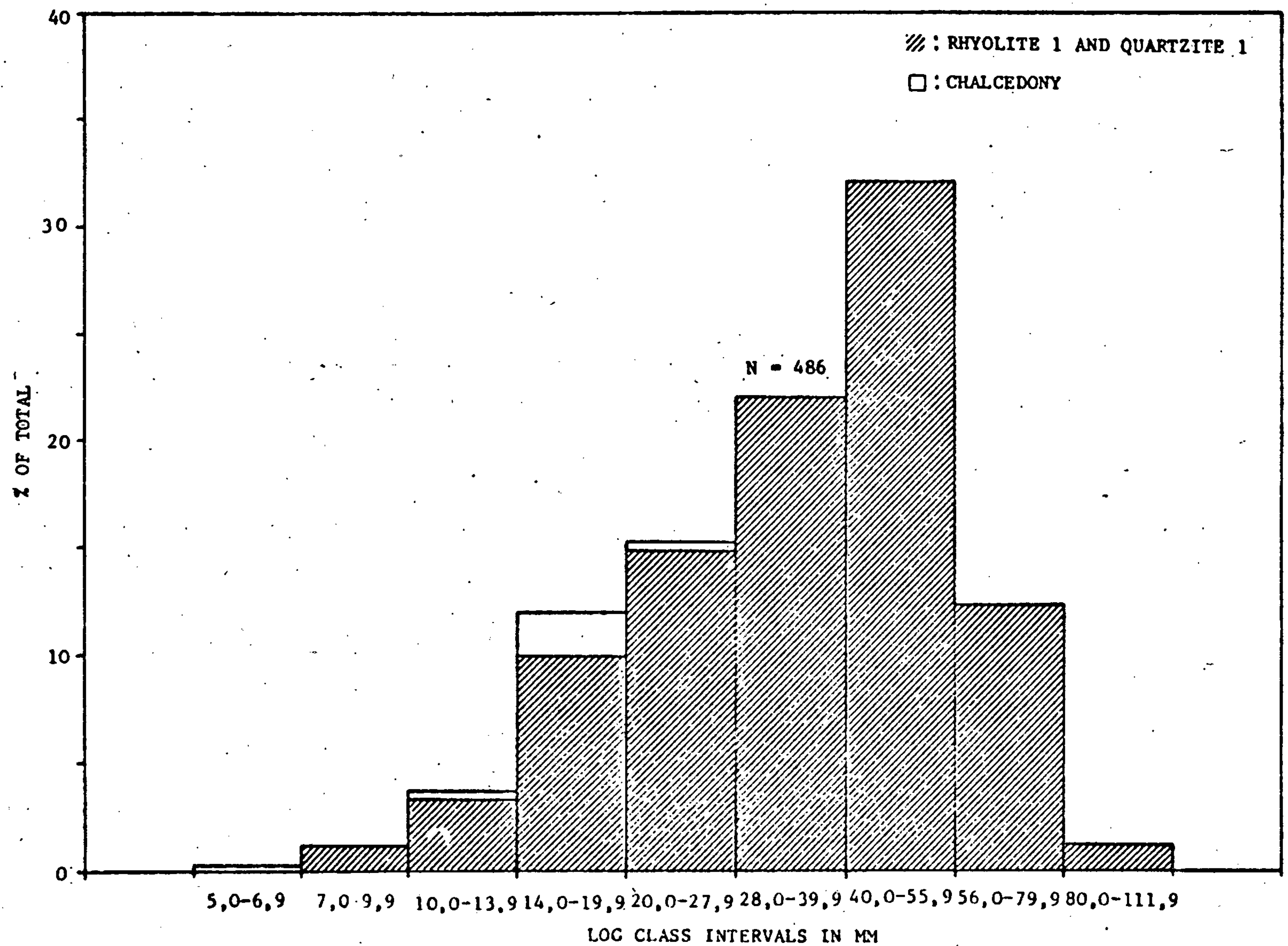
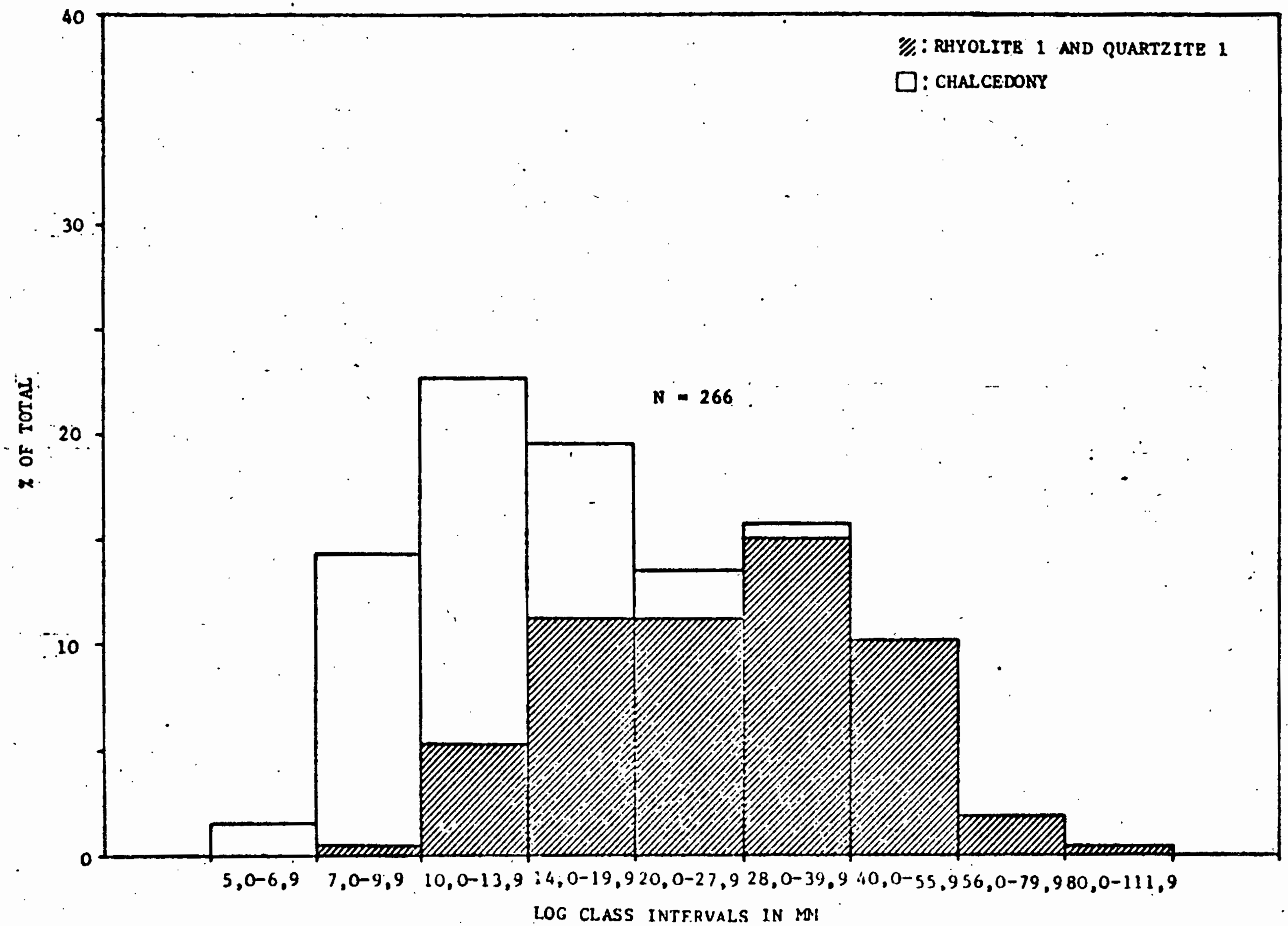


FIG. 59 BORDER CAVE STRATUM 1WA and 1BES . I2 SUBCLASS. LENGTH DISTRIBUTION



2.10.2 Stone artefacts

Comments are as follows :

(a) Spatial shifts in stone artefacts absolute frequencies cannot be objectively assessed, because of often marked variations in stratum thickness, but this stricture does not of course apply to proportions. Silicate percentages in squares with total samples of >10 were therefore analysed in order to determine how V values for these varied on a stratum basis. The resultant data, not presented here, indicated that this parameter is typified by rather high readings, which consequently militate against the confident corroboration of patterns based on casual impression only. More sophisticated tests may produce less equivocal results if applied to some possible trends, such as the apparent westward decline of silicate values in the 2WA.

(b) Retouched tool and pigment fragment frequencies are generally low and were only evaluated visually. A number of concentrations were noted but it was again found difficult to identify any as certainly non-random when the readings for that square were considered in terms of the total artefact sample from it and an assumed variability similar to that revealed by the silicate percentages, although some values are undoubtedly suggestive, such as those which occur in T24 of 2BS.LR.C.

2.11 Temporal Analysis

2.11.1 Fused or smelted items

An investigation to determine how the major classes vary with time of a stratum basis in Exc. 3A Rear was carried out by means of the data in Appendix 26. Comments are as follows :

(a) Sherds. It was noted that :

I. 1BS.UP.IA produced 150 items of which 16,0% are from disturbed contexts.

II. 1BS.UP.S produced 16 items of which 37,5% are from disturbed contexts.

III. 1BS.LR + 1WA produced 21 items of which all are from disturbed contexts.

This data is here taken to mean :

I. That sherds are not truly indigenous to the 1BS.LR + 1WA.

II. That 1BS.UP.IA and 1BS.UP.S differences in absolute frequency and disturbed proportion strongly suggest but do not indisputably prove that items in the latter level are due to intrusion from immediately above and/or the imperfect separation between them achieved by using 7.5 cm spits.

(b) Glass beads. It was noted that :

I. 1BS.UP.IA produced 216 items of which 2,8% are from disturbed contexts.

II. 1BS.UP.S-1WA produced 6 items of which 83,3% are from disturbed contexts.

These marked shifts in absolute frequency and disturbed proportion clearly indicate that such items are only in situ in the 1BS.UP.IA.

(c) Metal objects. The brass bead and aluminium disc from 1BS.LR are both from disturbed contexts and these items may therefore be regarded as probably displaced.

2.11.2 Stone artefacts

An investigation was carried out in order to determine if and how stone artefact number per unit volume of deposit varied with time on a stratum basis in Excs. 3A Rear and 3B. The 'flake +' category selected for use as an index was calculated by adding the equivocal Tool 2 group to flake minimum number (2.6.2). Volumes for the various sampled levels, corrected for absent data squares, derive from Appendix 5. Pertinent data are fully listed in Appendix 59. Results are given graphically in Figure 60. Comments are as follows :

(a) Perfect preservation in Exc. 3A Rear results in the values obtained there for any given level being the product of only two partly related variables, namely :

I. The occupation density/number of cave occupants as roughly represented by the frequency of 'flakes+' required to satisfy their material needs per unit time (stratum).

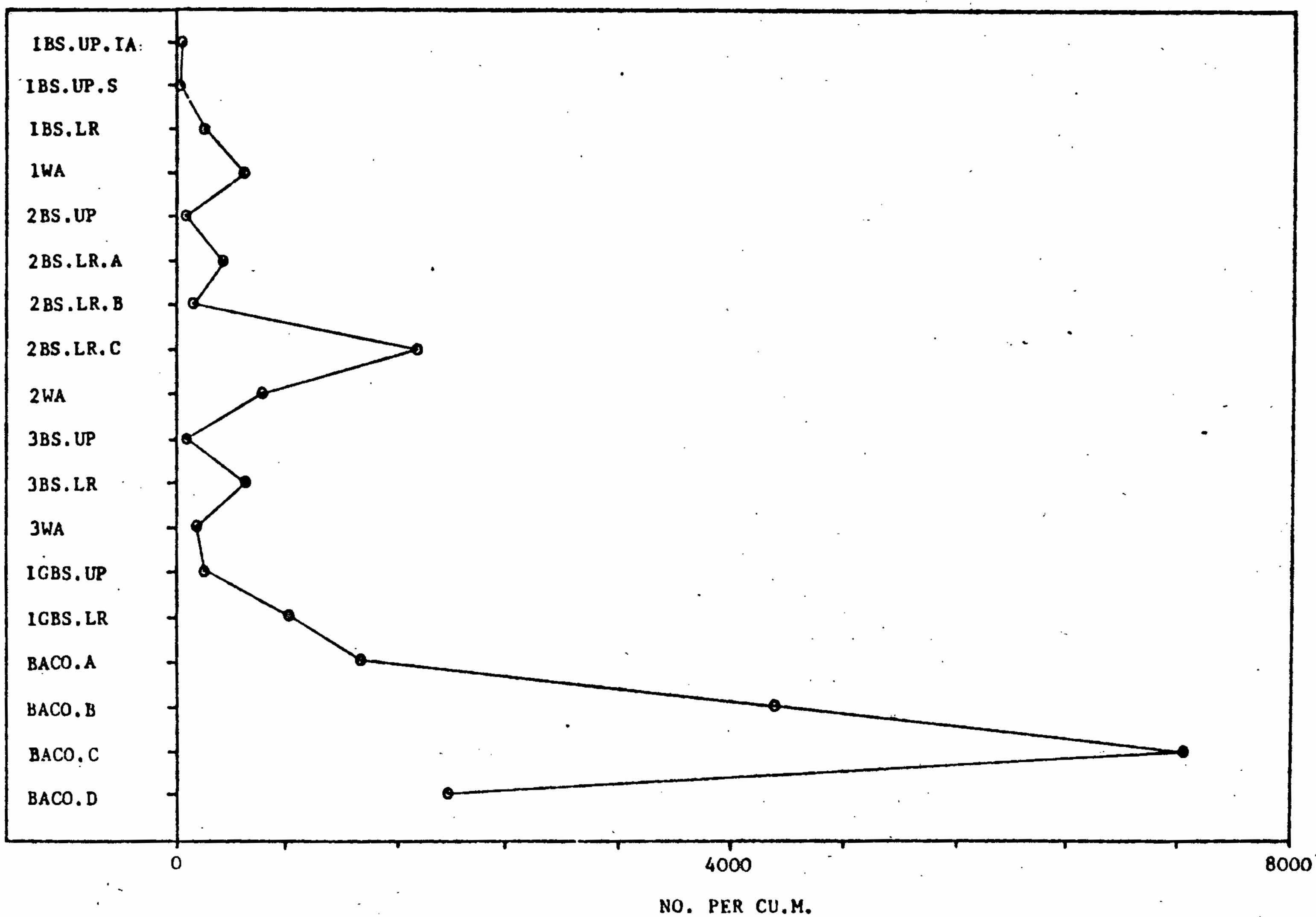
II. The true sedimentation rate/volume of mineral sediment formed plus cultural debris introduced per unit time (stratum).

Inferred dating evidence suggests that the rate of mineral sediment production was usually extremely low, with the possible exception of cryoclastic rubble zones. One implication of this is that the 'dampening' effect on value extremes which the reverse case has, should be at a minimum. That this is indeed the case is evidence by a minimum/maximum 'flakes+' stratum value ratio of ~0,1%.

(b) Interpretation of the results is somewhat impeded by the fact that the entire cave floor was never fully occupied at any one time. This resulted in large areas being either peripheral and/or unoccupied, with consequent sampling uncertainty in some levels (e.g. 3WA). However, stratigraphic evidence supports the view that the central portion of the cave as represented by Exc. 3A Rear was the focal occupation region

FIG. 60 STONE FLAKES + DENSITY CHANGES WITH TIME

BORDER CAVE STRATUM 3A+ 3B



subsequent to 3BS.LR.B, and the vertical variations in that portion of the profile are therefore regarded as reliable from this viewpoint.

(c) Additional distortions result from :

I. The presented data being incomplete in that it was decided not to interpolate the 1RGBS.A+B values into the sequence of readings from Exc. 3A Rear.

II. The BACO.B-D samples being derived from an area susceptible to moisture influx from the drip-line, with attendant attrition of the organic fraction (1.4.11). The 'flakes+' values for these levels are as a result almost certainly too high (but very probably by less than x2).

The deficiences and difficulties outlined above preclude undue importance from being attached to any but the coarser of the remarkably large fluctuations actually observed in Figure 60. On this basis, after making a 50% reduction for readings from BACO.B-D and deleting the irrelevant 1BS.UP.IA, it is concluded :

(a) That very low values (<100 'flakes+' per cu.m) relate to 1BS.UP.S, 2BS.UP and 3BS.UP.

(b) That very high values (>1000 'flakes+' per cu. m.) relate to 2BS.LR.C and BACO.A-D.

These extremes undoubtedly indicate major shifts in occupation density, presumably largely as a result of marked temporal changes in the environment. It is of note that significant typological breaks coincide with all of the low readings cited above.

3. THE FAUNA

3.1 Analytical Approach

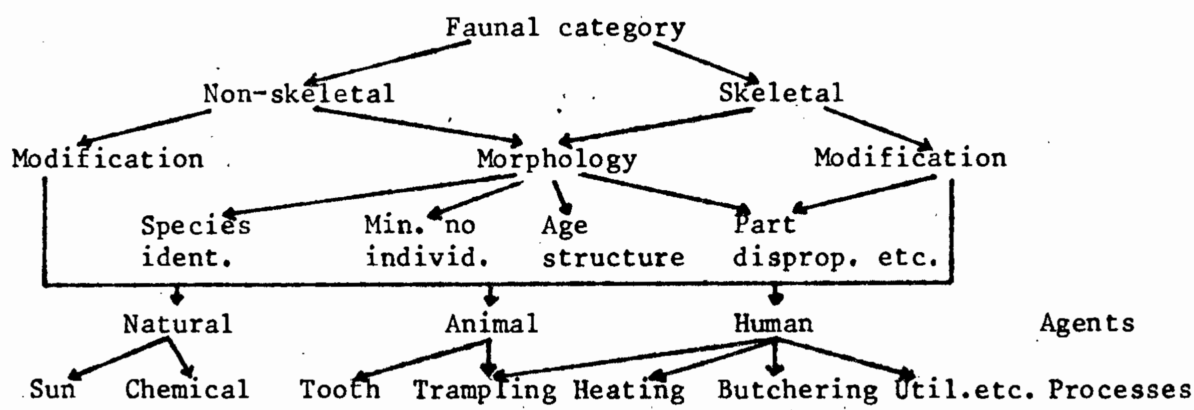
At Border Cave the quality of faunal preservation is exceptional, as a result of minimal chemical weathering, in areas well away from the drip-line (Fig. 61). This results in unusually reliable deductions being possible concerning:

a) Species identification and related data based on morphology.

b) The agents responsible for the bone accumulation.

c) The processes which led to the present state of modification.

Deductions in connection with these various aspects in any given open or cave occupation level may be based on an analysis in terms of the following hierarchy of primary information sources:



The arbitrary faunal categories isolated, in order of discussion, were: hominid; large mammal; small mammal; mollusc shell; ostrich eggshell; insect; millipede; hair; feather and coprolite. Fairly complete information retrieval, in terms of the above-mentioned scheme, was only attempted in the case of the large mammals. All Exc. 3A Rear categories were also subjected to spatial and temporal analysis, but these data were only evaluated when numbers or quantities sufficed.

3.2 Hominid

Full particulars concerning the five individuals recovered to date are given in Appendices 28-32. Numbering of fragments is according to the scheme adopted by de Villiers (1973) and Beaumont *et al.* (n.d.). Early forms of our own species are referred to in this dissertation as anatomically modern *Homo sapiens* (a.m.*H.s.*) (Howells, 1974). Equivalents with contentious nuances

Fig. 61 Major faunal categories

Numbering from top to bottom:

Row 1,left : From S24. 1GBS.UP. Six microfaunal fragments

Row 1,right : From R19. 1GBS.UP. Two mollusc shell fragments

Row 2,left : From R21. 3BS. Two ostrich eggshell fragments

Row 2,right : From R23. 2BS.LR.C. Jaw fragment with teeth of cf. Antidorcas bondi

Photograph by D. Rokos

in terms of phylogeny or systematics are Homo sapiens sapiens (eg. Beaumont and Vogel, 1972) and Homo sapiens afer (eg. Wells, 1969)

Evidence bearing on the stratigraphic provenances of these remains is as follows, with information being derived, unless otherwise stated, from Archaeological Survey file B20/1/2:

a) Border Cave 1. The cranial vault fragments initially found during 'fertilizer' removal in 1940 are said to have come from the north-east sector of Horton's Pit (Fig. 3). Statements differed however as to their precise position within the ~ 170 cm depth of sediments removed in that area (Fig. 9). Observations made in 1942 revealed that the 4WA surface extended undisturbed across the floor of that digging. The cranium may therefore be associated with any of the eight overlying M.S.A. sub-levels or with the thin and superficial Early L.S.A. and IA horizons (Figs. 13 and 14). Cooke and co-workers considered that the character of the adhesions in the small interstices of the skull pieces precluded the possibility that these had come from any ash or rubble horizon, and they concluded that the only matching stratum was the 'chocolate coloured layer' which constitutes the base of our 1GBS.LR (Table 1).

b) Border Cave 2. This partial mandible was found during the sieving of Horton's Dump in 1941 (1.3). Morphological evidence suggests that it is not attributable to Border Cave 1. Stratigraphic data cited in (a) would again exclude an ascription to levels below the 1GBS.LR.

c) Border Cave 3. This largely complete infant skeleton was found straddling squares F12 and G12 during systematic excavations in 1941. It came from a shallow but indubitable grave having a maximum length of 38 cm and breadth of 30 cm, with the long axis running north-east to south-west (Fig. 9). Pit walls sloped inwards, except in the north where undercutting was noted. Base depth increased southwards, with a maximum of ~ 137 cm in the north-west quadrant of G12. The first human fragments were found at just less than 114 cm and the grave-lip appeared to be marginally higher. Infilling was entirely comprised of loosely compacted chocolate coloured earth. Remains seemed to have been rather scattered and it was not found possible to deduce original posture. Associated was a perforated Conus shell, presumably an ornament or amulet, which must have been transported from at least 80 km away (Fig. 2). A number of the bones had reddish-brown blotches, which may represent traces of red ochre (de Villiers, 1973). The base of an undisturbed ~ 8 cm thick layer of deep brown sand overlying black ash, marking the lower limits of the 'refined' industry of Cooke et al. (1945), is recorded as lying ~ 5 cm above the apparent grave-lip, at a depth of ~ 107-109 cm in E12 and G12. Malan's field diary also notes an increase in Achatina shell in E 12 107-114 cm, which strongly suggests that this spit was at least partly probing the mollusc-rich 1GBS.UP (Fig. 85). It follows from these facts that the burial almost certainly refers to the surface levels of the 'normal' Pietersburg, but that it may at the very latest relate to the onset of the 'Epi-Pietersburg'.

d) Border Cave 4. This skeleton minus calotte was found outside the grid area, in the southernmost portion of the cave and close to the back wall, while clearing surface rubble prior to setting up a 'communal' sleeping area there, at the onset of field work in December 1970 (Fig.3). It came from a very shallow grave which had been cut through the locally very rubbly 1BS, from at or just below the present surface to bedrock at a maximum depth of ~ 15 cm. The body was largely surrounded and partly covered by casually stacked rock slabs. Apparent previous removal of some of these may well have partly exposed the skull, thereby leading to its disappearance then or later. The cadaver was found lying contracted on its left side, with back to the west and head to the north. Distance from right knee to chin was observed to be about 40 cm. Arms were crossed over the chest, the right under the left. An ~ 8 cm broad and very rusted iron bracelet encircled the left wrist. The right hand was over the left shoulder and on it rested the mandible. Ribs had all collapsed inwards and the pelvis was cracked, possibly from the weight of the overlying rocks. Shells of carrion beetle pupae surrounded the body and a small piece of leather was found immediately east of the pelvis. Almost all of the postcranial portions were present despite the bone being generally friable.

e) Border Cave 5. This major portion of a lower jaw was recovered in the author's presence by Colleen Powell on April 10, 1974. It came from just above the base of the intact 3WA, in the north-west corner of square T20 immediately adjacent to a marked depression to the east (Figs. 15 and 62). That stratigraphic anomaly extends into the face of the trench and would, for its further investigation, require the removal of strip U . From these data it is evident that the fragment relates to the onset of the 3WA, which contains a middle phase of the 'Epi-Pietersburg'.

Fig 62 C. Powell holds Border Cave 5 in the precise position, immediately above the base of 3WA, where it was found by her on April 10, 1974. Note the intact surface of this stratum some 25cm above the mandible.
Photograph by courtesy of G. Baker

3.3 Large Mammal

3.3.1 Morphological analysis

Data based on skeletal part morphology are comprehensively dealt with by Klein in Appendix 33. Non-mammalian remains noted but not listed there include snake bones from 1WA (1/1), 2BS.LR (1/1) and 2BS.LR.A (1/1). His Table 1 can be slightly amplified in terms of species range and/or temporal distribution by the following information from Cooke's notes in Archaeological Survey file B20/1/2 :

a) *Equus* cf. *capensis* (*Equus* cf. *kuhni*). A left M^2 found by Horton and recorded as being appreciably larger than any recent zebra.

b) *Hippopotamus amphibius*. A right lower canine is recorded from the BACO levels of Exc. 2.

c) *Redunca cf. arundinum*. A number of lower molars found by Horton are recorded as probably lowland reedbuck.

d) *Sylvicapra* cf. *grimmia*. A number of lower teeth found by Horton are recorded as probably grey duiker.

e) *Syncerus caffer*. Half a juvenile mandible is recorded from the BACO levels of Exc. 2.

f) *Pelorovis* spp. (*Bubalus* cf. *andersoni*). A heavily worn left M_3 found by Horton is recorded as being markedly larger than the extant buffalo.

Comparisons with the modern fauna at Hlane as given in Appendix 2 confirms that most of the species in Table 1 were historic inhabitants of this part of the eastern Lowveld (Klein, 1977). Two possible and unexpected absentees at the present time are:

a) ?*Lepus crawshayi*. A small hare only tentatively identified as such.

b) *Procavia* and *Dendrohyrax*. Dassie remains range between BACO.A and 1BS.UP, but are not known to occur today in the central and southern sectors of the Lebombo Mountains (Reilly, 1976).

3.3.2 Modification analysis: Processes

A fairly careful analysis of the observable processes which led to bone surface and/or state modification provided the following data for Exc. 3A Rear:

a) Natural. Sun cracking. Not observed.

b) Natural. Chemical corrosion. Not observed.

c) Animal. Tooth damage. Details are as follows:

I. Porcupine. One gnawed bone from 2BS.LR.A.

II. Rodent. One gnawed bone from 1BS.UP.

III. Carnivore. No certain punctate marks.

d) Human. Utilized. Two radial fragments with prong-like ends showing certainly smoothed surfaces were recovered from the 2BS.UP. (Fig. 63).

e) Human. Flaked. A minor proportion of the fragments in most levels shows mainly small 'trimming' scars running from breakage surfaces. No attempt was made to determine if these tend to occur on particular skeletal parts. It is therefore not possible to estimate to what extent this damage can be regarded as intentional.

f) Human. Butchering. A minor proportion of the fragments in most levels shows single or multiple but invariably shallow cut and/or chop marks. The former consistently preponderate and both are presumed to have been mainly inflicted by accident during slaughtering (Fig. 63).

g) Human. Heating. A fairly large proportion of the fragments in all levels shows varying degrees of fire damage. This is probably largely due to a fortuitous vertical or lateral proximity to hearths (de Graaff, 1961). However, occasional and/or supplementary use of fresh combustible bone as a fuel cannot be precluded. An analysis of the three surface state categories which can be strictly defined is given for a fairly typical sample from the 2BS.LR.C (Table 3). Observations suggest that proportions vary somewhat in spatial and temporal terms. In particular, the values for entirely calcined bone is believed to be particularly high for the orange 'fired' sediments which dominate the 3WA in Exc. 3A Rear.

It is clear from these few pointers :

a) That natural and animal agencies made only a very minor contribution to bone surface modification.

b) That the available evidence points to processes associated with man as the primary and predominant cause of bone surface modification.

3.3.3 Modification analysis : Fragmentation

A rather crude analysis was undertaken of the inferred processes which led to bone shape modification in Exc. 3A Rear. A more rigorous investigation of this aspect should perhaps focus on one easily identified and abundant skeletal part (e.g. limb-bones). Breakage changes in this category could then be studied by way of $\overline{X}$ and SX variations in shaft axis length relative

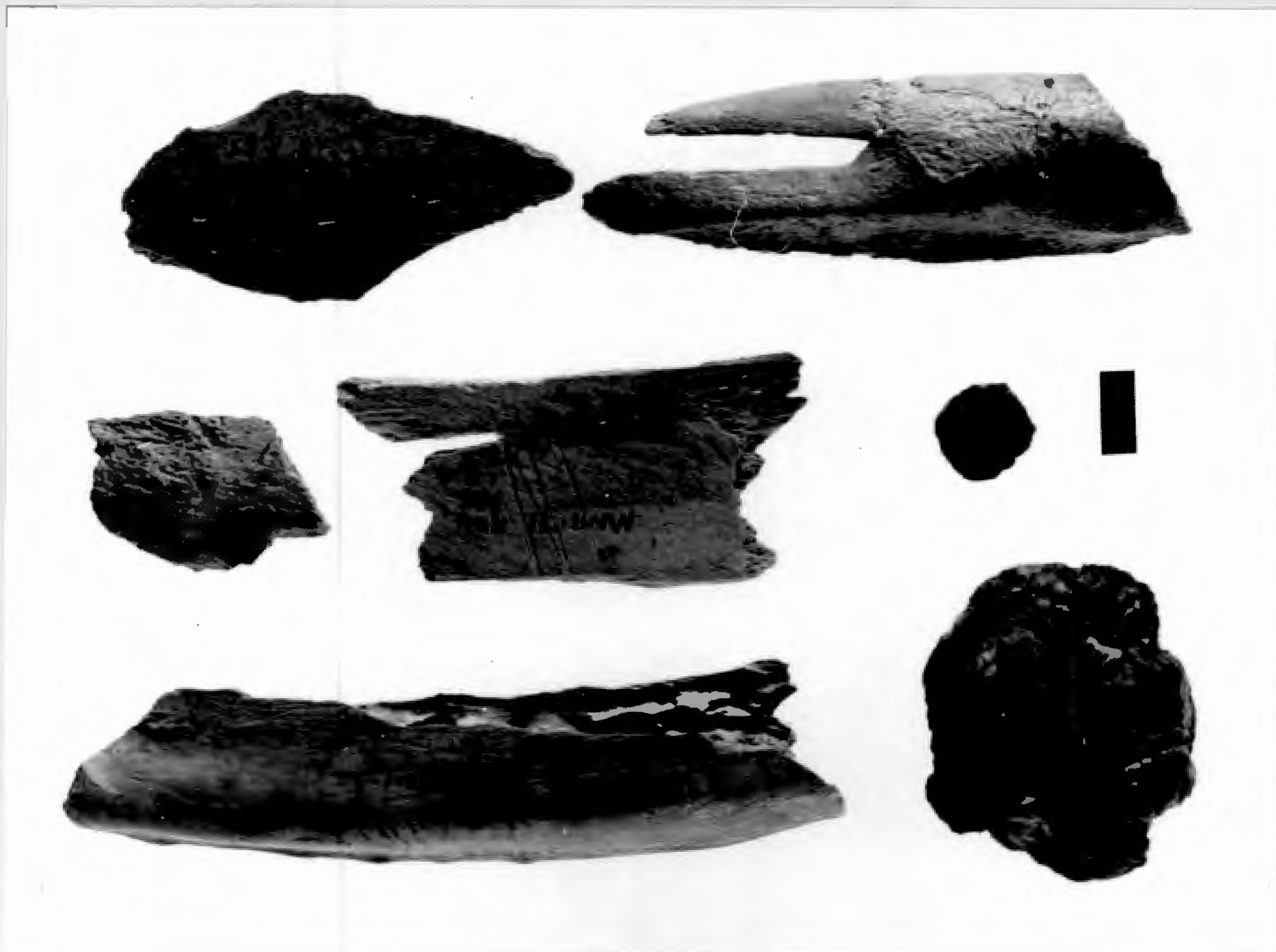


Fig. 63 Some damaged and utilized organic objects.
Numbering from top to bottom:

Row 1,left : From S21.1GBS.UP. Striated scapula fragment
Row 1,right : From Q17.2BS.UP. Radial fragment with smoothing on the surfaces of both prongs
Row 2,left : From S20. 2BS.UP. Horn-core base showing cut-marks presumably inflicted while skinning face
Row 2,centre: From R24.3BS.LR.A Striated scapula? fragment
Row 2,right : From Q21 38-46cm.1BS.UP.Sterile. One of four fragments of euphorbia? resin found in this square
Row 3,left : From R23. 2BS.LR.C.Striated buffalo? rib fragment
Row 3,right : From S19. 53cm - 1WA.1BS.LR. Beeswax fragment showing impressions made by vegetation while it was still soft

Identifications by J. Kitching

Photograph by D. Rokos

TABLE 3. An analysis of fire damage to macrofauna in a typical level

Bone surface damage	Mass in g.	% of total
Uncharred	587	64,9
Partly charred	114	12,6
Entirely charred :		
Black etc. (uncalcined)	133	14,7
White only (calcined)	70	7,8
Totals	904	100,0

to shaft wall thickness. We have here, as a matter of expediency, chosen the rough but easily calculated index provided by number of > 3 mm fragments per kg (1.5).

Pertinent data is fully listed in Appendix 34. Results are given graphically in Figure 64. Comments are as follows:

a) No attempt was made to correct for temporal shifts in S.G. These vary from ~ 1,90 in 1BS.UP and 1WA to ~ 2,07 in 2WA and 1GBS.UP (Appendix 55). An adjustment for this variable would have the effect of increasing values for the lower levels somewhat.

b) Values are seen to vary widely from ~ 780 in 2WA to ~ 1410 in 3WA, with a mean for all levels of ~ 1160. Readings for other sites (Appendix 61) suggest that this mean value may be regarded as indicative of extreme fragmentation.

When interpreting this information it is useful to consider bone fragmentation as the product of two independent groups of processes having largely indistinguishable effects, namely:

a) Pre-depositional processes, which would or could include breakage during: gnawing and/or marrow extraction by man and/or beast; slaughtering and/or tool making by man alone.

b) Post-depositional processes, which would include: chemical weathering; fire damage; trampling by man and/or beast. All of these are to some extent time-dependent as for example trampling damage, which is probably in most instances largely a function of occupation density and sedimentation rate.

Any evaluation of the relative effects of these two process groupings is impeded by the relatively few studied bone accumulations from sites which were not simultaneously occupied. One Southern African exception may be the I.A. collection excavated by L. Hodges from a ~ 30° talus slope on the Acropolis at Zimbabwe (Brain, 1974). The circumstances there would probably have tended to minimize group (b) processes, and the recorded value of ~ 65 fragments per kg is therefore of particular note. This reading, if at all typical of the breakage intentionally effected by man alone, could imply that > 90% of all fragmentation in our 'average' stratum is due to post-depositional processes. That this finding is conceivable is at least to some extent supported by the very frequent discovery during excavation and analysis of markedly contiguous joining tooth and bone fragments, suggesting that breakage of these postdated deposition (Fig. 65).

FIG. 64 MACROFAUNAL FRAGMENTATION CHANGES WITH TIME

BORDER CAVE. EXC. 3A REAR

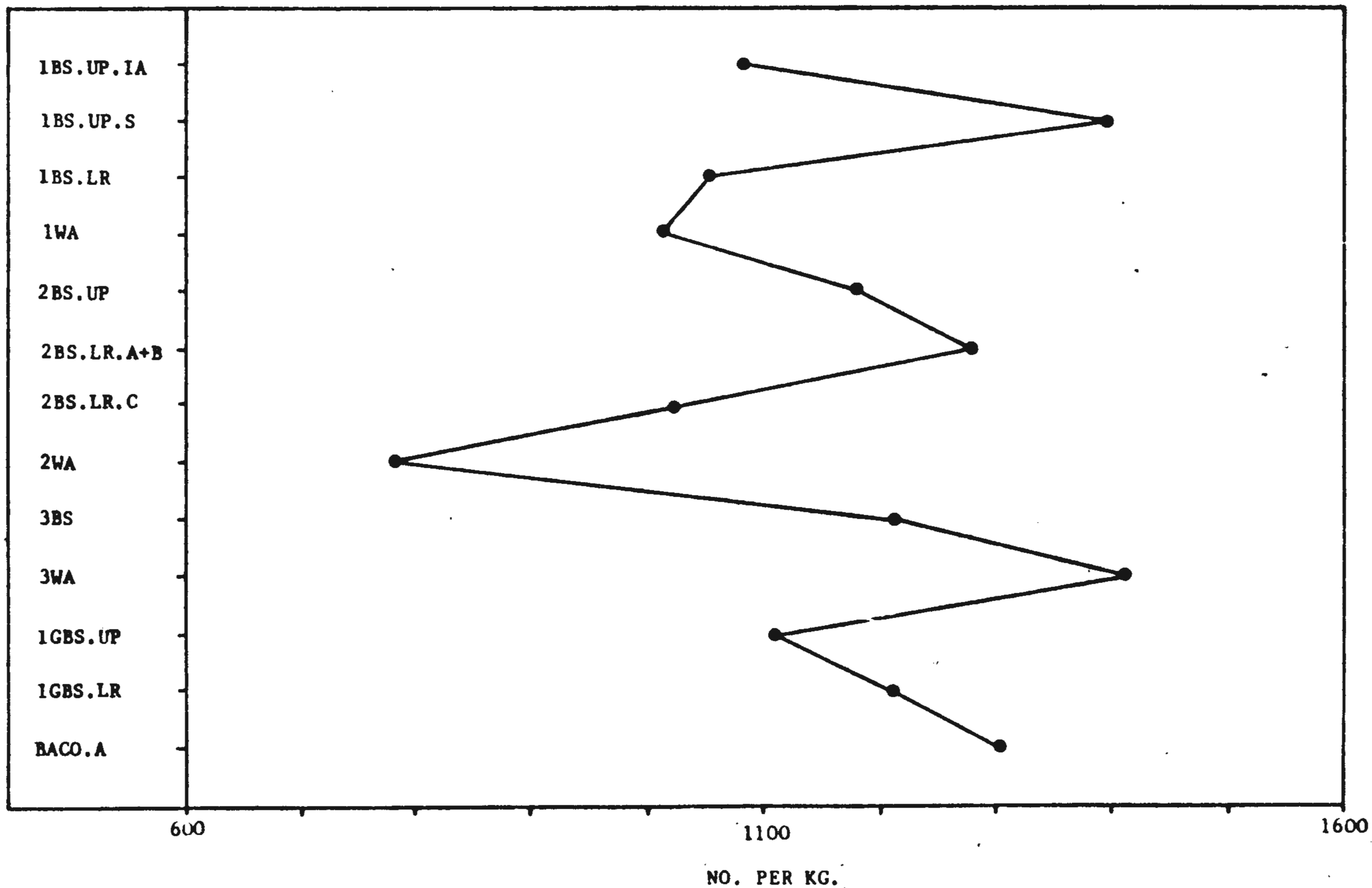


Fig. 65 Bone fragmentation
From S20. 2BS.LR.C Portion of a kudu-sized bovid tibia reconstructed from ten slivers by J. Kitching.
Photograph by D. Rokos

In Exc. 3A Rear we can certainly exclude chemical weathering in a consideration of which (b) grouping process dominated. This leaves fire heating and human trampling, with a further clue in this connection being provided by Figure 64. The shifts recorded there indicate that levels with a high ash content are typified by lower breakage values. This can be construed to mean that possibly enhanced breakage as a result of fire damage in those levels was more than offset by increased protection from trampling as a result of accelerated sedimentation. It may therefore be tentatively concluded that fragmentation at this site was mainly caused by prehistoric feet, with the extreme values recorded being a direct result of the very low rates of sediment formation in most strata.

3.3.4 Spatial analysis

An investigation of the lateral distribution of macrofaunal fragment numbers and masses on a square by square basis was undertaken for all levels in Exc. 3A Rear. The information compiled in this connection is listed in Appendices 35 and 60 . Comments are as follows:

a) V values for stone artefacts and macrofaunal fragments are of the same order in any given level.
b) No intact square in any stratum showed a certainly anomalous value when considered in terms of mean deposit thickness there (Appendix 4) and an assumed variability similar to that revealed by the silicate percentages (2.10.2).
c) The four disturbed squares in 1BS.UP.S produced fully ~ 50% of the total number of fragments found in that level. This inordinately high reading appears to be mainly due to mixing between 1BS.UP.IA and 1BS.UP.S.

3.3.5 Temporal analysis

An investigation was carried out in order to determine if and how macrofaunal fragment mass per unit volume of deposit varied with time on a stratum basis in Exc. 3A Rear. Pertinent data is fully listed in Appendix 59. Present comments are as follows:

a) Macrofaunal fragments occur throughout the deposit.
b) Mass per cu.m varies markedly, with a minimum/maximum stratum value ratio of ~ 1,5%.

3.4 Small Mammal

3.4.1 Morphological analysis

A provisional microfaunal list with some tentative environmental deductions is provided by de Graaff in Appendix 36. A more rigorous quantitative study of the reasonably large 'identifiable' samples should substantially amplify these data.

3.4.2 Spatial analysis

An investigation of the lateral distribution of microfaunal fragment numbers on a square by square basis was undertaken for all levels in Exc. 3A Rear. The information compiled in this connection is listed in Appendices 37 and 60 . Comments are as follows:

a) V values in any given level are usually much higher than those relating to stone artefacts and macrofaunal fragments.

b) No intact square in any stratum showed a certainly anomalous value when considered in terms of mean deposit thickness there (Appendix 4) and an assumed variability similar to that revealed by the silicate percentages (2.10.2).

c) The two disturbed squares in 1BS.UP.TA produced fully ~ 21% of the total number of fragments found in that level. This inordinately high reading appears to have been caused by an TA pit which cut into the IBS.UP.S (1.4.1.1).

3.4.3 Temporal analysis

An investigation was carried out in order to determine if and how microfaunal fragment number per unit volume of deposit and other parameters varied with time on a stratum basis in Exc. 3A Rear. Pertinent data are fully listed in Appendices 37 and 59. Present comments are as follows:

a) Microfaunal fragments occur throughout the deposit.

b) Number per cu.m varies markedly, with a minimum/maximum stratum value ratio of 10%.

c) The proportion of jaws with teeth to total fragments has a mean for all levels of ~ 7% and a range of ~ 1-13%. Values tend to decrease markedly with depth as indicated by means of ~ 10,5% for 1BS. as compared to ~ 2,5% for 1GBS.

d) The proportion of charred to total fragments has a mean for all levels of ~ 10% and a range of ~ 1-47%. Mean values range markedly between ~ 3% for BS. levels and ~ 19% for WA and GBS levels.

3.5 Mollusc Shell

3.5.1 Morphological analysis

Data based on shell fragment morphology are provided by Plug in Appendix 38.

3.5.2 Spatial analysis

An investigation of the lateral distribution of mollusc shell fragment numbers on a square by square basis was undertaken for all levels in Exc. 3A Rear. The information compiled in this connection is listed in Appendix 39. Comments are as follows:

a) Occurrences in levels with high values were noted to be mainly confined to areas forward of strips Q-T21 (e.g. 1WA and 1GBS.UP).

b) Occurrences in levels with low values are often markedly localized and appear to indicate the post-depositional breakage of single shells (e.g. S18 and S24 in 3BS).

c) The three disturbed squares in 1BS.UP.S produced fully ~ 88% of the total number of fragments found in that level. This inordinately high reading appears to be mainly due to mixing between 1BS.UP.S and 1BS.LR.

3.5.3 Temporal analysis

An investigation was carried out in order to determine if and how mollusc shell fragment number per unit volume of deposit and other parameters varied with time on a stratum basis in Exc. 3A Rear. Pertinent data are fully listed in Appendices 39 and 59 . Present comments are as follows:

a) Mollusc shell fragments occur throughout the deposit.

b) Number per cu.m varies markedly, with very high values being almost entirely limited to two zones centred respectively on 1WA and 1GBS.UP. This suggests that these two levels differ from all others, perhaps in terms of seasonality of occupation and/or outside environment.

c) The proportion of charred to total fragments in samples of > 40 has a mean for all levels of ~ 46% and a range of ~ 13-71%. These values are seen to be substantially higher than those pertaining to microfauna. This difference may relate to the probable protection afforded the rodent bones by their original encapsulating owl coprolite (Beaumont, 1973a).

3.6 Ostrich Eggshell

3.6.1 Morphological analysis

Identifications were all checked by the author subsequent to the initial sorting in 1972 (1.5).

3.6.2 Spatial analysis

An investigation of the lateral distribution of ostrich eggshell fragment numbers on a square by square basis was undertaken for all levels in Exc. 3A Rear. The information compiled in this connection is listed in Appendix 39. Comments are as follows:

a) A number of post-2BS occurrences are markedly localized and appear to represent abandoned raw material that was being used for bead production (e.g. R23 of 1BS.LR).

b) A number of pre-1WA occurrences are markedly localized and appear to represent post-depositional breakage of larger fragments collected for some unknown reason (e.g. Q24 of 2BS.LR.C).

c) None of the pre-1WA squares or even levels produced enough fragments to represent anything like a single shell. The present evidence does not therefore support the possibility that these objects were used as water-containers during the M.S.A.

d) A casual inspection suggested that there was no spatial correlation between mollusc and ostrich shell fragment numbers.

e) Disturbed squares produced fully ~ 68% of the total fragment number found in 1BS.UP.IA and 1BS.UP.S. These probably all derive from the 1BS.LR.

3.6.3 Temporal analysis

An investigation was carried out in order to determine if and how ostrich eggshell fragment number per unit volume of deposit and other parameters varied with time on a stratum basis in Exc. 3A Rear. Pertinent data are fully listed in Appendices 39 and 59. Present comments are as follows:

a) Ostrich eggshell fragments occur throughout the deposit.

b) Number per cu.m varies markedly, with very high values being almost entirely limited to a single zone centred on the 1WA. This correlates precisely with the first appearance in that level of ostrich eggshell beads.

c) The proportion of charred to total fragments ranges between ~ 13% in 1BS.LR. and ~ 35% in 1WA. These values seemingly approximate to those for mollusc shell.

3.7 Insect

3.7.1 Morphological analysis

Identifications by the Transvaal Museum are provided in Appendix 40. Some of the more photogenic items are illustrated in Figures 66 and 67.

Figure 66 Insect remains from Exc. 3A Rear

Numbering from left to right

Top, no. 1 : From T21 38-46cm. 1BS.UP. Iron Age. Specimen (body) of sub-family Anthiinae

Top, no. 2 : From T23 38-46cm. 1BS.UP. Iron Age. Specimen (complete) of Tragocephala variegata

Top, no. 3 : From R22 15-23cm. 1BS.UP Iron Age. Specimen (body) of family Curculionidae

Bottom, no. 1 : From Q22. 2BS.UP. Specimen (forewings) of Eurycorypha preserpinea

Bottom, no. 2 : From S23 23-30cm. 1BS.UP. Iron Age. Specimen (head frag.) of Kheper sp.

Bottom, no. 3 : From S23 2BS.LR.A+B. Specimen (head frags.)of sub-family Scaritinea

Fig.67 Small beetle (length 1,5mm)

From Q22. 2BS.UP. Ascribed to family Ptinidae, genus Meziosoma

Identified at Transvaal Museum

Photograph by P. Nagel

3.7.2 Spatial analysis

A record was compiled of all squares known to contain insect fragments in the post-2WA strata of Exc. 3A Rear. This information is listed in Appendix 41. Comments are as follows:

a) The concentration in R22 of 1BS.UP.IA is linked to an IA pit which may have acted as a trap if it was standing open at the time (1.4.1.1).

b) The concentration in Q22 of 2BS.UP actually represents the various portions of only two individuals (Figs. 66 and 67).

3.7.3 Temporal analysis

An investigation to determine how insect fragment numbers vary with time on a stratum basis in Exc. 3A Rear was carried out by means of the data in Appendix 41. Comments are as follows:

a) 1BS.UP.IA produced 20 items from 9 undisturbed squares.

b) 1BS.UP.S produced 9 items from 7 undisturbed squares.

c) 1BS.LR produced 3 items from 2 undisturbed squares.

d) 1WA produced no items at all.

e) 2BS.UP produced 12 items (3 individuals) from 2 undisturbed squares.

f) 2BS.LR produced 1 item (entirely charred) from 1 undisturbed square.

The evidence is ambiguous, but is here taken to mean:

a) That insects are associated with but decrease in frequency between 1BS.UP.IA and 1BS.UP.S.

b) That in and below 1BS.LR the fewer squares involved and the decline in absolute numbers both point to an intrusive origin for the associated uncharred remains.

3.8 Millipede

3.8.1 Morphological analysis

Identifications were all checked by the author subsequent to the initial sorting in 1972 (1.5). Some typical samples are illustrated in Figure 68.

3.8.2 Spatial analysis

A record was compiled of all squares known to contain millipede segments in the post-2WA strata of Exc. 3A Rear. This information is listed in Appendix 41. Comments are as follows:

a) Segments were found to be very abundant in some areas and levels. No attempt was made to effect a total retrieval of these in view of their

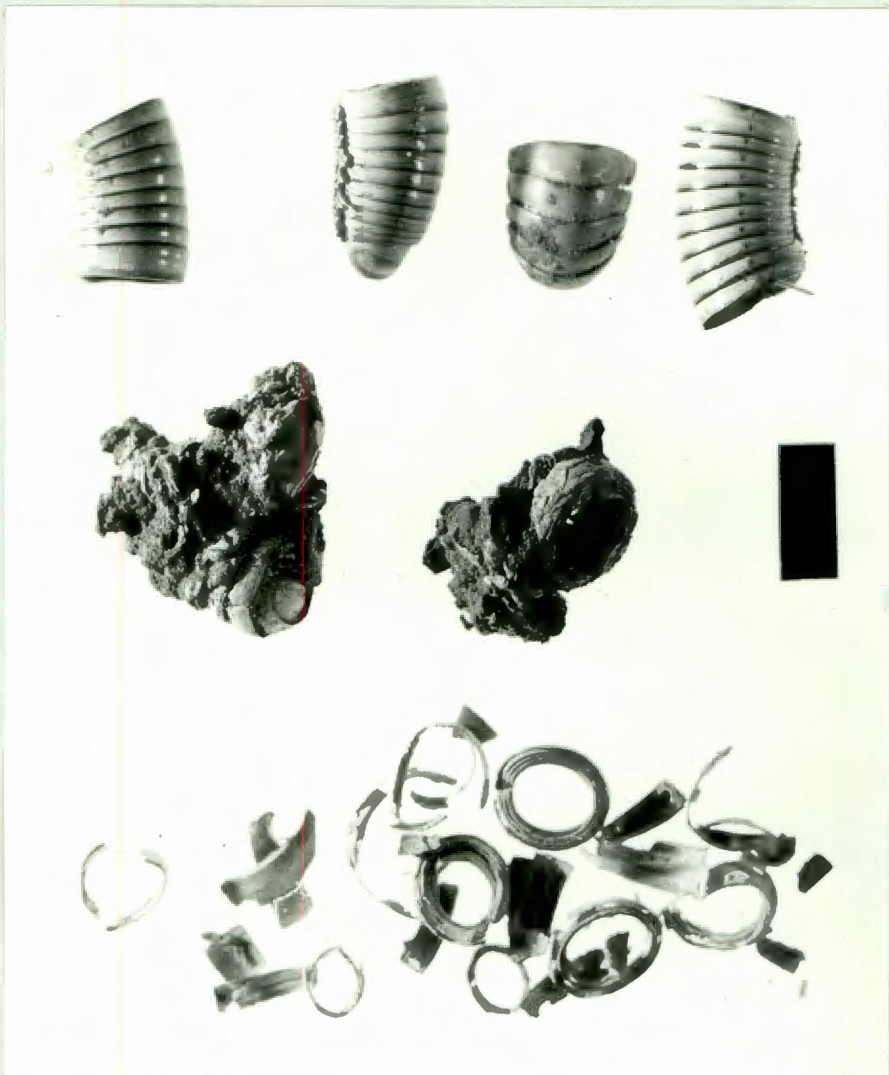


Fig. 68 Millipede segments

Numbering from top to bottom

Row 1, all : From S16 84-91cm. Disturbed. Probably Iron Age.

Row 2, left : From Q18. 1WA

Row 2, right : From R17. 2BS.LR.C

Row 3, all : From Q21. 2BS.LR.C

Photograph by D. Rokos

usual fragility and consequent tendency to fragment further on handling. As a pragmatic alternative we collected representative samples and noted squares with obtrusive abundances, but even this attenuated data must be regarded as being far from complete.

3.8.3 Temporal analysis

The details in Appendix 41 were used to make a broad assessment of how millipede segments as a whole vary with time on a stratum basis in Exc. 3A Rear. Comments are as follows:

a) Obviously intrusive segments from collapsed or intact portions of recent rodent burrows originating from Horton's Pit were noted in : R18 of 1GBS.UP; S19 of 1GBS.LR; S18, S19 and T18 of BACO.A (1.4.11).

b) In situ segments were noted to be particularly abundant in the 2BS.UP. Millipedes are not normally eaten by man but appear to be preyed upon by rodents, as revealed by (a). This evidence may thus be taken to indicate that human occupation at that time was infrequent, a possibility which is seen to be in good accord with the 'flakes+' evidence (2.11.2).

c) In situ fragments were found to be largely or entirely limited to levels above the 3WA. This fact is of note in that the exoskeletons of millipedes and insects are both largely comprised of chitin and sclerotin. There does not therefore seem to be any obvious biochemical reason why remains of the latter could not be of equivalent age.

3.9 Hair

3.9.1 Morphological analysis

The items in this category are ascribable to the following species:

a) Klipspringer. Identified by A. Boshier. In R17 and R18 of 1WA.

b) Nyala. Identified by Colonel G. de Beer. In 2BS.UP (Fig. 69).

c) Rodents. Identification by J. Kitching. In 1BS.UP.TA, 1BS.UP.S and 1WA. These fur fragments were either noted in or are believed to derive from owl pellets. (Fig. 71).

3.9.2 Spatial analysis

A record was compiled of all squares known to contain hair in the post-2WA strata of Exc. 3A Rear. This information is listed in Appendix 41.

3.9.3 Temporal analysis

The data in Appendix 41 was used to make a broad evaluation of how hairs as a whole vary with time on a stratum basis in Exc. 3A Rear. Comments

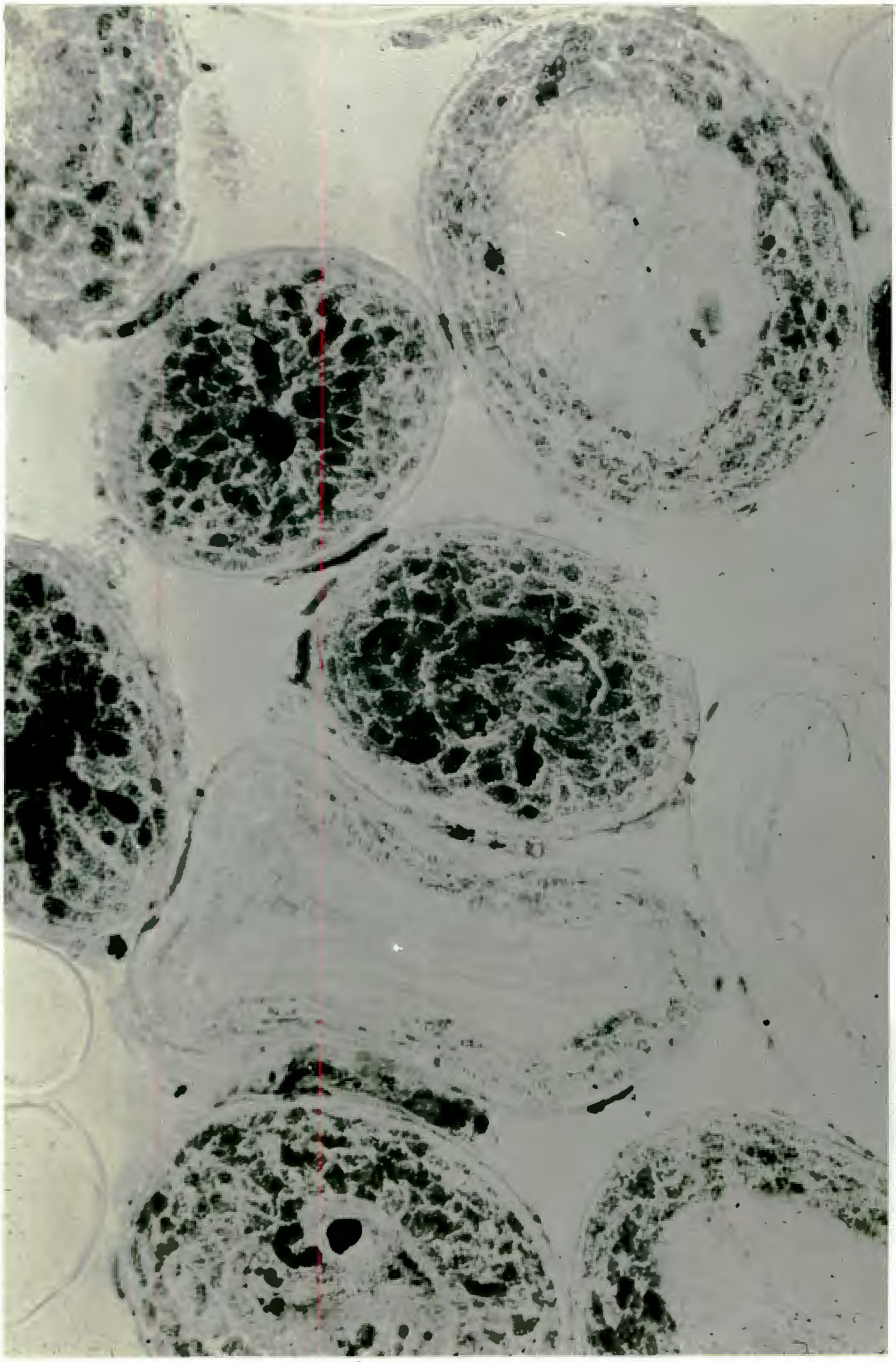


Fig. 69 Photomicrograph of nyala hair sections from S20 2BS.UP
Slide by courtesy of Col. G. de Beer
Photograph by courtesy of I. McLachlan

are as follows:

a) The 1BS.UP.IA and 1BS.UP.S rodent hair samples are believed to have been protected from decay organisms prior to burial by the encapsulating coprolite.

b) The 1WA and 2BS.UP hair samples all derive from compact nodules and are considered to owe their preservation to rapid burial and subsequent protection in a saline micro-environment.

c) SEM study indicated that the nyala hair sample was in a poor state of preservation and this data does not therefore contravent its stratigraphic ascription (Colonel G. de Beer, pers. comm.).

d) It is of note that skeletal remains of nyala and klipspringer occur at the site and that the former is seemingly confined to the Stone Age strata (Appendix 33. Table 1).

3.10 Feather

3.10.1 Morphological analysis

Identifications based on feather morphology are provided by Savile-Davis in Appendix 42. Some typical items are illustrated in Figure 70.

3.10.2 Spatial analysis

A record was compiled of all squares known to contain feathers in the post-2WA strata of Exc. 3A Rear. This information is listed in Appendix 41. Comments are as follows:

a) A very marked concentration occurs in T20 of 1BS.UP.S. This may indicate an unisolated portion of the IA pit which partly straddles that square (1.4.1.1).

b) Frequencies in all levels tend to increase towards the drip-line. This is in good accord with the observed present and presumed past distribution of nests in the cave.

3.10.3 Temporal analysis

An investigation to determine how feather numbers vary with time on a stratum basis in Exc. 3A Rear was carried out by means of the data in Appendix 41. Comments are as follows:

a) 1BS.UP.IA produced 58 plumes from 10 undisturbed squares. About 16% of the total number found are from contaminated contexts.

b) 1BS.UP.S produced 12 plumes from 4 undisturbed squares. About 81% of the total number found are from contaminated contexts.

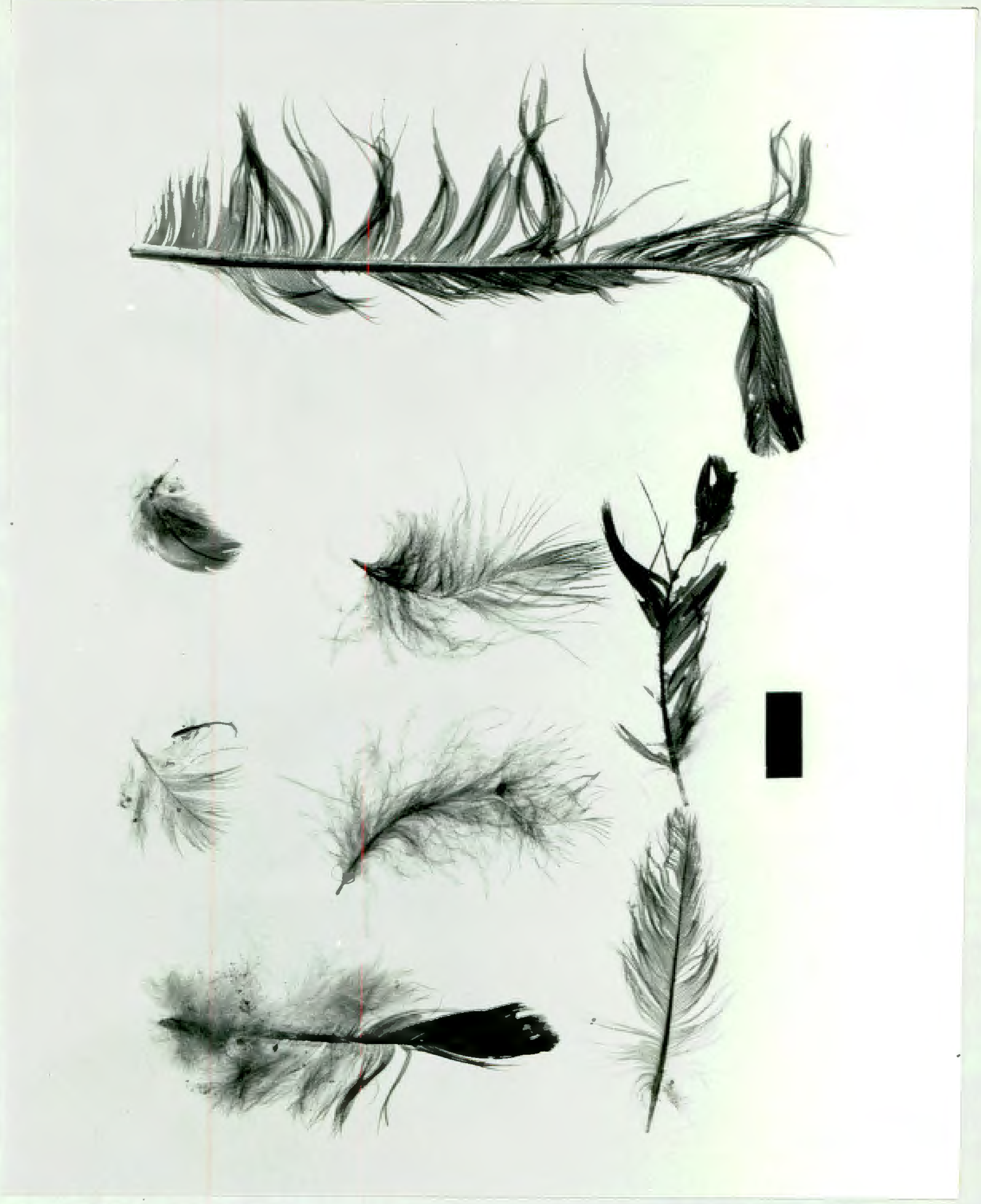


Fig. 70 Some feathers
From T9. IBS. Onychognathus morio morio
Identification by R. Savile-Davis
Photograph by D. Rokos

c) 1BS.LR and 1WA produced one plume from one undisturbed square. About 99,5% of the total number found are from contaminated contexts

The evidence is ambiguous, but is here taken to mean:

a) That plumes are associated with but decrease in frequency between 1BS.UP.IA and 1BS.UP.S.

b) That in and below 1BS.LR the fewer squares involved and the high proportions from disturbed deposit both point to an intrusive origin for the associated plumes.

c) That two plumes found in T19 of 3BS are almost certainly intrusive.

However, it should be noted that feathers and hair are both largely composed of keratin. There is therefore no apparent biochemical reason why some of the former could not predate the 1BS.UP.S.

3.11 Coprolite

3.11.1 Morphological analysis

The items in this category were ascribed by J. Kitching to the following creatures (Fig. 71) :

a) Medium-sized bird. 1BS.UP IA? and 1BS.UP.S.

b) Small mammal. 1BS.UP.S. only.

c) Small felid. 1BS.UP.S and 1BS.LR.

d) Hyaena. 2BS.LR only.

e) Goat. 1BS.UP.IA - 2BS.LR?

f) Cattle. 1BS.UP.IA - 2BS.UP?

Comments are as follows:

a) The 'cattle' droppings could relate to any large ungulate.

b) The bird droppings probably relate to rock pigeon.

3.11.2 Spatial analysis

A record was compiled of all squares known to contain copralites in the post-2WA strata of Exc. 3A Rear. This information is listed in Appendix 41.

3.11.3 Temporal analysis

The data in Appendix 41 was used to make a broad evaluation of how particular coprolite categories vary with time on a stratum basis in Exc. 3A Rear. Comments are as follows:

a) Medium-sized bird droppings are rare possibly because the trench is mainly backward of areas usually traversed by the cave's avian inhabitants.

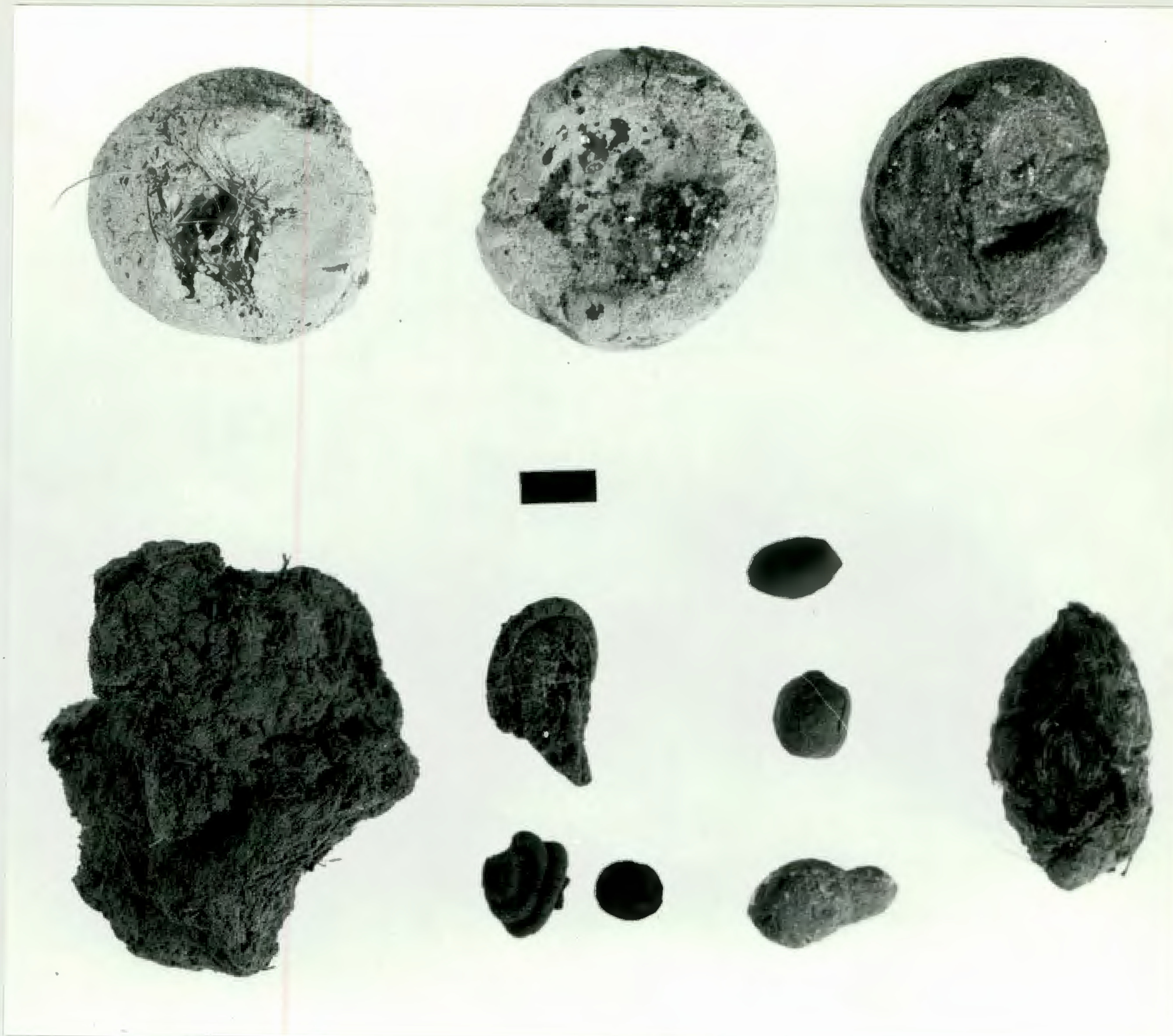


Fig. 71 Coprolites

Numbering from top to bottom and left to right

Row 1, no. 1	: Modern. Hyaena
Row 1, no. 2	: Border Cave. R18. 2BS.LR. Hyaena
Row 1, no. 3	: Makapansgat Limeworks. Hyaena
Row 2, no. 1	: From S24. 61-69cm. 1BS.UP. Sterile. Cattle
Row 2, no. 2 (top)	: From Q21 38-46cm. 1BS.UP. Sterile. Rock pigeon
Row 2, no. 2 (bottom)	: From T19. 1GBS.'C'. Intrusive. Rodent.
Row 2, no. 3 (top)	: From R20 46-53cm. 1BS.UP. Sterile. Goat.
Row 2, no. 3 (bottom)	: From T19 46-53cm. 1BS.LR. Small carnivore
Row 2, no. 4	: From Q22 15-23cm. 1BS.UP. Iron Age. Owl pellet containing abundant fur

Identifications by J. Kitching

Photograph by D. Rokos

b) Small mammal droppings are rare, in contrast to the large numbers recovered from the previously detailed 1GBS.UP - BACO.A burrowings from Horton's Pit (1.4.11).

c) Small felid droppings are rare, and all have a high content of very fragmented millipede segments.

d) Hyaena droppings are confined to a single dropping recovered from R18 of the 2BS.LR.

e) Goat droppings are common, with one very marked concentration which relates for some unknown reason to the IA pit in R21 of 1BS.UP.IA. Some further details are:

   I. 1BS.UP.IA produced 89 items from 16 undisturbed squares.
   II. 1BS.UP.S produced 36 items from 9 undisturbed squares.
   III. 1BS.LR produced 11 items from 3 undisturbed squares.
   IV. 1WA - 2BS.LR together produced 2 items from 2 undisturbed squares.

   The evidence is ambiguous, but is here taken to mean:

   I. That goat droppings are associated with but decrease in frequency between 1BS.UP.IA and 1BS.UP.S.
   II. That in and below the 1BS.LR the fewer squares involved and the decline in absolute numbers both point to an intrusive origin for the associated droppings.
   III. That since the advent of goats in this area is unlikely to predate the IA, the external evidence would support an intrusive origin for the droppings in 1BS.UP.S.

f) Cattle droppings are infrequent, with a curiously high proportion being from the rear sector of the trench in 1BS.UP.IA and 1BS.UP.S. Some further details are:

   I. 1BS.UP.IA produced 5 items from 5 undisturbed squares.
   II. 1BS.UP.S produced 8 items from 5 undisturbed squares.
   III. 1BS.LR - 2BS.UP together produced 2 items from 2 undisturbed squares.

   The evidence is ambiguous, but is here taken to mean:

   I. That cattle droppings are associated with both 1BS.UP.IA and 1BS.UP.S.
   II. That in and below the 1BS.LR the fewer squares involved and the drop in absolute frequencies both point to an intrusive origin for the associated droppings. However, this is far from certain in view of the relatively large size of these items and the

consequent difficulty ofenvisaging some mechanism which could have led to their downward displacement.

III. That since the advent of cattle in this area is unlikely to predate the I.A, that external evidence would suggest in view of (I) that either large wild bovids sometimes entered the cave, conceivably to lick salt encrustations off the walls (J. Kitching, pers. comm.), or that cattle were present locally at times prior to the advent of late I.A. occupation in 1BS.UP.IA (Appendix 50.

4. THE FLORA

4.1 Analytical Approach

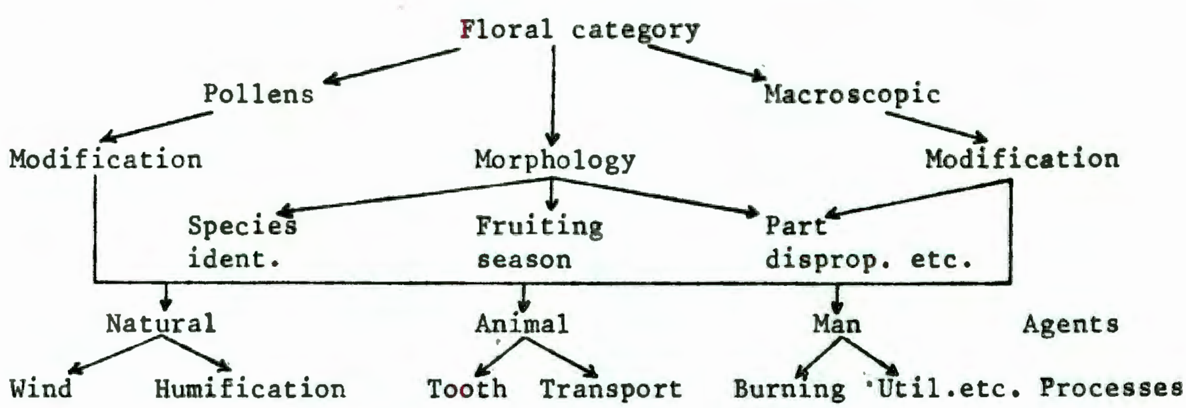
The quality of floral preservation in areas away from the drip-line is unique for a living site (Figs. 12 and 72), presumably in large measure due to the extreme aridity within the cave (Beaumont, 1973a). This happy circumstance makes it possible to obtain detailed information concerning:

a) Species identification and related data based on morphology.

b) The agents responsible for the floral accumulation.

c) The processes which led to the present state of modification.

Deductions in connection with these various aspects in any given open or cave occupation level may be based on an analysis in terms of the hierarchy of primary information sources outlined below. It is of note that this scheme, as compared to that in 3.1, incorporates an additional group of processes, which are necessitated by the fact that plants are static forms of life. It follows from this that the very presence of such debris in some contexts, such as in a cave which has never supported vegetation growth, can be used to deduce the possible agents which led to their displacement, even though there may be no evidence in terms of alterations to surface or shape.



The arbitrary floral categories isolated, in order of discussion, were: wood and charcoal; leaf; seed; grass; lycopod; fine fibre; 'tobacco-like' material; mastic, and pollen. Fairly complete information retrieval, in terms of the above-mentioned scheme, was only attempted in the case of wood and charcoal. All Exc. 3A Rear categories were also subjected to spatial and temporal analysis, but that data was only evaluated when numbers or quantities sufficed.

Fig. 72 Major floral categories in the stone age strata

Numbering from top to bottom:

Row 1 : From S21 69cm - 1WA41BS.LR. Unidentified wood fragments

Row 2,left : From R19.2BS.UP. Unidentified 'tobacco-like' vegetation

Row 2,right: From R20.2BS.LR.B Unidentified fine fibre

Photograph by D. Rokos

4.2 Wood and Charcoal

4.2.1 Morphological analysis

Most items in these two states are potentially identifiable to genus or species by means of thin-section analysis but this would, in view of the wide variety of woody plants in the area today, require a very comprehensive comparative collection, which is unfortunately unavailable at the present time.

4.2.2 Modification analysis : Processes

A fairly careful analysis of the observable processes which led to wood surface and/or state modification provided the following data for Exc. 3A Rear:

a) Natural. Humification. Details are as follows:

   I. 1BS.UP.IA - 1BS.UP.S items are in herbarium condition.

   II. 1BS.LR. - 2WA items are slightly humified.

   III. 3BS items are moderately-markedly humified.

b) Man. Burning. Charcoal is the major state present above the 3WA and the only state present below the 3BS. Circumstances precluded an attempt to quantify stratum shifts in the proportion of wood to charcoal. A fair percentage of the wood fragments were noted to have charred ends.

c) Man. Utilized. Remarkably few of the woody fragments show signs of intentional or fortuitous surface alteration. Most of those which may qualify in this connection are illustrated in Figure 73. None of these are regarded as consistent or convincing enough to necessitate their inclusion with the artefacts proper. The following categories were identified:

   I. Certainly cut reed fragments. The smooth truncations suggest that these were collected while green. Items are largely confined to the 1BS.LR and 1WA.

   II. Possibly shaped wood fragments. These may represent shaft portions of larger tools or weapons. Items are entirely restricted to the stone age levels.

   III. One V-shaped wood fragment. This shows marks seemingly inflicted by a metal blade and derives from the 1BS.UP.IA.

It is clear from these indications:

a) That bio-chemical decay mechanisms were remarkably inhibited at this site, resulting in wood being preserved in levels dating back to the M.S.A.

Fig. 73 Some damaged or utilized woody objects

Numbering from top to bottom:

No. 1: From T20. 1WA. Pointed wood fragment
No. 2: From Q21 61cm - 1WA.1BS.LR. Smoothed? wood fragment
No. 3,left (top): From Q16. 1WA. Smoothed? wood fragment with notch
No. 3,left (bottom): From S19 30-38cm. 1BS.UP.Iron Age. Cut bird snare? fragment
No. 3,centre: From S19 38-46cm. 1BS.UP.Iron Age. Hollow reed fragment cut at both ends
No. 3,right (top):From S20 61cm - 1WA.1BS.LR. Reed fragment with cut end
No. 3,right (bottom): From R22 7,5-15cm. 1BS.UP.Iron Age. Reed fragment with cut end

Photograph by D. Rokos

b) That the available evidence points to processes associated with man as the sole cause of non-natural wood damage.

c) That wood was introduced into the cave for the predominant purpose of making and sustaining fires.

d) That there is an unexpected absence of evidence that wood was used for artefactural pruposes, despite the probability that at least some 'Early L.S.A.' and M.S.A. tool classes were hafted (e.g. Mason, 1962).

4.2.3 Modification analysis : Fragmentation

No analysis was undertaken of inferred processes which led to wood shape modification in Exc. 3A Rear. Most items are in the form of small twigs, but some are clearly derived from some larger source. However, it is of note that not one piece was of a size which would normally be termed 'firewood'. This may indicate that Stone Age man did not collect large wood, or that large wood was unavailable, or that extreme economy was practised. The last-mentioned alternative is most acceptable from the viewpoint of minimum hypothesis, but is on the other hand rather difficult to reconcile with the frequent loss or abandonment of stone artefacts, which must often have represented a greater energy investment in terms of distance to probable source (2.4.2).

4.2.4 Spatial analysis

A record was compiled of all squares known to contain wood fragments in the various strata of Exc. 3A Rear. This information is listed in Appendix 43.

An investigation of the lateral distribution of charcoal nodule mass on a square by square basis was undertaken for all levels of Exc. 3A Rear. The information compiled in this connection is listed in Appendix 43. Comments are as follows:

a) V values in any given level are of the same order as those relating to stone artefacts and macrofaunal fragments.

b) No intact square in any stratum showed a certainly anomalous value when considered in terms of mean deposit thickness there (Appendix 4) and an assumed variability similar to that revealed by the silicate percentages (2.10.2).

c) The four disturbed squares in 1BS.UP.S produced fully ~45% of the total charcoal nodule mass found in that level. This inordinately high reading appears to be mainly due to mixing between 1BS.UP.IA and 1BS.UP.S

4.2.5 Temporal analysis

The data in Appendix 48 was used to make a broad evaluation of how wood fragments as a whole vary with time on a stratum basis in Exc. 3A Rear. Comments are as follows:

a) Wood fragments range down to and include the 3BS level containing 'Epi-Pietersburg'.

b) If wood preservation (4.2.2) is purely a function of time, then it may be deduced:

   I. That 1BS.UP.TA and 1BS.UP.S are not very widely separated in time.

   II. That 1BS.UP.S and 1BS.LR are separated by a significant hiatus.

   III. That 1BS.LR and 2WA are not very widely separated in time.

   IV. That 2WA and 3BS are separated by a significant hiatus.

An investigation was carried out in order to determine if and how charcoal nodule mass per unit volume of deposit varied with time on a stratum basis in Exc. 3A Rear. Pertinent data are fully listed in Appendices 43 and 59 . Present comments are as follows:

a) Charcoal nodules occur throughout the deposit.

b) Mass per cu.m varies markedly, with a minimum/maximum stratum value ratio of ~ 1,5%.

4.3 Leaf

4.3.1 Morphological analysis

Identifications based on leaf morphology are fully detailed by J. Anderson in Table 1 of Appendix 44. A number of typical items are illustrated in Figure 74.

4.3.2 Modification analysis

The presence of leaves only in a cave which does not support floral life is in itself indicative of their 'removal' from outside sources by natural, animal, or human agencies. A preliminary evaluation of the relative importance of these three categories is provided in Table 3 of Appendix 44. The interpretation of this is impeded by the finding that ~30% of the species involved do not apparently grow in that area today. It is nevertheless evident that most of them derive from woody plants which are known to have been of particular interest to man (Bot. Res. Inst., Pretoria, Ethnobotany files). However the present evidence does not preclude the possibility that a large but unknown proportion could have been introduced by agents such as wind and nesting birds.

Fig. 74 Some excavated leaves

Numbering from left to right:

No. 1 : From T21. 1WA. Disturbed? Aloe marlothii

No. 2 : From Q17. 2BS.UP. Encephalartos lebomboensis

No. 3 : From Q22. 1WA. Encephalartos villosus

No. 4, top : From S20 30-38cm. 1BS. UP. Iron Age. Tarenna barbertonensis

No. 4, bottom : From R21. 15-30cm. 1BS. UP. Iron Age. Strychnos henningsii

No. 5, top : From T18 46cm. 1WA. 1BS.LR. Linociera foveolata

No. 5, bottom : From R22 15-23cm. 1BS.UP. Strychnos spinosa

Identifications by J. Anderson

Photograph by D. Rokos

4.3.3 Spatial analysis

A record was compiled of all squares known to contain leaves in the various strata of Exc. 3A Rear. This information is listed in Appendix 43.

4.3.4 Temporal analysis

An investigation to determine how leaf numbers and species vary with time on a stratum basis in Exc. 3A Rear was carried out by means of the data in Table 4 and in Table 1 of Appendix 44. Comments are as follows:

a) Undoubtedly in situ leaves are confined to levels above the 3BS.

b) Encephalartos lebomboensis leaves are exceptionally 'solid' and this physical feature may have resulted in their preferential preservation and consequent predominance in levels below the 1WA.

c) In Appendix 44 it was deduced that Linociera foveolata leaves were probably in situ in 1BS.LR and 1WA. As a check on this evaluation a 1WA sample was submitted to the Physical Research Laboratory in Pretoria for dating by means of their mini-counter (Vogel and Behrens, 1977). The result obtained was as follows (H.I. Behrens, letter dated April, 1978).:

Pta - 1995 Linociera foveolata leaves S 21. 1WA > 25,500 B.P.

The reading confirms that this species ranges back to the 'Early L.S.A.' (Appendix 49). Its marked relative abundance in the 1BS.LR may thus be real and significant.

4.4 Seed

4.4.1 Morphological analysis

Identifications based on seed morphology are fully detailed by J. Anderson in Table 2 of Appendix 44. A number of typical or interesting items are illustrated in Figures 75 and 76. It is unfortunate that the mass of maize cob was too low for a decisive C-14 determination.

4.4.2 Modification analysis

The presence of seeds only in a cave which does not support floral life is in itself indicative of their 'removal' from outside sources by either man, bird or beast, with natural agencies being largely excluded in this instance. A preliminary evaluation of the relative importance of these three categories is provided in Table 4 of Appendix 44. The interpretation of this is further facilitated by the finding that almost all of the species involved are still extant in that area. It is patent that the majority relate to shrubs or trees which are of known value to pre-industrial peoples (Bot. Res. Inst., Pretoria. Ethnobotany files). Nevertheless, the available data does not exclude the likelihood that some possibly minor proportion may have been brought in by various other creatures (particularly birds).

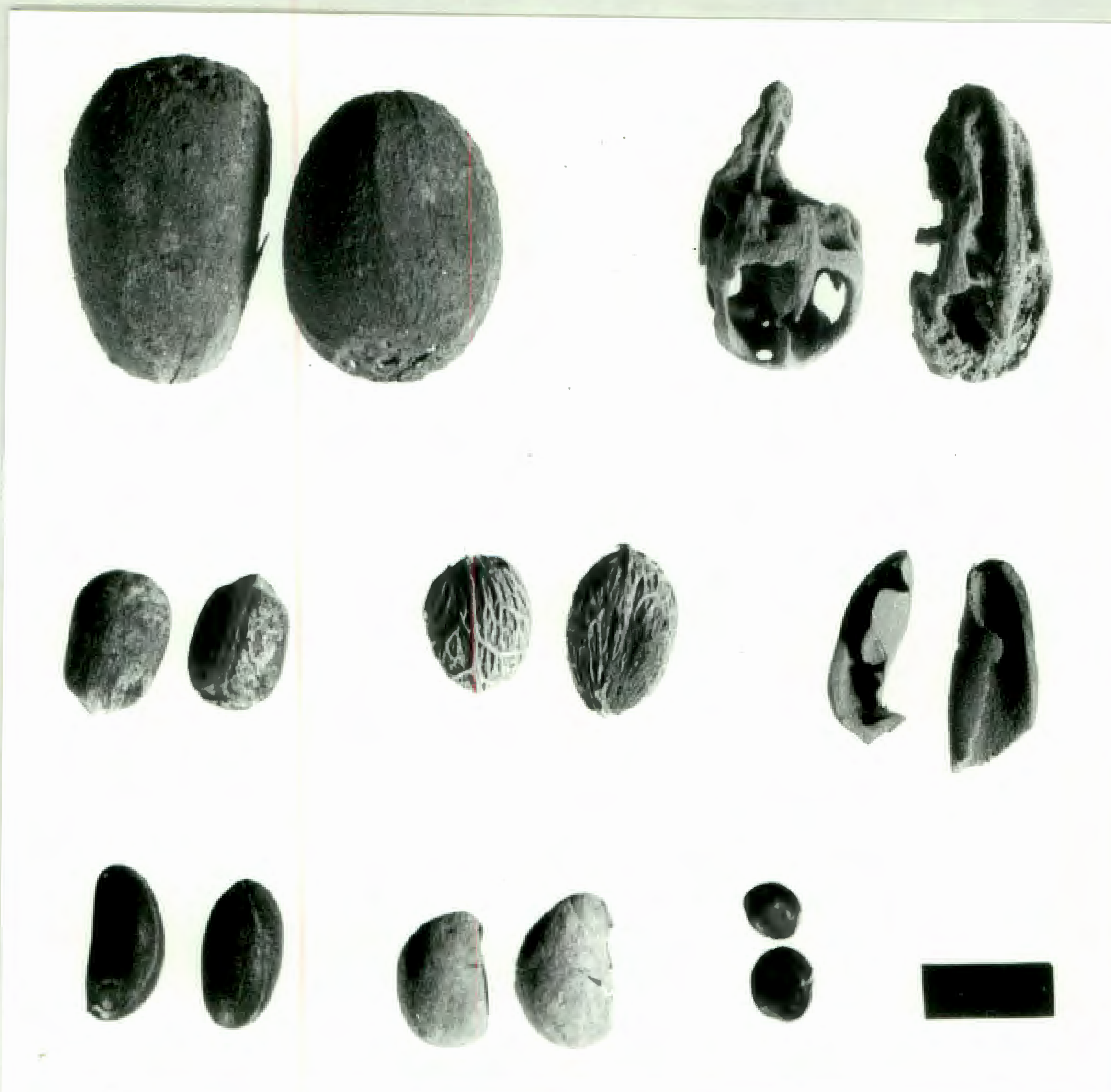


Fig. 75 Some excavated seeds.
Numbering from top to bottom and left to right:

Row 1, no. 1 :From Q17 56cm.-1WA.IBS.LR. Disturbed. Encephalartos sp.
Row 1, no. 2 :From S19 53cm.-1WA.IBS.LR. Encephalartos sp.
Row 1, nos.3 & 4:From T22 30-38cm.IBS.UP.Iron Age.Harpephyllum caffrum
Row 2, nos.1 & 2:From T22. 38-46cm.IBS.UP. Iron Age. Ricinus communis
Row 2, nos.3 & 4:From Q16. 61cm.-1WA.IBS.LR. Disturbed. Teclea natalensis
Row 2, nos.5 & 6:From T18 46cm.-1WA.IBS.LR. Disturbed. Ricinus communis (coats)
Row 3, nos.1 & 2:From Q18 48-61cm.IBS.LR.Disturbed. Diospyros dichrophylla
Row 3, nos.3 & 4:From Q19.38-53cm.IBS.UP.Sterile. Ekebergia capensis
Row 3, nos.5 & 6:From T22 30-38cm.IBS.UP.Iron Age. Pappea capensis

Identifications by J. Anderson

Photograph by D. Rokos

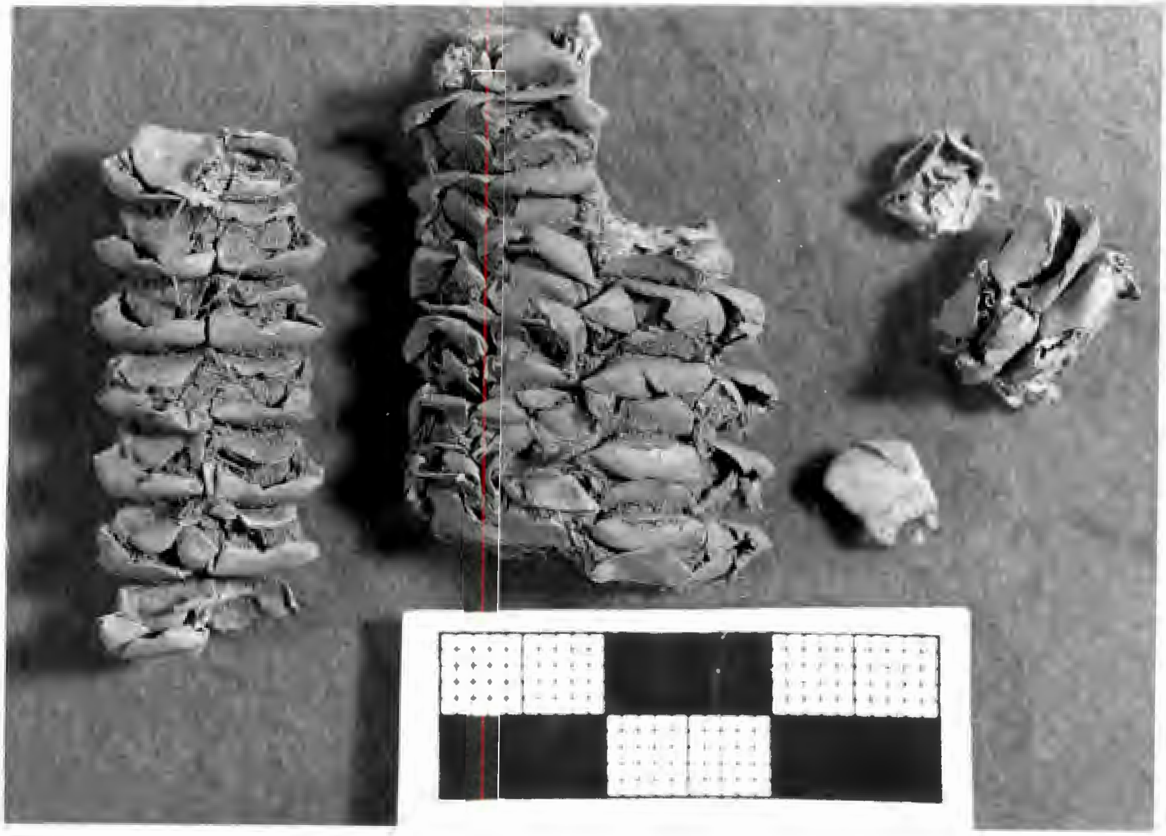


Fig. 76 Maize cob fragments
From T21 8-15cm. 1BS.UP. Iron Age. Dated to 90 ± 105 B.P.
(Pta - 1728)
Photograph by G. Smith

Table 4 Absolute abundance changes with time in various floral categories

Border Cave. Exc. 3A Rear

Arbitrary groupings	Stratum							
	1BS.UP I.A.	1BS.UP S	1BS.LR	1WA	2BS.UP	2BS.LR A+B	2BS.LR C	2WA
Wood	xxx	xxx	xxx	xxx	xx	xx	xx	xx
Thorns			x	x	x	x	x	x
Leaves	xxx	xx	x	x	x	x	x?	x
Seeds	xxx	xx	x	x	x?	x?	x	x
Grass	xxxx	xxx	xx	xx	x?	x?	x?	x
Lycopod	xx	xx						
Fine short fibre			xx	xx	x	x	x	x
'Tobacco-like' material			xx	xx	xx	xx	xx	xx

Abbreviations

x? = Very rare. Perhaps intrusive

x = Very rare

xx = Rather rare

xxx = Rather common

xxxx = Very common

4.4.3 Spatial analysis

A record was compiled of all squares known to contain seeds in the various strata of Exc. 3A Rear. This information is listed in Appendix 43.

4.4.4 Temporal analysis

An investigation to determine how seed numbers and species vary with time on a stratum basis in Exc. 3A Rear was carried out by means of the data in Table 4 and in Table 2 of Appendix 44. Comments are as follows :

a) Seeds are not associated with levels below the 2WA, bar intrusive items from the rodent burrows in BACO.A (1.4.11).

b) The preservational proneness of the wood and seed categories are probably rather similar and the marked relative paucity of the latter in the 1BS.LR - 2WA levels is therefore of potential significance (cf. Isaac, 1971). This data can be variously construed to mean that the cave occupants at those times: did not utilize fruits and seeds as a food source; occupied the site only at times or seasons when these were not available; or foraged in a floral setting in which the relevant species were absent. Of these alternatives, the second cannot be excluded because the majority of listed species are in fact summer-ripening (B. Maguire, pers. comm.), while the last is apparently invalidated by faunal evidence which indicates an outside environment closely comparable to the present during 2BS.UP - 2WA times (Klein,1977).

c) In Appendix 44 it is shown that the number of items in most seed species show a sharp decline with depth and this is taken to mean that some or all of the lower 'in situ' specimens may owe their location to 'downward drift'. As a check on this interpretation a number of *Diospyros dichrophylla* seeds were submitted to the Physical Research Laboratory in Pretoria for dating by means of their mini-counter (Vogel and Behrens, 1977). Results are as follows (J.C. Vogel, letter dated August, 1977):

I.	Pta - 1941	*Diospyros* seed Q18. 1WA.	A.D. 1963 ± 1
II.	Pta - 1938	*Diospyros* seed Q19. 1WA.	A.D. 1971 ± 1
III.	Pta - 1939	*Diospyros* seed Q19. 2BS.UP.	A.D. 1968 ± 1

It seems clear from these results that some of the lower items are actually the result of displacement from the modern surface during excavation. This interpretation is supported by the fact that the dated seeds are all from Strip Q, which is immediately adjacent to the north wall of Exc. 3A Rear. That was the side from which buckets were always taken to the sieves.

4.5 Grass

4.5.1 Morphological analysis

Fragments from 1BS.LR to 2BS.LR.C. were regarded by R. Ellis as too damaged for taxonomic diagnosis. However, some items in the salt-consolidated basal levels of the 2WA were identified by him as undoubtedly grass. Subsequent $^{13}C/^{12}C$ tests on these revealed them to be of C_4 type, thus demonstrating that the Kranz syndrome dates back to a least the M.S.A. (J. Vogel, pers. comm.).

4.5.2 Modification analysis

The agencies involved in the introduction of grass into the cave cannot be certainly identified. A fair number of the 1BS.UP fragments have attached roots, which probably excludes nesting birds in those instances.

4.5.3 Spatial analysis

A record was compiled of all squares known to contain grass in the various strata of Exc. 3A Rear. This information is listed in Appendix 43.

4.5.4 Temporal analysis

A broad evaluation was made of how grasses as a whole vary with time on a stratum basis in Exc. 3A Rear. The assessment is listed in Table 4. Comments are as follows:

a) Grass abundance decreases markedly with depth.

b) In Table 4 grass fragments are listed as certainly present in 1BS.LR and 1WA. As a check on this evaluation a 1WA sample was submitted to the Physical Research Laboratory in Pretoria for dating by means of their mini-counter (Vogel and Behrens, 1977). The result obtained was as follows (H.I. Behrens, letter dated April, 1978).:

   Pta - 1964   Unidentified grass Q18   1WA   > 26,500 B.P.

   The reading partly vindicates the vertical distribution data listed in Table 4 and confirms the association of grass with the 'Early L.S.A.' (Appendix 49).

4.6 Lycopod

4.6.1 Morphological analysis

This category was identified and isolated during final processing by J. Anderson.

4.6.2 Modification analysis

These items occur in levels in which occupation by man was only intermittent, which would seem to indicate an introduction by some unknown animal agency.

4.6.3 Spatial analysis

No record was compiled of squares known to contain lycopods in the various strata of Exc. 3A Rear.

4.6.4 Temporal analysis

A broad evaluation was made of how lycopods as a whole vary with time on a stratum basis in Exc. 3A Rear. The assessment is listed in Table 4. Comments are as follows:

a) Lycopods are confined to levels above the 1BS.LR.

b) Lycopod absence in the Stone Age strata may indicate an environmental shift.

4.7 Fine Fibre

4.7.1 Morphological analysis

Botanical Research Institute staff were unable to determine which of many possible species was used as a basis for this category. A typical sample is illustrated in Figure 72.

4.7.2 Modification analysis

This material was probably entirely collected by man (see below). Its present state may be the result of natural decay or intentional modification. There was no evidence for subsequent use to produce cordage. Occurrences were noted to be strongly associated with the following category and both may in fact represent differing portions of the same plant.

4.7.3 Spatial analysis

A record was compiled of all squares known to contain fine fibre in the various strata of Exc. 3A Rear. This information is listed in Appendix 43. Occurrences were invariably in the form of thin but extensive lenses which may represent 'bedding' material (Beaumont, 1973a)

4.7.4 Temporal analysis

A broad evaluation was made of how fine fibre varies with time on a stratum basis in Exc. 3A Rear. The assessment is listed in Table 4. Comments are as follows:

a) Fine fibre is only certainly present in levels above the 3BS.

b) Fine fibre is entirely confined to the Stone Age strata.

4.8 'Tobacco-like' Material

4.8.1 Morphological analysis

Botanical Research Institute staff were unable to identify the apparently single species involved. Details of a microscopic study by J. Brown are provided in Appendix 45. A typical sample is illustrated in Figure 72.

4.8.2 Modification analysis

This material was probably entirely collected by man (see below). Occurrences were noted to be strongly associated with the previous category and both may in fact represent differing portions of the same plant.

4.8.3 Spatial analysis

A record was compiled of all squares known to contain 'tobacco-like' vegetation in the various strata of Exc. 3A Rear. This information is listed in Appendix 43. Occurrences were invariably in the form of thin but extensive lenses, which may represent 'bedding' material (Beaumont, 1973a).

4.8.4 Temporal analysis

A broad evaluation was made of how 'tobacco-like' vegetation varies with time on a stratum basis in Exc. 3A Rear. The assessment is given in Table 4. Comments are as follows:

a) 'Tobacco-like' vegetation is only certainly present in levels above the 3WA.

b) 'Tobacco-like' vegetation is entirely confined to the Stone Age strata.

4.9 Mastic

4.9.1 Morphological analysis

The items in this category were identified as follows by J. Kitching:

a) Euphorbia resin. From Q21 of 1BS.UP.S and 1BS.LR.

b) Beeswax. From S19 of 1BS.LR.

The latter item, when heated, still produced a distinctive odour. Some of these specimens are illustrated in Figure 63.

4.10 Pollen

4.10.1 Morphological analysis

About 10 soil samples were collected by E.M. van Zinderen Bakker in 1972. Standard processing of these produced only a few grass pollens (L. Scott, pers. comm.). A further 20 samples were collected by A. Horowitz in 1975. These are at present still undergoing low pollen density analysis (Frenzel, 1964). He reports that some are 'rich in a variety of pollen grains and fern spores' (letter dated March, 1977).

5. PHYSICAL AND CHEMICAL

5.1 F.U.N.

5.1.1 Results

Analytical results as derived from Protsch (1973) or received from K.P. Oakley and T. Molleson are fully listed in Appendix 46.

5.1.2 Discussion

A number of problematical finds relating to man's phylogeny have been effectively resolved by using nitrogen values in fossil bone as a first order relative dating technique (e.g. Oakley 1963). This particular method depends on the fact that the proportion of that element tends to decrease with time as protein is removed by various agencies. However, the effect only holds strictly true if vertical and lateral variations in the physico-chemical environment within the sampled deposit are minimal (Protsch 1973). In contexts where this is certainly so, anomalies can still occur in view of data which indicate :

a) That nitrogen content may vary between species and even in the bones of a single individual (Protsch 1973). Estimates of this value in the collagen of modern remains range between 4,7% and 5,4% (Protsch 1973).

b) That heating of bone by overlying and/or adjacent hearths (de Graaff 1961) results in the preferential release of low molecular weight hydrocarbons (Silverman 1964) with a consequent and often drastic drop in nitrogen values (Protsch 1973).

The following general principles may therefore be deduced:

a) That when comparing readings from spatially separated areas at a site, it must first be demonstrated that any observed differences are not due to environmental shifts.

b) That it is desirable whenever possible to base all comparisons on the same skeletal part of the same species.

c) That the highest reading in a series of values for a given level is likely to be the most reliable in contexts where the presence of fire is established.

The following preliminary comments relate to the listed data:

a) The author mislaid the provenance details pertaining to BM-SA 162. It is therefore not known whether this sample relates to 1BS.UP.IA or to 1BS.UP.S.

b) UCLA and BM laboratory procedures may well have differed somewhat (Protsch 1973). An unproven evaluation is thus implicit in the tentative equation in Appendix 46 of UCLA with BM Washed.

c) The size of the distortion induced by heating was checked by submitting a calcined and an uncharred specimen from the 3WA to the BM. These gave readings of 0,24% and 0,74% respectively, indicating a ~ 70% nitrogen loss on charring, which is in excellent accord with the results quoted by Protsch (1973).

d) The readings reveal major environmental differences between areas deep within the cave and those skirting the drip-line, as is clearly evidenced by macrofaunal values for the broadly equivalent 3WA and 1RGBS, which range between 0,00% and 0,15% in Exc. 3B, as compared to 0,74% in Exc. 3A Rear. This substantial discrepancy points to a markedly higher rate of protein attrition in the former area, as was anticipated on preservational grounds alone. Viable comparisons between the two trenches are clearly precluded, and that stricture may also apply to the IA skeleton BC4, which came from ~ 5 m inside the drip-line (Fig.3).

The following conclusions appear to be substantiated by the listed data:

a) There is no reliable reading for the 1BS.UP.IA in view of preliminary comments (a) and (d).

b) If the enunciated principles are used to evaluate only the maximum readings for the macrofauna from Exc. 3A Rear, it becomes evident that there are only minimal changes with depth, as indicated by values of: 0,95% for 1BS.UP; 0,98% for 2WA; and 0,84% for BACO.A. This data suggests that a very rapid initial decline from ~ 5,0% to ~ 1,0% was followed by a remarkably gradual reduction subsequent to burial (T. Molleson, pers. comm).

c) None of the hominid remains show any signs of fire damage. BC5 was found in a shallow grave which would have served to protect these bones from the heat of overlying hearths, which are in any case insubstantial (Fig. 14). In addition, the amino acid printout configurations strongly suggested that temperature extremes had not affected BC1-3 (Bada, pers. comm). The perceptibly lower readings for human relative to animal bones from the same stratum is therefore not easily explicable in terms of that variable (e.g. BM-SA 153 compared to BM-SA 151, or

BM-SA 168 compared to BM-SA 167). This suggests that principle (b) may be relevant and possible corroboration of this is provided by evidence that animal bones are denser than those of a.m.<u>H.S.</u> (Constable <u>et al.</u>, 1973). The effects of this difference may well have been to facilitate the rate of collagen loss in the latter case, thereby leading to the relatively low hominid values documented at this site.

d) If comparisons are confined to the human remains in view of this finding, then it would seem evident:

   I. That the reading for B.C. 4 is about 2 x higher than those relating to any of the other individuals, despite the fact that it came from an area where the nitrogen depletion rate would probably have been higher than that applicable to the rest, which all came from localities backward of about strip 10 (3.2).

   II. That the readings for B.C.3 and B.C.5 are in fairly good accord with the stratigraphic and typological evidence concerning their temporal relationship.

   III. That readings relating to B.C.1 and B.C.2 are similar and perhaps lower than those for B.C.3 and B.C.5 despite evidence (Appendix 47) that their values are not distorted by fire. The clear implication is that the unprovenanced remains from Horton's Pit are perhaps somewhat older and certainly not younger than the 3WA. This deduction is therefore fully compatible with the claim by Cooke <u>et al.</u> (1945) that B.C.1 was probably associated with the 1GBS.LR (3.2).

5.2. <u>Amino Acid</u>

5.2.1 <u>Results</u>

Analytical results and comments by Bada are provided in Appendix 47.

5.2.2. <u>Discussion</u>

Considerable work has recently been carried out on amino acid racemization as a means of dating fossil bone (Bada 1972; Bada and Protsch, 1973; Bada and Schroder, 1975). This technique is of potential importance in view of the ~ 50 Kyr limit to C-14 and because other radionuclide decay methods have only very restricted applications. There are however two major limitations to it, namely:

a) The racemization reaction is very temperature-sensitive.
b) The racemization rate depends on the nature of and chemical conditions surrounding the matrix in which the amino acids are contained.

The following general principles may therefore be deduced:

a) That comparisons are only reliable if the relevant readings are based on the same matrix material category (e.g. bone, shell, etc.)
b) That comparisons should preferably be restricted to samples drawn from those portions of a site which do not show significant environmental differences.
c) That when (a) and (b) are complied with, then the lowest reading in a series of values for a given level is likely to be the most reliable in contexts where the presence of fire is established.

Difficulties were anticipated with the application of this method to Border Cave, because of:

a) The very low rate of mineral sediment production and the very high incidence of fired debris which appears to typify most levels (Appendix 54). This combination implies that accumulation may never have been rapid enough to effectively bury and thus protect bone from temperature distortions due to adjacent and/or overlying hearths (de Graaff 1961).
b) The extreme paucity of moisture in areas of the cave well back of the drip-line, which could conceivably have led to critical limitations and/or variations in the availability of the hydroxide ion for abstraction of the α-proton (Bada and Schroeder, 1975).

The following strategies were applied in an effort to evaluate and circumvent presumed major problems:

a) Sampling was entirely confined to uncharred bone fragments from Exc. 3A Rear.
b) A number of macrofaunal samples were submitted in order to check on how common temperature abberations were. These all proved to be largely or entirely racemized, presumably as a result of accidental fire damage and/or the intentional roasting of meat by man (Beaumont, 1973a).
c) A number of microfaunal samples were submitted on the assumption that these were entirely introduced by owls and that the original encapsulating coprolite would have provided optimal protection from fire damage (3.5.3).
d) Care was taken only to select microfaunal samples from:

I. Squares having very low proportions of charred fragments (Appendix 37).

II. Strips well to the back of the trench, where hearths tend to thin out markedly.

III. Levels with relatively low charcoal nodule values (Appendix 43).

e) A large number of samples were submitted from each level in the hope that the resultant data would provide reliable minimum readings for each of these.

Microfaunal results were as follows:

a) Bada was unable to obtain a good 'calibration' value for the 1BS.UP.S, and could not be persuaded that a viable alternative was provided by 2BS.UP, which has a sound minimum date (Appendix 49).

b) The great majority of the submitted samples do not seem to have been processed and there can thus be no certainty as to whether the readings on hand actually provide the lowest possible D/L results for the relevant strata.

c) The very few values received do, however, show an expected increase with depth, if readings which do not conform with stratigraphy are deleted, as is shown by : 0,26 for 1BS.UP.IA; 0,55 for 1BS.LR; and 0,61 for 3BS.

If this admittedly inadequate series is compared with the hominid values, claimed to be free of temperature distortion, then it would seem likely :

a) That B.C. 3 predates the 3BS, which is in good accord with the stratigraphic evidence concerning their temporal relationship.

b) That B.C.1 and B.C.2 are of about the same age as B.C.3, with the possibility of a somewhat greater antiquity for B.C.1, which is in fair agreement with both the nitrogen readings (5.1) and the conclusion of Cooke et al. (1945) (3.2).

5.3 Thermoluminescence

5.3.1 Results

Analytical results and comments by Fremlin are provided in Appendix 48.

5.3.2 Discussion

The pioneering work by Fremlin on the application of the TL technique to burnt cryptocrystalline rocks and to ostrich eggshell is of considerable importance. The normal environmental and maximum saturation values which he cites would seem to indicate that the method is capable of datings which would span all or much of the Brunhes, with an ultimate local limit being provided by the uncertain advent of regular fire-making at some time in the Acheulian. However, the construction of such a chronology is likely to require perseverance and exceptional contexts, if a true indication is provided by the rather low proportion of satisfactory samples isolated at Border Cave.

Difficulties were anticipated with the application of this technique to that site because of:

a) The fact that the matrix samples were not collected with the requirements of the method in mind, and probably do not represent the exact sediment which surrounded any of the submitted burnt stone and shell samples.

b) The possibility of severe environmental inhomogeneity in those strata formed by interdigitating brown sand and ash lenses, which seem likely to differ in terms of their radioactive content.

c) The very low rate of mineral sediment production and the very high incidence of fired debris which appears to typify most levels (Appendix 54). This combination implies that accumulation may never have been rapid enough to effectively bury and thus protect samples from possible reheating by overlying and/or adjacent hearths, resulting in an enhanced probability of obtaining anomalous glow curves.

Interpretation of the results is as follows:

a) All submitted stone samples had undoubted thermal fractures. The finding that the great majority of these showed no natural glow or were saturated in the high temperature region may suggest that prehistoric fires were typically small, with temperatures of well below ~ 500°C.

b) Two chalcedony samples from widely separated squares in the 3WA produced identical readings of ~ 56,5 Kyrs. ± 10%. Both were technically imperfect but the extent and direction of their distortions are not known. A very uniform orange sediment dominated the recovery area and background radioactivity was therefore perhaps fairly constant. The readings are seen to be not incompatible with the C-14 age of > 49 Kyrs. B.P. for the overlying 2BS.UP (Appendix 49).

c) The four chalcedony and ostrich eggshell samples from differing squares and spits in BACO.A produced concordant readings of ~ 175 Kyrs ± 10%

for matrix (a) and ~ 435 Kyrs ± 10% for matrix (b). It is indeed unfortunate that these technically perfect samples should all have come from a level where environmental inhomogeneity is extreme. Neither of the readings are regarded as viable, in view of the typological affinities of the associated aggregate with Wymer's M.S.A. II, which undoubtedly post-dates isotope substage 5e at Klasies River Mouth (Butzer, n.d.).

5.4 Fission Track

5.4.1 Results

A number of fire pocked and splintered obsidian fragments from one area in the 1RBS of Exc. 3B were submitted to the Fission Track Unit at the University of Birmingham. K. Stammers (letter dated 1976) reports that it was not found possible to produce a sample of adequate optical quality in order to observe ambiguous tracks, and any attempt at age determination had therefore to be abandoned.

5.4.2 Discussion

A number of additional burnt fragments were noted in the the 1RGBS (Epi-Pietersburg). These have not as yet been sent for analysis. Obsidian occurs locally in the form of lenses within the rhyolites (Hunter, in Explanatory notes to accompany sheet 2731 BB. Geol. Survey and Mines. Dept. Swaziland).

5.5 Carbon-14

5.5.1 Results

Analytical results and comments by Vogel are provided in Appendix 49. The additional readings listed in Appendix 50 are based on information received from Bada or derived from Protsch (1973).

5.5.2 Discussion

Radiocarbon dating of the 1BS.LR-1RGBS levels was mainly carried out at the National Physical Research Laboratory in Pretoria. These measurements are preponderably based on charcoal nodules, of which Exc. 3A Rear produced ~ 35 kgs. Pretreatment was usually with both acid and alkali. Results are corrected for variations in isotopic fractionation. Carbon dioxide proportional counters having a sensitivity range of ~ 50 Kyrs. were used for detection (Vogel, n.d.)

Measurements are considered to be particularly reliable in view of:

a) The abundance of ideal dating materials, namely wood fragments and charcoal nodules, which often have individual masses of > 1 g.

b) The virtual absence of moisture deep inside the cave, with a consequent decline in contamination by way of humic substances and calcium carbonate.

c) The total absence of plant life deep inside the cave, with a consequent lack of contamination by way of present or past rootlets.

d) The fairly horizontal disposition of the strata, which precludes the possibility of mixing by means of slumping.

e) The marked stratigraphy and the clean interfaces between most levels.

f) The negligible incidence of disturbance due to animal agencies (e.g. rodents).

It should on the other hand be borne in mind:

a) That the LJ and UCLA readings for the 1BS.LR and 1WA are not strictly comparable to Pta values because of differences in materials dated and pretreatment techniques (J. Vogel, pers. comm.).

b) That the slow rate of sedimentation which typifies most levels implies that a great time-span may be represented by a short vertical distance, thus enhancing potential susceptibility to mixing.

c) That deposit removed during the initial digging of the IA pits would certainly have biased superficial 1BS.UP vegetation and charcoal nodule samples in some areas of Exc. 3A Rear.

d) That westward and northward slumping into Horton's Pit of the fairly sterile 1BS.UP sediments that formerly sealed the Early L.S.A. levels, has brought the latter increasingly close to the modern surface forward of Q-T 22, thereby leading to an increased possibility of recent mixing in that portion of Exc. 3A Rear.

A 'most likely' interpretation of the datings is given in Appendix 49. Alternative scenarios which have still to be disproved relate to the following portions of the profile:

a) Vogel regards the readings for 1BS.UP.S as being probably due to a variable mixture between debris derived from the IA and Early L.S.A. However, the Pta-506 and Pta-721 samples were seemingly based entirely on vegetation in herbarium condition, with no items clearly showing the slight humification so typical of the Stone Age levels (4.2.2). It is therefore possible that these determinations are valid, which would in turn suggest the following two alternatives:

   I. That 1BS.UP.S accumulated between ~ 28,500 B.P. (LJ-?) and ~ 650 B.P. (LJ-2891), with Pta-721 being representative of an intermediate horizon.

II. That 1BS.UP.S accumulated between ~ 13,300 B.P. (Pta-721) and ~ 650 B.P. (LJ-2891), with LJ-? being the result of basal mixing.

b) Vogel regards the readings from 1BS.LR and 1WA as indicative of a fairly rapid accumulation of those levels at ~ 37,000 B.P. This view places perhaps undue emphasis on the three readings from square T21, which in turn necessitates the dismissal of Pta-1190. However, in terms of the principle that the oldest reading in this time-range is likely to be the most reliable (Beaumont and Vogel, 1972), it is perhaps equally possible that 1BS.LR dates to ~ 38,600 B.P. (Pta-704) and that 1WA dates to ~ 45,000 B.P. (Pta-1190). The following facts can be cited in support of this alternative:

I. That there are perceptible raw material and metrical differences between the 1BS.LR and 1WA, which would appear to require a certain degree of temporal separation (e.g. Appendices 18 and 19).

II. That the 1WA readings from square T21 are in inverse stratigraphic order. This is explicable in terms of the statistical uncertainty of the readings, but could equally well be an indication of minor mixing (~ 1,0%).

III. That the upper levels of the 2BS.UP are virtually sterile with the exception of millipede segments. It is therefore somewhat unlikely that the twigs used for the Pta-1190 date could have been due to mixing with that level.

5.6 $^{13}C/^{12}C$

5.6.1 Results

Some possible archaeological applications, based on ideas developed in 1974, are provided in Appendix 51. Analysis of relevant samples from Border Cave are still proceeding at the National Physical Research Laboratory in Pretoria. Some results to date are:

a) That all tested grass samples from the 2WA are of C_4 type (J.C. Vogel, pers. comm.)

b) That BC4, dated to ~ A.D. 1460, has $\delta\ ^{13}C$ values of -9,5% and -11,8% (Appendix 49).

5.6.2 Discussion

The following remarks are pertinent:

a) Stone Age bones show expectedly low collagen values (J.C. Vogel, pers. comm.). They are thus hardly ideal for the experimental work necessary at the present stage in the development of this method. It is nevertheless hoped to establish, on the basis of tooth samples drawn from the 2BS, whether A. bondi had a diet comparable to A. marsupialis (Vogel, 1976; Klein, 1977).

b) The scale of Upper Pleistocene climatic shifts in Southern Africa as documented by recent research (van Zinderen Bakker, 1976) makes it conceivable that Kranz grasses could have occupied the Lebombos at times when temperatures were lower and continentality greater (Appendix 54). The available readings indicate that this possibility can be excluded in the case of 2WA, which is in good accord with deductions based on faunal evidence (Klein, 1977).

c) The values for B.C4 fall well within the C_4 distribution, which indicates that the diet of this individual was based on some unknown combination of:

I. Animal meat derived preponderantly from C_4 grazers.

II. Plant material derived preponderantly from C_4 grasses.

An IA agriculturalist with a lifelong addiction to the meat of herd animals is considered to be a rather remote possibility. The evidence may rather be regarded as tentative support for the cultivation of C_4 crops such as sorghum and millet in this area some five centuries ago. This deduction would then be in excellent agreement with a direct reading of 730 ± 60 B.P. (Pta - 1060) on a specimen of the former cultigen from Shongweni (Davies 1975).

5.7 D and ^{18}O

5.7.1 Results

Negotiations are still under way to have wood samples analysed in this connection.

5.7.2 Discussion

Libby et al. (1976) and Gray and Thompson (1976) have presented evidence that the stable isotope ratios of hydrogen and oxygen in individual tree rings vary with the air temperature which prevailed at the time of their formation. This data suggests that it may eventually be found possible to use the fossil wood at Border Cave to obtain an annual temperature record, accurate to perhaps ~ 0,1°C for all levels above the 3WA (4.2.5).

5.8 Salt

5.8.1 Results

Salt analyses and comments by Rapson are provided in Appendix 52.

5.8.2 Discussion

Salt appears to occur in the following two modes at Border Cave:

a) As usually small crystals diffused throughout the deposit, bar the slightly damp lower BACO levels (1.4.11).

b) As marked subhorizontal zones of limited areal extent, of which the most obtrusive by far was at the base of 2WA (1.4.4).

It is clear from the evidence that these modes may have resulted from some as yet unknown combination of the following range of conceivable sources:

a) Summer sea mists (Beaumont 1973a)

b) Plagioclase decomposition (Appendix 54)

c) Organic debris (Appendix 52)

d) 'Pan' salt (Appendix 52)

e) Human urine (Appendix 52)

The following comments are pertinent:

a) An introduction by way of sea mists is feasible in view of the mechanism described by MacIntyre (1974)

b) Bada (letter dated 1973) claimed that sea mist was an unlikely agency, in view of the probability that droplets would evaporate rapidly, leaving behind only microscopic crystals, but it is patent that this stricture is in fact not applicable to mode (a) occurrences.

c) Bada (letter dated 1973) was of the opinion that the often large mode (b) crystals were probably produced from saturated solutions, such as would occur on evaporation in a 'urinal area'. He also mentioned that salt so formed would contain distinctive amino acids, but large samples submitted in order to test this possibility have seemingly not as yet been analysed.

5.9 Calcite

5.9.1 Results

All recovered calcite crystals were counted and that data was then used to compute the variations in their incidence on a stratum basis as listed in Appendix 53.

(b) The density and distribution of the IA debris recovered from stratum 1BS.UP.IA was consistently low and sporadic, a finding which is best construed to mean that the items owe their presence to occasional visits rather than sustained occupation. A further clue in this connection is provided by the numerous empty pits, which may represent intentionally hidden food caches, dug by the local inhabitants at times of unrest.

6.1.1.2 'Early Later Stone Age'

The 'Early L.S.A.' technocomplex of Southern Africa is characterized by (Beaumont and Vogel, 1972: 155) :

(a) Ground bone and stone objects, with particular importance being attached to the presence of bone points and shell beads.
(b) A variety of scraper types, mainly straight- and convex-edged, which dominate the formal stone tool complement.
(c) Infrequent backed items, which may include true geometric microliths (van Noten, 1977; Deacon, n.d.).
(d) An abundance of scaled pieces (usually termed outils écaillés / pièces èsquillées).
(e) The presence, where suitable materials were available, of very refined microbladelets and related cores, but apparently only in levels predating ~ 12 Kyrs. B.P. (Klein, 1974: 258).
(f) The exclusive occurrence of flakes with plain platforms, bar occasional and probably fortuitous dihedrals.

Aggregates which conform with most of these criteria at Border Cave are confined to the 1WA/1BES and 1BS.LR. There are however certain minor discrepancies, namely:

(a) The absence of backed items, despite suitable materials and adequate samples.
(b) The extreme rarity of microbladelets, despite suitable materials and adequate samples.
(c) The inordinately high faceting proportion in 1WA + 1BES and 1BS.LR, particularly for the Rhyolite 1 fraction of the I2 subclass, where values reach ~ 10% (Appendix 12).

An examination of the faceted flakes showed them to be absolutely typical of those levels in terms of features such as high cortex retention and relative thickness (Appendices 11 and 22). There are therefore no good grounds for regarding these items as being perhaps intrusive from the underlying 2BS.

This evidence is thus in full accord with the presence of a few very crude radial prepared cores in the 'Early L.S.A.' levels (Appendix 14).

A consideration of the above-mentioned data, in terms of the hiatus between the 2BS.UP and 1WA, as revealed by the C-14 measurements (Appendix 49), led the author some years ago to envisage the 1WA/1BES and 1BS.LR aggregates as probably representing the terminal phase in a postulated transition between the M.S.A. and 'Early L.S.A.' (Beaumont 1973a). Although such a succession is still believed to exist, it is now considered that the cultural ascription then proposed for these particular assemblages was poorly founded, in view of the principle that aggregates are best assessed on the basis of all of their constituent class parameters, with particular reference to the most advanced elements present.

The view point now adopted is therefore:

(a) That the 1WA/1BES and 1BS.LR assemblages belong undoubtedly to the 'Early L.S.A.', particularly in view of their content of bone arrow ? points and ostrich eggshell beads, two forms which are common to all subsequent lithic industries.

(b) That there are no major typological differences between 1WA/1BES and 1BS.LR. despite seemingly slight shifts in attributes, such as raw material class proportions (Appendix 18), which may indicate a certain degree of temporal differentiation (5.5.2).

(c) That the radiocarbon determinations clearly demonstrate that this techno-complex was in existence by at least ~ 37 Kyrs B.P., and perhaps even at or before ~ 45 Kyrs B.P. (Appendix 49).

6.1.1.3 Middle Stone Age

The M.S.A. technocomplex of Southern Africa is characterized by (Goodwin, 1928: 411; Beaumont and Vogel, 1972: 157-158):

(a) A variety of retouched forms which have been termed Trimmed Points 1 and 2 in this dissertation (2.3).

(b) A consistent but variable incidence of points formed by convergent dorsal flaking from the butt (cf. Keller, 1969: 137).

(c) A significant proportion of flakes with faceted platforms and of cores showing radial preparation (Figs. 33 and 35).

Aggregates which conform with most of these criteria at Border Cave range between BACO.D and 2BS.UP. The sharply defined and relatively limited temporal span of segments, as also their relative abundance in levels which contain them, makes it possible to effect a workable subdivision of that continuum into three site-specific units, namely:

(a) M.S.A.1, between BACO.D and 1GBS.UP. Typified by the total absence of Backed pieces 2, and by usually high values for Points and Trimmed Points 2. (Figs. 30 and 32). The progressive increase with time in the relative proportion of formal tools in these levels (Fig. 31) apparently constituted a major basis for a previous subdivision into two local phases of the Pietersburg s.s. (Cooke et al., 1945; Malan, 1950).

(b) M.S.A. 2, between 1RGBS and 3BS. Typified by the marked presence of Backed pieces 2, and by consistently low values for Points and Trimmed points 2 (Figs. 30 and 32). This grouping equates with the 'refined' Pietersburg of Cooke et al (1945) and the 'Epi-Pietersburg' of Malan (1949a).

(c) M.S.A.3, between 2WA and 2BS.UP. Typified by the absence of crescents, and by consistently low values for Points, Backed pieces 2 and Trimmed points 2 (Figs. 30 and 32). Two distinct subunits within this entity can be isolated, namely:

   I. An early phase, between 2WA and 2BS.LR.C. Distinguished by the presence of Modified butts, and by low values for Chalcedony and Scaled pieces (Figs. 30 and 38).

   II. A late phase, between 2BS.LR.B and 2BS.UP. Distinguished by the absence of Modified butts, and by high values for Chalcedony and Scaled pieces (Figs. 30 and 38).

The 2BS.UP at Border Cave contains an aggregate which is characterized in typological terms by fairly high values for dihedral and polyhedral platforms and for radial prepared cores, but by very low values for Points (one broken item only) and for Tools 1 (Figs. 30, 33, 35). These data indicate that the assemblage is marginal for two of the three technocomplex criteria listed above, and there are thus good grounds for regarding it as a terminal occurrence within the M.S.A. Of considerable interest therefore are the related C-14 readings which clearly show that even the latest manifestation of it predates 49 Kyrs. B.P. at Border Cave (Appendix 49).

6.1.2 Morphometric

Untrimmed flake samples from all identified levels at Border Cave were subjected to a detailed typological investigation (2.3.3). Grouping was initially on the basis of three primal plan-form categories, which approximate to those first recognised by Mason (1957). These were then subdivided in terms of the extent to which shape had been determined by dorsal preparation. The subclasses with dimensions entirely dictated by flaked surfaces were then used for a metrical study, in which parameters relate directly to the underlying technology.

Measurement was undertaken for the specific purpose of testing the hypothesis that the three plan-form categories were discrete entities which did not represent fractions of a single homogeneous flake matrix (Freeman, 1972: 46). The results obtained, insofar as the I2, B2 and P2 subclasses are concerned, were found to reveal:

(a) That the absolute dimensions of the three categories usually differ in any given aggregate, with the frequency distribution of each being 'normal' when plotted on a log scale (e.g. Figs. 53 and 57).

(b) That the dimensional ratios of the three categories usually differ in any given aggregate, with the frequency distribution of each being 'normal' when plotted on a log scale (e.g. Figs. 78-80).

(c) That the dimensional and ratio coefficient of variation values for the three categories usually differ in any given aggregate (e.g. Figs. 45 and 48).

(d) That dimensional, ratio and V values for differing categories, with material constant, follow dissimilar courses with time (e.g. Figs. 42-48).

(e) That dimensional, ratio and V values for differing materials, with category constant, follow dissimilar courses with time (e.g. Figs. 42-48).

These concordant findings:

(a) Cannot be reconciled with the concept of untrimmed flakes as a single uniform débitage grouping (e.g. Kleindienst, 1961).

(b) Would seem to vindicate the view that the cited subclasses were each deliberately produced for differing purposes (Mason, 1967).

In terms of these deductions the extent of utilization damage is seen to be an attribute of uncertain significance (2.8), depending as it does on an interaction of various factors, such as the nature of the raw material and the extent of work done (Clark, 1960).

FIG. 78 B/L RATIO IN I2 AND B2 AND P2 SUBCLASSES COMPARED

BORDER CAVE. STRATUM BACO.C+D. RHYOLITE 1 + QUARTZITE 1

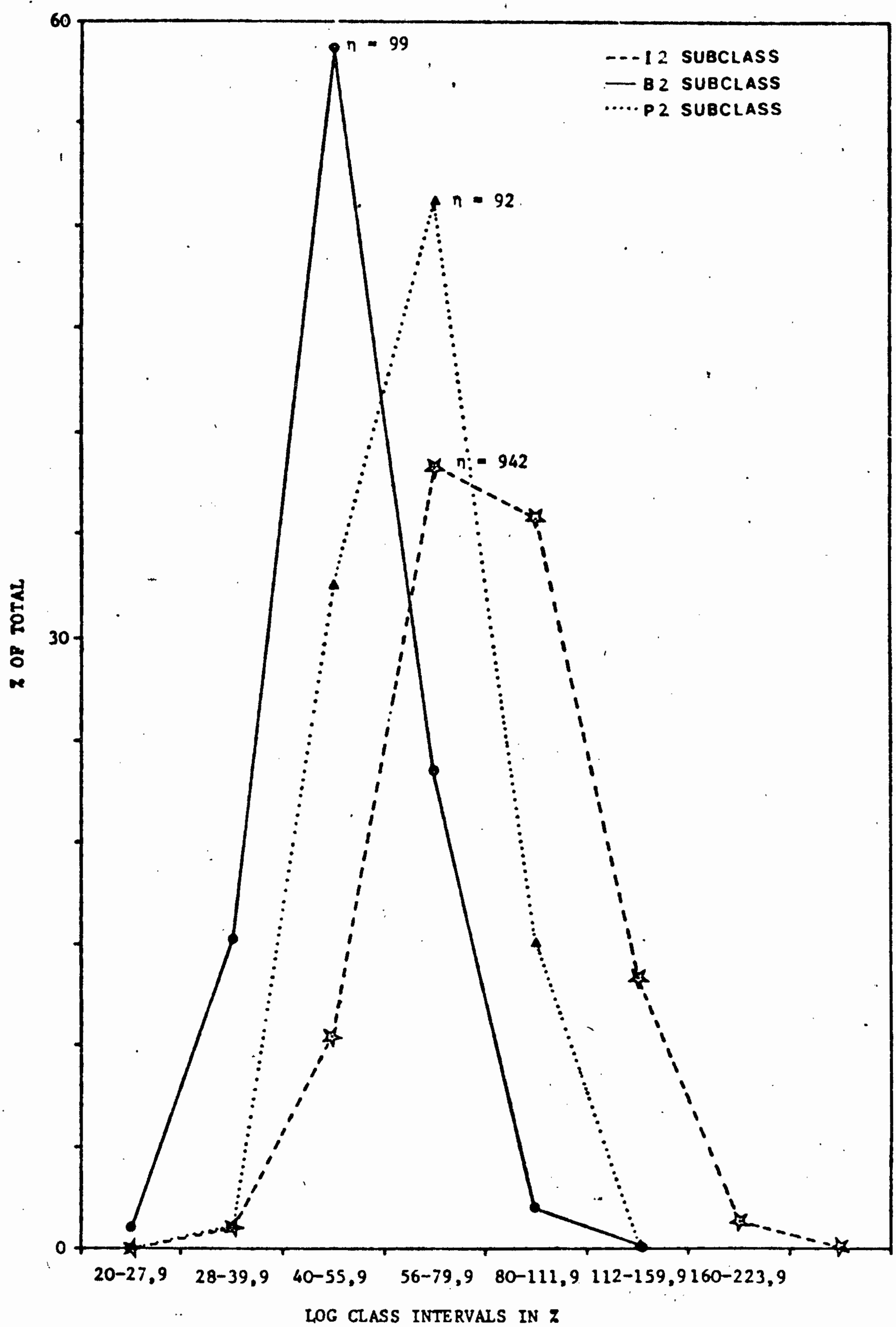


FIG. 79 B/L RATIO IN I2 AND B2 SUBCLASSES COMPARED

BORDER CAVE. STRATUM IRGBS. A+B. RHYOLITE 1 + QUARTZITE 1

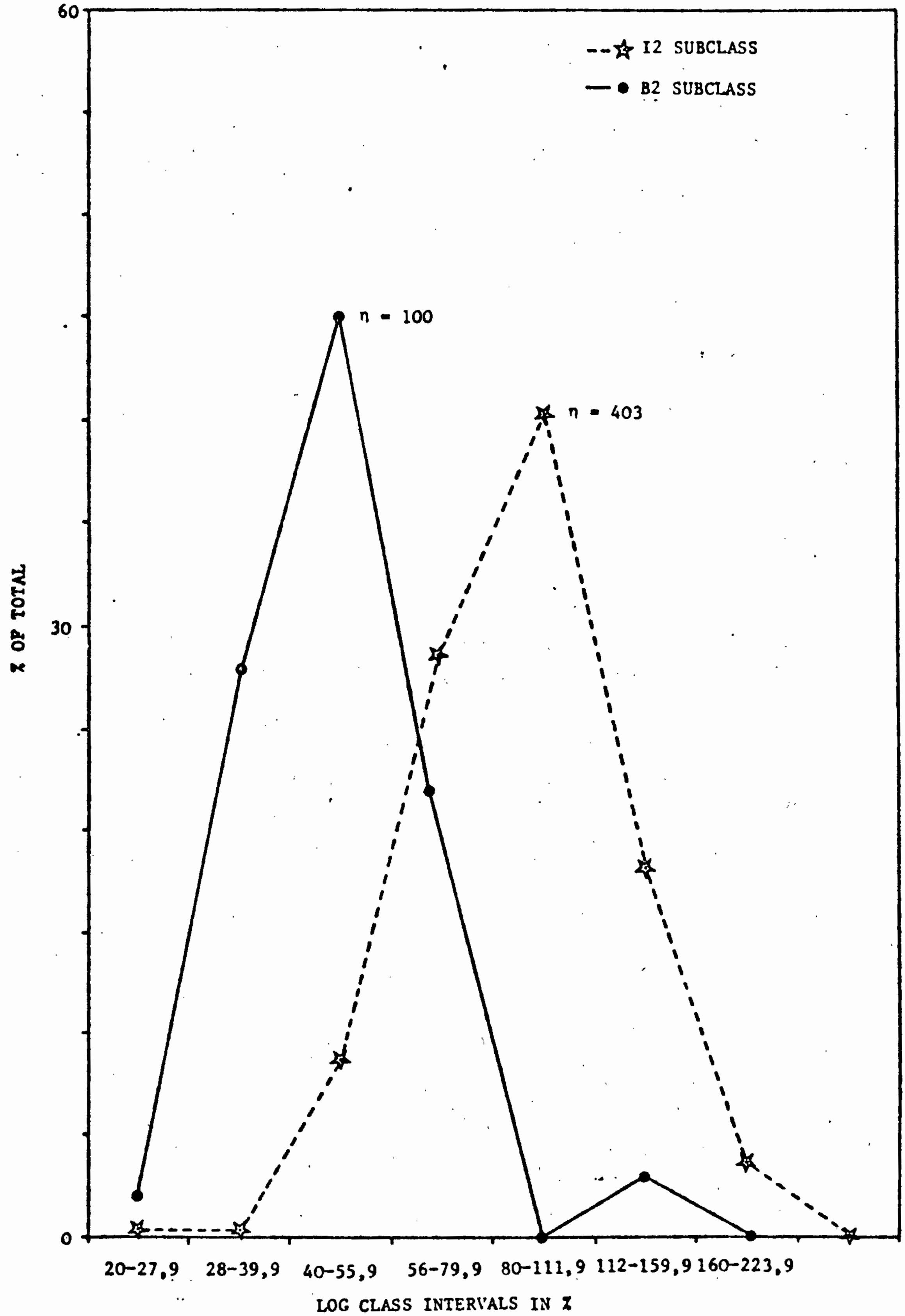
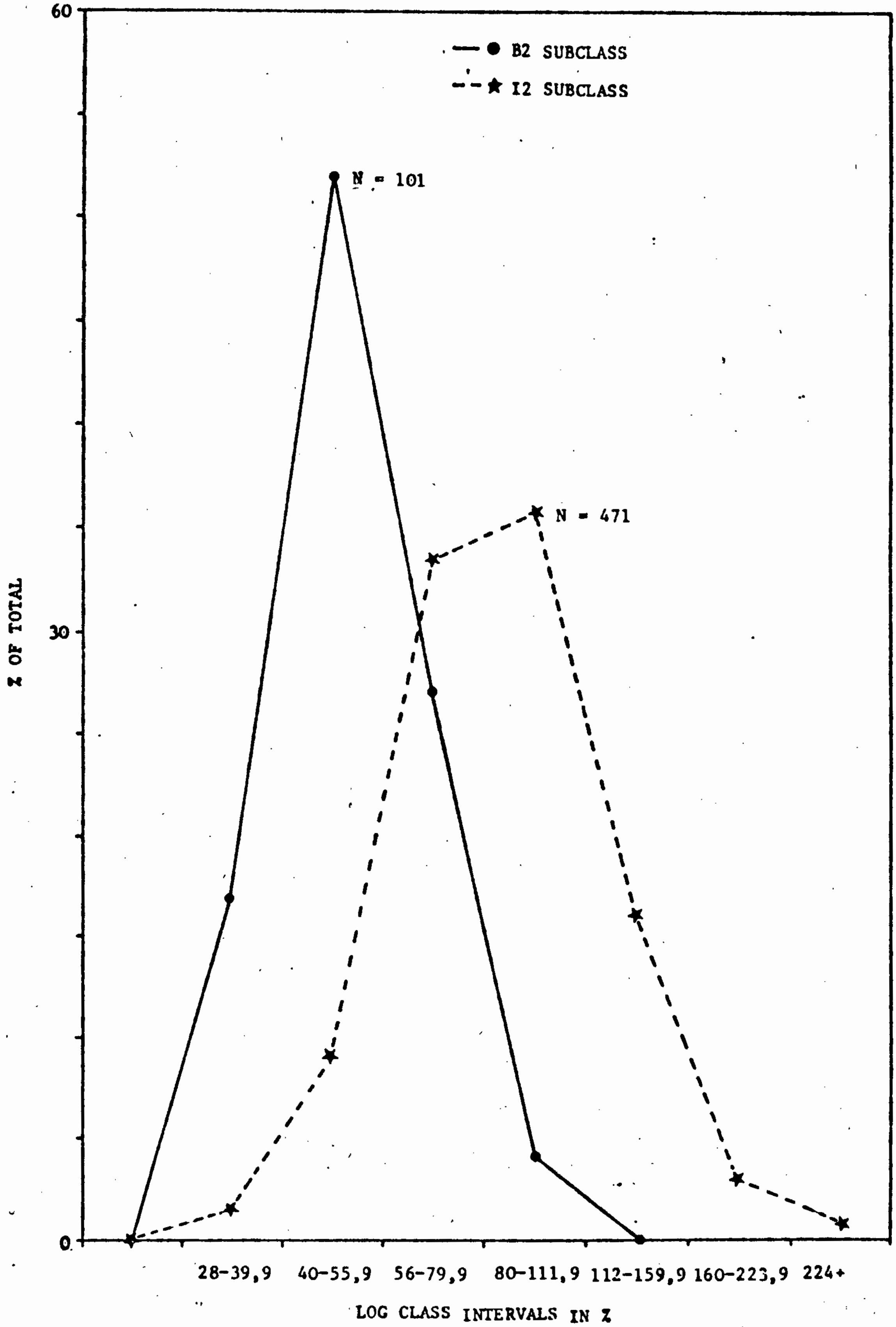


FIG. 80 B/L RATIOS IN I2 and B2 SUBCLASSES COMPARED

BORDER CAVE. STRATUM 2BS.LR.C. RHYOLITE 1 + QUARTZITE 1



The precise status of subclasses with dorsal cortex remain ambiguous because of inadequate B1 and P1 samples, which limited study to the I1/I2 relationship (Appendix 25). Our data in this connection indicate :

(a) That corresponding metrical parameters for these two series members follow differing temporal courses (Fig. 41).

(b) That the utilization proportion means for these two series members differ systematically in the case of Rhyolite 1 (2.8).

The tentative deduction is that I1 forms at this site are largely the fortuitous product of core preparation, as is suggested by the fairly constant I1/I2 frequency proportions (Appendix 11), but that they nevertheless constituted a flake reservoir which was frequently tapped, as is indicated by an edge damage mean value of ~ 60% relative to I2 (2.8).

Morphometric studies based on untrimmed flakes have a variety of possible applications, namely:

(a) For determining whether or not a particular artefact class is in fact a discrete entity. An example is provided by the above discussion, in which certain firm conclusions were reached, despite the 'absence of comment from the makers' (Mason, 1967: 742).

(b) To establish the nature of the relationships within a series of superimposed aggregates, by identifying breaks, anomalies and trends. For instance, metrical shifts at Border Cave confirm typological evidence that the M.S.A. there is best regarded as an unbroken continuum (2.9) with consistent trend deviations, believed to be largely idiosyncratic, being confined to one area of the 1GBS.UP.

(c) For assessing the affinities of an aggregate with few or no formal diagnostic tools, by comparison with untrimmed flakes of known ascription. An example is provided by the remarkably amorphous basal industry at Peers Cave which has nevertheless been ascribed to the M.S.A. (Anthony, 1967; Sampson, 1972: 114). In Figures 81 and 82 a random I2 collection from that site is contrasted with comparable samples from the M.S.A. at Border Cave and the E.S.A. at Montagu Cave. Affinities for both parameters are seen to be with the latter aggregate, a finding which is perhaps compatible with the presence of handaxes in the talus there (Jolly, 1948). However, this indication cannot by itself be regarded as conclusive, in view of a possible distortion induced by the morphometric insensitivity of coarse-grained materials such as T.M.S., (Fig. 92) and also because of the presence at Peers Cave of a very low

FIG. 81 I2 SUBCLASS. B/L RATIO: VARIOUS AGGREGATES COMPARED

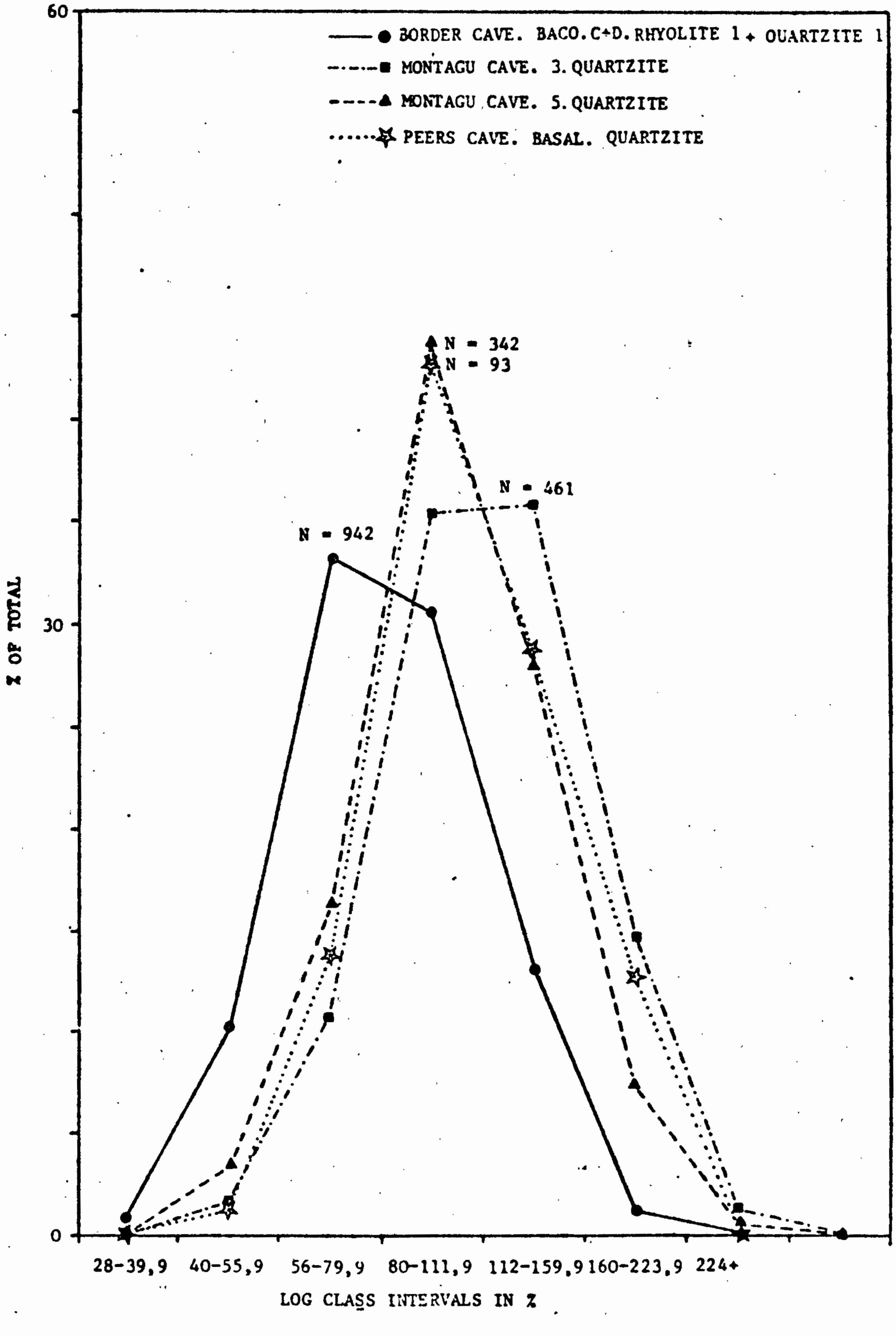
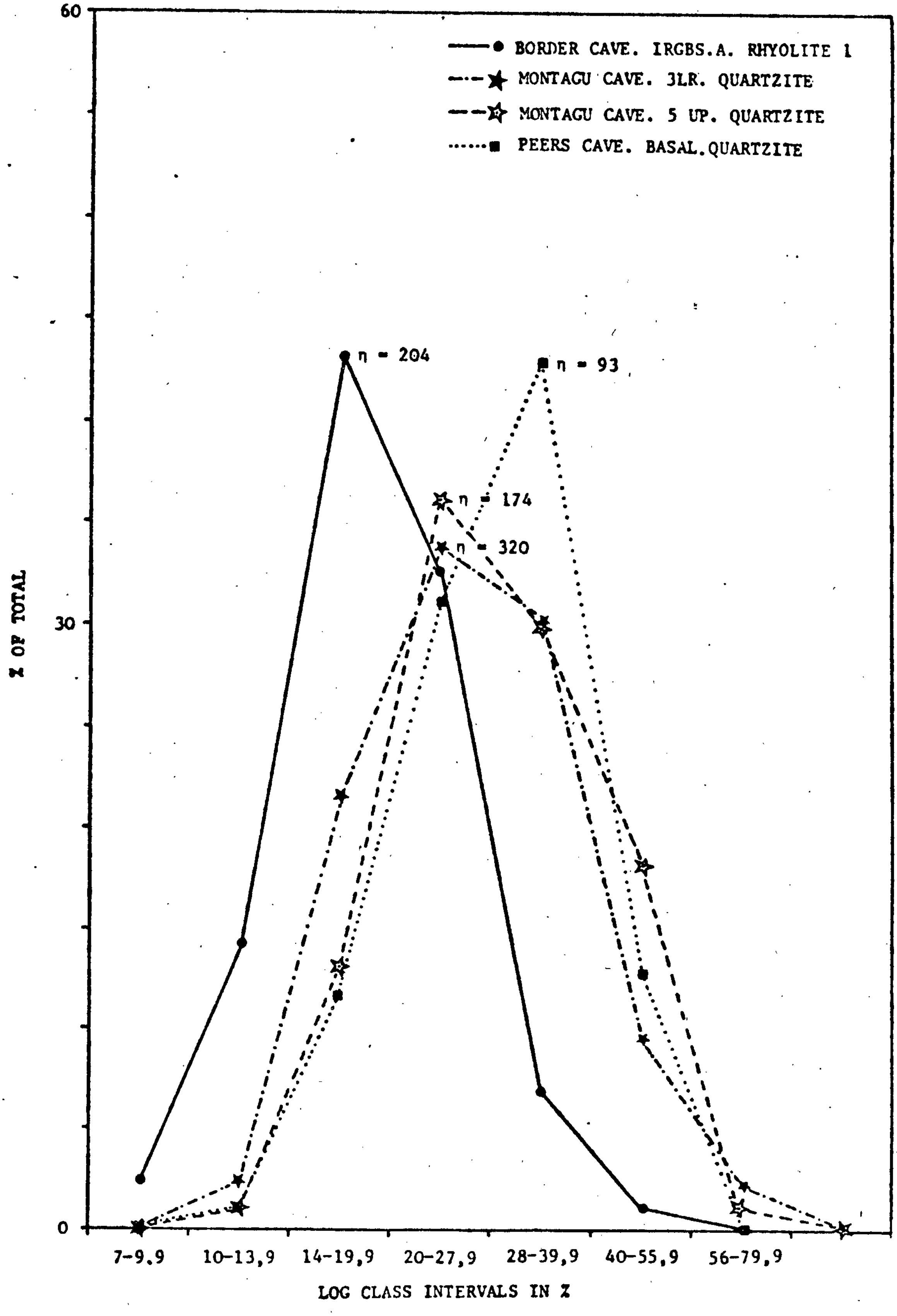


FIG. 82 I2 SUBCLASS. REL.T : VARIOUS AGGREGATES COMPARED



proportion (< 1,0%) of undoubted P2 types within the untrimmed flake matrix (Beaumont, unpublished data).

(d) To predict the likely 'profile' of aggregates which lie immediately beyond the span of a given sequence, by means of the limited temporal extrapolation of typological and/or metrical trends at that site. For instance, forward extension of M.S.A. shifts documented at Border Cave undertaken prior to the analysis of the 'Early L.S.A.', yielded parameters which coincided very closely with those subsequently established for these assemblages. Conversely, a hypothetical sample predating BACO.D is predicted to have: a Tool 1 range dominated by Scrapers and Trimmed points 1 and 2 (Fig. 30); a reduced value for the formal tool/flake minimum number proportion (Fig. 31); an increased value for the I2 dihedral faceting proportion (Fig. 33); a reduced value for the radial prepared core proportion (Fig. 33); an increased value for the coarse-grained material proportion (Fig. 38); and I2 flakes which are larger (Fig. 42), narrower (Fig. 43), thicker (Fig. 44) and less varied in size and shape (Fig. 45). This 'identikit' description appears to correspond fairly closely with the attributes actually recorded for very early M.S.A. aggregates, such as that from Bed 4 at the Cave of Hearths (Sampson, 1972: 82-97).

6.2 Fauna and Flora

6.2.1 Hominids

6.2.1.1 Iron Age

IA remains are limited to BC4. This partial skeleton belongs to a slightly built individual of uncertain sex and with an age at death of between 38 and 45 years (Appendix 31). Measurements, indices, and non-metrical characters of the mandible fall well within the corresponding ranges of the male South African Negro (Appendix 31). The vertebrae and limbs indicate nutritional deficiencies and extreme osteoarthritis, while the teeth show severe attrition with dentine exposure (Appendix 31). Low ^{13}C depletion values for the bones point to an exclusively C_4 intake, which may reflect a diet largely based on cultigens such as millet and/or sorghum (Appendices 49 and 51). Artificial damage to the shaft of the right humerus probably represents a witchdoctor's attempt at curing a 'frozen' shoulder, thereby suggesting that this extant practice is of fair antiquity (Appendices 31 and 49). On the left wrist was a heavy iron bracelet, from which a date within the last two millennia may be inferred on the basis of external evidence as to the advent of the local I.A. (Dart and Beaumont, 1969). The body came from a shallow and stone-covered grave with a lip at or just below the 1BS.UP.IA surface in the southern sector of the cave (Fig. 3). Two corrected and calibrated radiocarbon determinations based directly on the remains indicate a calendrical age of ~ A.D. 1460, which is quite close to the lower limits of the I.A. occupation span documented in Exc. 3A Rear (Appendices 49 and 50).

6.2.1.2 Middle Stone Age

The vestiges of two individuals from Border Cave are undoubtedly attributable to the M.S.A. Salient details concerning these are as follows:

(a) B.C.3. This incomplete skeleton represents an infant of between four and six months of age (Appendix 30). Various metrical and morphological features align it with both Khoisan and South African Negro (Appendix 30). The remains seemed to have been rather scattered and the excavators were unable to deduce the original posture (3.2). Some of the bones show reddish-brown stains, which appear to indicate the application of haematite powder, either before or after dissolution of the flesh (de Villiers, 1973). Associated was a single perforated Conus shell, clear proof of some form of contact with the coast, 80 km or more to the east (Fig. 2). The vestiges came from a small and shallow but indubitable grave with a maximum depth of ~24 cm (3.2). Lip data indicates an association with 1GBS.UP horizons lying ~ 5 cm below the base of the intact 1RGBS (Fig. 14). This implies that the burial relates to the very end of M.S.A. 1 (6.1), with a minimum radiocarbon age of > 49 Kyrs. B.P. (Appendix 49).

(b) B.C.5. This partial mandible probably belongs to a male, with an estimated age at death of between 25 and 35 years (Appendix 32). The metrical and anatomical features as a whole appear to favour a link with the South African Negro (de Villiers, 1976). Wear surfaces of all the intact teeth show severe attrition, with pulp cavities being exposed in some (Appendix 32). The specimen was recovered from just above the base of the undisturbed 3WA, immediately adjacent to an only partly excavated depression (a grave?) (1.4 and 3.2). Associated artefacts represent a middle phase of M.S.A.2 (6.1), which has a minimum C-14 date of > 49 Kyrs. B.P. (Appendix 49).

6.2.1.3 Unprovenanced

The vestiges of two individuals from Border Cave were found during the sieving of material derived from Horton's Pit. Salient details concerning these are as follows:

(a) B.C.1. This incomplete cranial vault probably represents a male, with an age at death of perhaps 30 years (Cooke et al.,1945). D^2 values demonstrate that this skull is very similar to Tuinplaas, but significantly different from recent Khoisan and South African Negro populations (Appendix 28). Discriminant analysis shows that this separation is mainly a result of its greater size, particularly with respect to breadth (Appendix 28). This difference is perhaps of importance in view of the known reduction in that parameter between Upper Palaeolithic and Neolithic crania from Western Europe (Frayer, 1972). The relatively complete skull portions found contrast markedly with mean macrofaunal fragment mass values (<1,0g), which suggests the possibility that burial had protected the pieces from damage due to trampling (3.3). B.C.1 is said to have come from the northwest section of Horton's Pit, but accounts differed as to its precise stratigraphic position in the sequence of sediments exposed there (3.2). Observations made in 1942 revealed that the 4WA surface extended undisturbed over the floor of that digging, thereby providing a lower dating limit (3.2). Cooke et al.(1945), on the basis of soil adhesions in the small interstices of the skull, concluded that it had come from a distinctive chocolate-brown layer, lying immediately above the 4WA and corresponding to our 1GBS.LR (Table 1). That claim is supported by the author's interpretation of the nitrogen and aspartic acid readings, which suggest the fragments are of the same age or even somewhat older than B.C.3 (5.1 and 5.2). This likelihood would then clearly be in good accord with the F- and N- verified (Protsch, 1973) association of the almost identical Tuinplaas skull (Appendix 28), with an 'advanced' Pietersburg assemblage (van Riet Lowe, 1929). Our overall conclusion is therefore that the morphometric data precludes an I.A. ascription and thereby implies a pre-1BS.S association, while the other concordant evidence would seem to support strongly the probability that the skull refers to the 1GBS which has a minimum radiocarbon age of > 49 Kyrs. B.P. (Appendix 49).

(b) B.C.2. This partial mandible belongs to a fully adult individual and shows close metrical affinities with the San female (Appendices 29 and 32). The possibility of burial is not precluded in view of the great size of the specimen relative to macrofaunal mass means (3.3). A lower dating limit is provided by the intact 4WA surface noted in 1942 (3.2). Related nitrogen and aspartic acid values are not significantly different from those for BC1 (5.1 and 5.2). The chances are therefore that this item is also ascribable to the 1GBS and that it has a date in excess of > 49 Kyrs. B.P. (Appendix 49).

6.2.2 Subsistence

Various studies have shown that antelope remains constitute a preponderant fraction of the bone at most early hominid occupation sites in Southern Africa (e.g. Brain, n.d.: 98). Even a cursory examination of relevant data indicates that these species vary enormously in mass and thereby in their content of edible meat. Figure 83 attempts to dramatize this single fact by ordering the mass ranges of most extant adult hoofed mammals in the subcontinent, using values largely derived from Dorst and Dandelot (1970) and Brain (1974a: 7).

The following procedures were adopted in order to obtain some idea as to how predation patterns actually relate to antelope mass in the various stratum groupings from Exc. 3A Rear at Border Cave:

(a) Attention was limited for practical reasons to the four bovid size categories listed by Klein in Table 1 of Appendix 33.

(b) The mean adult masses for all species within each of these categories was obtained by transposing the average values obtained for the similar groupings of Brain (1974a: 7).

It should be stressed that the readings obtained make no pretence at great precision because:

(a) No attempt was made to integrate the specific non-bovid data (e.g. the equids) into the present analysis (Appendix 33).

(b) Postcranial bone fragmentation rates may differ between young and old individuals and/or small and large species (Appendix 33).

The results of this investigation are listed in Table 5. From this it is evident :

(a) That the meat complement obtained from the Small category was consistently very low, with values of between ~ 1,0 and 2,0%.

(b) That the meat complement obtained from the Large category was consistently very high, with values of between ~ 59 and 79%.

(c) That the early inhabitants of the cave had a meat diet which was based to a remarkable extent on Syncerus caffer. This deduction follows from the low proportion of eland relative to buffalo and the possibility that juveniles of both species are included in other categories (Appendix 33, Tables 1 and 7).

FIG. 83 MASS RANGES OF EXTANT ADULT HOOFED MAMMALS IN SOUTHERN AFRICA

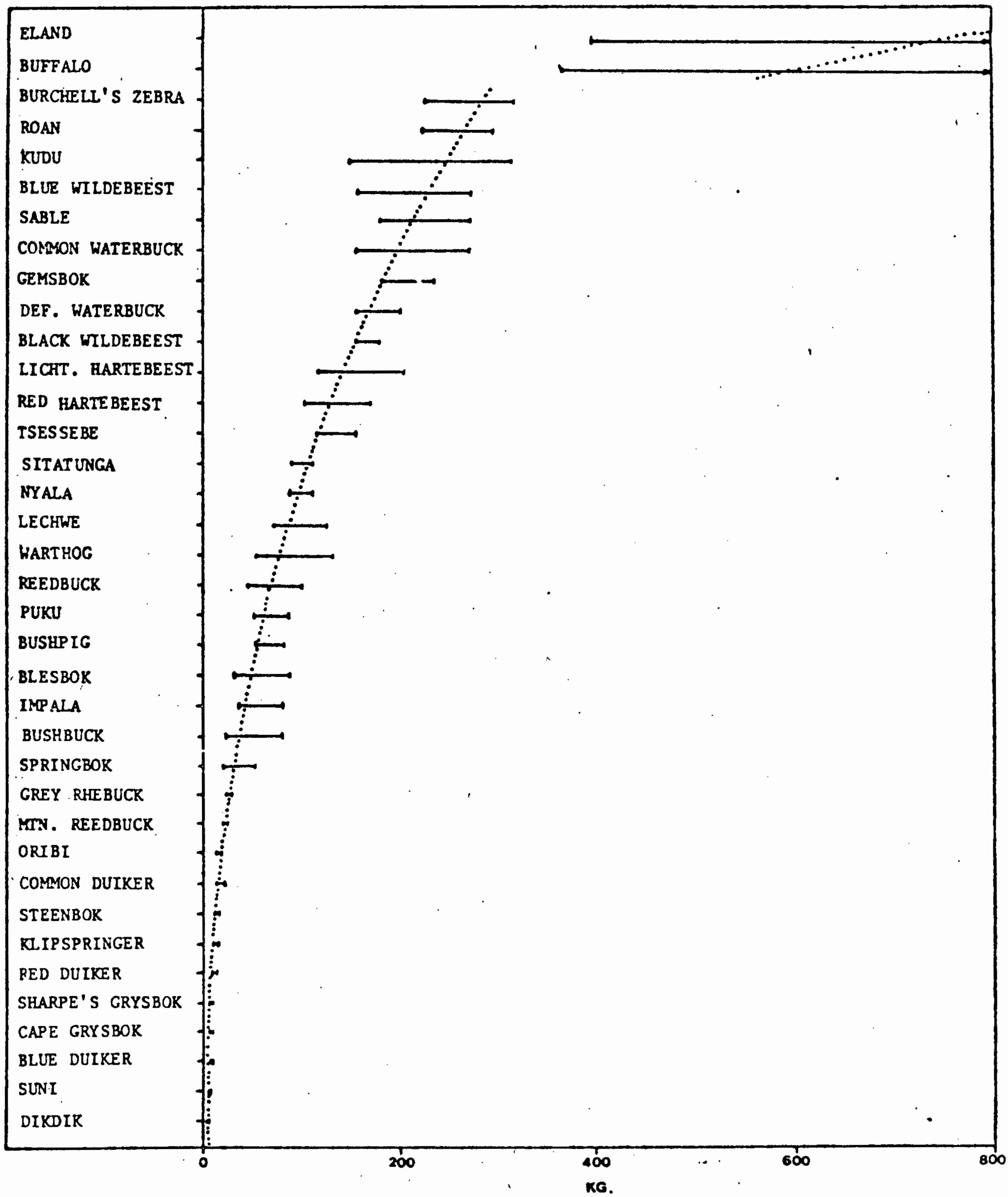


Table 5. Bovid postcranial category proportions in terms of live mass

Border Cave. Exc. 3A Rear

Stratum grouping	Size category	Minimum number	Mean class mass (kg)	Total class mass (kg)	% total mass
1BS.LR + 1WA	Small	6	10,3	61,8	1,1
(Early L.S.A.)	Small medium	8	49,0	392,0	7.0
	Large medium	4	178,2	712,8	12,7
	Large	7	636,3	4454,1	79,2
		25	-	5620,7	100,0
2BS.UP-2SB.LR.A	Small	5	10,3	51,5	1,8
(M.S.A.3. Late)	Small medium	5	49,0	245,0	8,4
	Large medium	4	178,2	712,8	24,4
	Large	3	636,3	1908,9	65,4
		17	-	2918,2	100,0
2BS.LR.C + 2WA	Small	3	10,3	30,9	0,7
(M.S.A.3 Early)	Small medium	7	49,0	343,0	7,9
	Large medium	8	178,2	1425,6	32,8
	Large	4	636,3	2545.2	58,6
		22	-	4344,7	100,0
3BS.UP - 3WA	Small	3	10,3	30,9	0,7
(M.S.A.2)	Small medium	4	49,0	196,0	4,3
	Large medium	3	178,2	534,6	11,7
	Large	6	636,3	3817,8	83,4
		16	-	4579,3	100,1
1GBS.UP - BACO.A (M.S.A.1)	Small	4	10,3	41,2	1,1
	Small medium	4	49,0	196,0	5,1
	Large medium	6	178,2	1069,2	27,8
	Large	4	636,3	2545,2	66,1
		18	-	3851,6	100,1

6.2.3 Seasonality

No direct evidence exists as to the time/s of the year when prehistoric peoples may have occupied Border Cave (Klein, 1977). However, there are a few highly circumstantial indications, namely:

(a) It has been noted that the upper Stone Age levels are virtually bereft of seed remains, despite the probability that these would have been preserved if they had been present in the deposit (4.4). This finding led to the formulation of three alternatives, which are that man at that time:

I. Was exclusively concerned with meat as a food source.

II. Only occupied the site at times when seeds were not available.

III. Foraged in a floral environment which lacked seeds.

Seasonality inference in terms of these possibilities would be limited to (II), which implies an occupation during mid or late winter (B. Maguire, pers. comm.).

(b) The buffalo is an extremely dangerous beast and yet is represented by more teeth than any other single species (Archaeological Survey file B20/1/2; Appendix 33; Table 1). That humans hunted this animal on an opportunistic basis, limited to times when it was particularly vulnerable, is demonstrated by the dental age distribution, which shows marked peaks for State I (29%) and States V and VI (42%) (Appendix 33; Table 8). T. Reilly (pers. comm.) is of the opinion that these data suggest:

I. That predation was largely confined to females at or very soon after giving birth (Klein, 1975). Buffalo in this region appear to calve the year round, but with a peak incidence in early summer.

II. That predation was largely confined to females and/or their weanlings, at times of maximum environmental stress, which coincides in this area with the dry season. The habitat is at its most hostile then, and many animals may become extremely weak, with mortality being most marked in the immatures. This pattern is a result of fodder and nutritional deficiencies, resulting from a reduced foodbase and foraging range, ultimately induced by water source and volume limitations.

An overall evaluation of this evidence is that the dental age distribution indicates some uncertain mix of these two alternatives, with the high value for preserved State I teeth possibly favouring a dominance of (II), which would in turn suggest an occupation in late winter.

(c) Klein has documented a low frequency and even absence of very young wildebeest, hartebeest/tsessebe, etc. at Border Cave (Appendix 33, Table 7). He comments that one interpretation of this finding is that these species were migratory and that the calves were perhaps born elsewhere. That this could have been the case may be inferred from historical accounts which indicate that game moved from the lowveld/sweetveld to the highveld/sourveld between winter and summer, and vice-versa (Reilly, 1976: 4). These patterns of movement, in accord with those of recent sheep farmers, were based on the fact that sweetveld is palatable when it is mature and dry in winter, whereas the highveld produces a grass fodder which attracts game in early spring, but provides only poor and sparse grazing during the dry season (Maggs, 1975: 449). Thus the highveld and the lowveld complement each other as year round grazing regimes, which apparently induced oscillatory game movements in the past, although it should be stressed that there would always have been sedentary herds and species which remained in either region. The scale of these migrations is provided by transport rider accounts of a mere century ago, which record that wagon trains were more than occasionally caught up in the wake of immense herds of mixed game which left the veld '...without grazing, and game had to be shot for the fresh stomach contents which was then used to feed the trek oxen to keep them alive'. (Reilly, 1976: 4).
The implication of these data is that herd animals such as wildebeest and hartebeest would have moved away from the lowveld with the first spring rains in the high country to the west. Since Alcelaphine calves are mainly born in summer, it follows that they would already have been fairly large on arrival in the lowveld, thereby rendering explicable the low proportion of their teeth ascribable to State 1, if we assume a winter occupation at Border Cave.

It is concluded that the admittedly tenuous evidence cited above points most consistently to site habitation during the latter half of winter. If this view is correct, then it would seem that the pattern of these seasonal visits was remarkably constant with time, which in turn suggests that it may ultimately have been based on some environmental constant such as the proximity of the site to the Ngwavuma River. That major lowveld waterway has been known to cease flowing in winter (Daniels, 1962), and this tendency may well have been more marked when temperature and rainfall was lower (e.g. van Zinderen Bakker, 1976). Inferred conditions approximating to that state would seem in fact to have prevailed during the accumulation of the 'Early L.S.A.' and M.S.A.2 (Appendix 33). At such times the river may well have been reduced during winter to a few discontinuous pools, which would then have acted as focal points for great aggregations of game. It is perhaps not accidental that buffalo, with their known dependence on water, should achieve extreme mass proportion values of ~79 and ~83% at those times (Table 5).

6.2.4. Settlement range

The extent and direction of home range movements is indicated by everyday objects such as :

(a) The occurrence of bones belonging to plains-loving species such as zebra, which suggests some unknown degree of familiarity with the low-veld to the west (Appendix 33).
(b) The persistent and sometimes extensive use of fine-grained quartzite, most probably obtained from exposures in the Ngwavuma Poort, ~ 2 km to the south (2.4).
(c) The occasional and never extensive use of low-grade obsidian, which presumably derives from thin lenses on the scarp face below Ingwavuma, ~ 8 km to the south (5.4.2).
(d) The persistent and sometimes extensive use of cryptocrystalline materials only known to occur in fair abundance on the lower dip-slope of the Lebombos, ~ 15 km to the east and south-east (2.4).

A very low proportion of the artefacts are based on materials which are seemingly not indigenous to the general vicinity of the cave, but it is not known whether these represent the limit of the groups annual range and/or barter with neighbouting peoples. Such items include:

(a) Certain fragments of high-grade red and specular haematite associated with the Stone Age strata. These could perhaps be local, but may derive from the ore-body at Ngwenya, where there were workings relating to the Early I.A., 'Late L.S.A.' and M.S.A.1 (Beaumont, 1973b).
(b) Two talcose schist boned stone fragments from the 1WA and 1BS. LR. This rock-type may have come from localized occurrences in the granites, at least 40 km to the west (Fig. 8). However, the only major source of this material, still utilized for tourist trade items, are Swaziland System outcrops near Ngwenya, 120 km to the north-west (2.4).

5.9.2 Discussion

The following comments are pertinent:

a) When considering the frequency data it should be noted that it is not known to what extent a total retrieval of these items was effected and significance should probably only be attached to the grosser variations.

b) A large proportion of the crystals were adhering to rhyolite spalls and it therefore seems likely that most or all of them actually formed on the cave roof, from which they were presumably detached mainly at times of accelerated éboulis formation.

The following broad deductions can be drawn:

a) That crystal values are extremely low in the BACO levels of Excs. 3A Rear and 3B. This would suggest that conditions for their formation were unsuitable then, in view of the occurrence of spall zones in those strata (Appendix 54).

b) That crystal values are particularly high in the 1RBS and 1RGBS of Exc. 3B. This would suggest one or both of the following alternatives:

   I. That conditions for their formation were ideal during or prior to the formation of these strata.

   II. That conditions for their formation were always optimal in roof areas bordering on the drip-line.

5.10 Sediments

5.10.1 Results

Analytical results and a comprehensive evaluation by Butzer are provided in Appendix 54.

5.10.2 Discussion

It should be borne in mind that the sampling basis of the reconstruction has the following actual or potential limitations:

a) We cannot as yet be absolutely sure that all of the levels in the cave have been identified.

b) There is still some doubt as to the precise stratigraphic relationship between certain levels.

c) The 1RGBS.A+B was not sampled because of the mistaken impression at the time (1974) that these levels corresponded precisely with the 3WA

d) The features of single and thus possibly atypical samples have been used to characterize entire levels.

Fig. 77 Crystalline minerals from the deposit - numbering from top to bottom:

Row 1: From S17. 236-244cm. BACO.A. Gypsum crystals

Row 2, left: From OZ7. 1RGBS.A Calcite crystal

Row 2, right: From R19. 3BS. Halite crystal

Photograph by D. Pokos

6. SITE SYNTHESIS

6.1 The Artefacts

6.1.1 Typology and Raw Material

Border Cave provides ideal conditions for a study of the dynamic aspect of class analysis because of the following circumstances:

(a) The occurrence there of an exceptionally complete cultural sequence covering much of the Upper Pleistocene prior to ~30 Kyrs B.P. (6.3).

(b) The extremely slow sedimentation rates which typify most strata as evidenced, for example, by the uniformly high macrofaunal fragmentation values (Deacon and Brooker, 1975: 207). The implication is that artefacts drawn from such levels should provide good random samples which approximate closely to the prevailing norms, with a minimum of distortion due to idiosyncratic fluctuations, such as may occur in contexts where accumulation was rapid (e.g. shell middens).

The results for the Stone Age, as detailed in 2.6, fully confirm this postulate and also reveal that contiguous levels are linked to a remarkable degree by confluent raw material frequency shifts and overlapping formal tool temporal spans. For instance, the 3BS and 2WA aggregates differ markedly in some respects, yet each is clearly related to the other, both by the persistence of Backed pieces 2 in the latter and by the advent of Modified butts in the former (Fig. 30; Cooke et al., 1945: 8). The essential inference is that there is thus no compelling reason for regarding any portion of the lithic succession at this site as not being an entirely indigenous development (cf. Cooke, 1971; Wymer and Singer, 1972).

Many of the observed frequency shifts at Border Cave, such as the increase in cryptocrystalline raw materials between BACO.D and 3WA, or the partial replacement of Trimmed points 1 by Backed pieces 2 between 1RGBS.B and 3BS, are clearly reflections of very widespread trends (e.g. Mason, 1957; Volman, n.d.). The absence of any certain exception to these changes, if considered in terms of minimum hypothesis, would suggest that they were probably synchronous, particularly in view of the lack of major geographical barriers in southern Africa (cf. Sampson, 1972 and 1974).

Subdivision of the Stone Age continuum seemingly represented at this site must of necessity be a matter of arbitrary definition tempered by pragmatic considerations. Some difficulties in this connection are:

(a) The relatively few sharp interfaces revealed by the formal tool data (Fig. 30).

(b) The strong correlation between certain raw materials and artefact classes (e.g. Howells and Clarke, 1961; Kleindienst, 1962). A Border Cave example is provided by the relatively low proportion of Points based on chalcedony (2.6.3). This finding, for example, clearly suggests the possibility of anomalous values for that tool category in the conceivable case of areas where only cryptocrystalline materials were available.

Despite these actual or potential problems it is possible to identify certainly the following major cultural entities, using a classification based on a mix of typological and technological criteria, which are in broad accordance with the original definitions proposed by Goodwin and van Riet Lowe (1929) and Mason (1952).

6.1.1.1 <u>Iron Age</u>

The I.A. technocomplex of Southern Africa is characterized by (Huffman, 1970: 3) :

(a) Signs of cultivation and/or animal husbandry.

(b) Semi-permanent villages of stone or pole and daga.

(c) Objects of smelted metal, including iron.

(d) Hand-made ceramic items, but mainly pottery.

Aggregates which conform with most of these criteria at Border Cave are confined to the 1BS.UP.IA, but the possibility that the 1BS.UP.S may belong in part of the I.A. is not precluded by cited evidence (2.11; 3.11), relating to the vertical distribution of sherds, goat pellets and large bovid droppings. The author's view is that these data are, with the exception of the 'cattle' coprolites, more easily explained as being the result of intrusion from above and/or the poor isolation of the 1BS.UP.S achieved by using arbitrary spits (1.3).

Some additional deductions are:

(a) That I.A. occupation of this area, as documented in the cave, certainly ranged back to $\sim 590 \pm 70$ B.P. (LJ - 2890) (Appendix 50). The possibility of typological shifts within this fairly protracted period is suggested by the marked contrast between the glass bead samples which were:

   I. Collected from the surface in the vicinity of B.C.4. Dominated by small specimens of very varied hue (Fig. 29).

   II. Recovered from the upper levels of Exc. 3A Rear. Typified by large irregular opaque pink oblates (Fig. 29).

(c) The possible echinoid spine and five shells of Nassa found in levels above the 2BS. (2.4 and 2.5). These must have come from at least 80 km away, but perhaps from somewhat further during Interpleniglacial times (van der Hammen et al., 1967).

(d) The single perforated Conus shell associated with BC3 and ascribable to the end of M.S.A.1 (3.2). This evidence for contact with the coast at that time is obviously compatible with the occurrence of M.S.A. middens at Revés Duarte and Kassimatis, both near Maputo (Barradas, 1965).

It is concluded that the present evidence is insubstantial, but that it does suggest links with areas near Mbabane and demonstrate contact with the Indian Ocean (Fig. 8). A further inference would be that possible seasonal movements seem to have been limited to a radius of ~120 km from Border Cave.

6.2.5 Bone survival

The bone recovered from Exc. 3A Rear was perfectly preserved (3.1), with no evidence for significant loss due to agents other than man (3.3.). This finding has an important implication in that it becomes feasible to consider relevant data in terms of the potential limiting case in which the total recovered macrofaunal mass would correspond to or even exceed the calculated total minimum number of individuals mass in any given level. Any marked deviation from this approximate relationship would then imply some combination of the following distortions induced by the cave occupants:

(a) The incomplete and/or preferential transfer of the skeletal parts from recovery site to cave (Perkins and Daly, 1968).

(b) Fragmentation due to firing, trampling, etc. This general process category is also here taken to include attrition due to soft bone consumption (Brain, n.d. : 104).

The following procedures were adopted in order to obtain an approximate idea as to the total magnitude of these two distortions:

(a) All bone fragments larger than 3-4 mm were collected from the sieves during excavation (1.5).

(b) All bone samples were weighed, mainly to the nearest gram, by means of a torsion balance (Appendix 35).

(c) A number of specific gravity determinations were made on random fossil bone samples from various levels at Border Cave (Appendix 55).

(d) A number of specific gravity determinations were made on random modern defatted bone samples housed at the B.P.I. Palaeontology (Appendix 56).

(e) A few intact adult antelope skeletons were weighed and the proportion of defatted bone mass to estimated live mass for each individual was calculated (Appendix 57). It should be noted that specimen C87 refers to Connochaetes taurinus.

Manipulation of the above-mentioned data proceeded as follows:

(a) The total bone mass for each stratum grouping was adjusted for differences in S.G. by conversion to the B.P.I.Palaeontology 'defatted bone standard' of ~ 1,21 (Appendix 56).

(b) The total bone mass for each stratum grouping was converted to total carcass mass subsequent to step (a), by applying the calculated proportion value of ~ 5% (Appendix 57).

(c) The total carcass mass for each stratum grouping, as roughly represented by the bovid size category data in Appendix 33, was determined in the way detailed in 6.2 and Table 5.

(d) The total carcass mass for each stratum grouping, as determined in (c) was reduced by an arbitrary 50%, in order to make due allowance for immature animals (Appendix 33, Table 7).

(e) The bone survival percentage was then calculated by dividing (b) by (d), i.e. the live mass equivalent of the bone actually found by that which should have been present, if no loss had been incurred by means of the distortions initially mentioned.

It should be noted that the readings obtained are actually the maximum values possible, because of two intentional biases which would have both acted in the same direction, namely:

(a) Analysis was confined to the minimum number of individuals recorded in the four bovid size categories, and survival estimates would therefore have been lower if the full range of taxa present in each stratum grouping had been included.

(b) The arbitrary correction for immature animals of 50% is patently too high in view of the dental age distributions determined by Klein, and survival estimates would therefore have been lower if a more realistic proportion had been selected (Appendix 33 Table 7).

The actual results obtained for the various stratum groupings are fully listed in Appendix 58. Comments are as follows:

(a) The amount of missing bone varies from > 71,5% in 2BS.LR.C + 2WA to > 97,5% in 3BS + 3WA.

(b) There is a marked inverse correlation between bone survival and bone fragmentation values, which suggests that loss was mainly due to extreme comminution (Appendices 34 and 58).

(c) The remarkably high losses recorded would imply that any 'schlepp effect' deductions based on body part disproportions could well be suspect at this site, a possibility hinted at by Klein (1977 : 24).

Since low bone survival readings are likely to be largely a function of high occupation densities and/or low sedimentation rates, the additional implications are:

(a) That BS strata were probably typified by very low accumulation rates, in view of the relatively few 'flakes +' values in those levels (Fig. 60).

(b) That WA strata were probably typified by very high accumulation rates, in view of the relatively high 'flakes +' values in those levels (Fig.60).

A basic problem which precludes any more specific statement is the absence of time control in the Stone Age strata at Border Cave. Far more satisfactory deductions are sometimes possible for sites at which the necessary preconditions are met and where an absolute chronology is available. An example in which it is possible to demonstrate a marked occupation density increase coinciding with the Holocene onset is provided in Figures 6 and 7 of Appendix 61. It may be mentioned that the anomalous bone values in stratums 3g and 3h coincide precisely with the upper limit of the seasonal water-table there. This additional factor subjected the macrofauna within its compass to a natural weathering process which was not operative in the overlying strata.

6.2.6 Category associations

An investigation was carried out in order to determine if and how number or mass per unit volume of deposit varied with time on a stratum basis in Exc. 3A Rear. The primary groupings in question were: 'flakes+' (2.11.2), charcoal nodules; macrofauna; microfauna; mollusc shell and ostrich eggshell. Volumes for the various sampled levels, corrected for absent data squares, derive from Appendix 5. Pertinent data are fully listed in Appendix 59. Results are given graphically in Figs. 84 and 85.

The following difficulties and deficiencies preclude undue importance from being attached to any but the coarser of the observed fluctuations:

FIG. 84 DENSITY VALUES : COMPARISONS

BORDER CAVE. EXC. 3A REAR

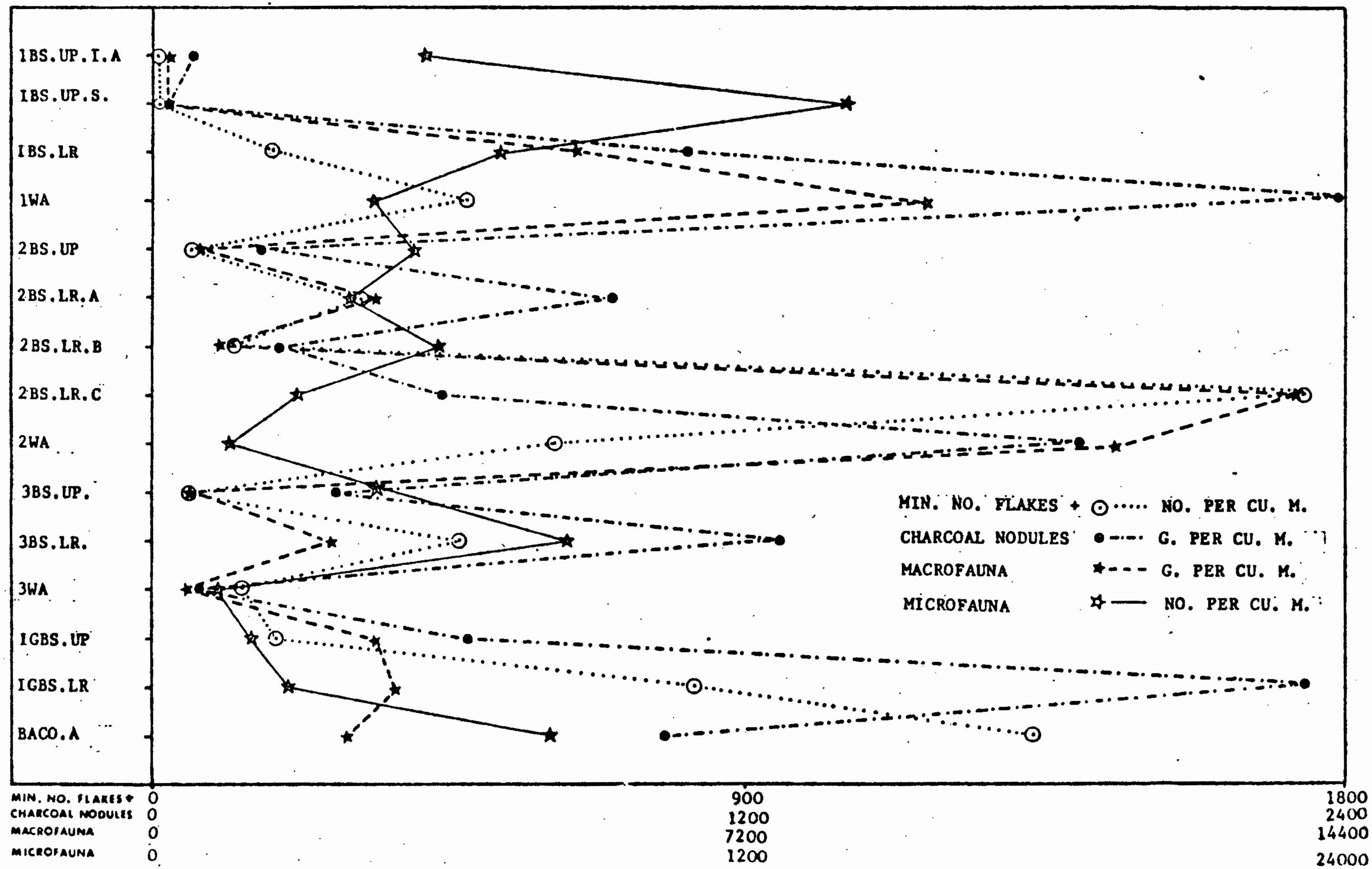
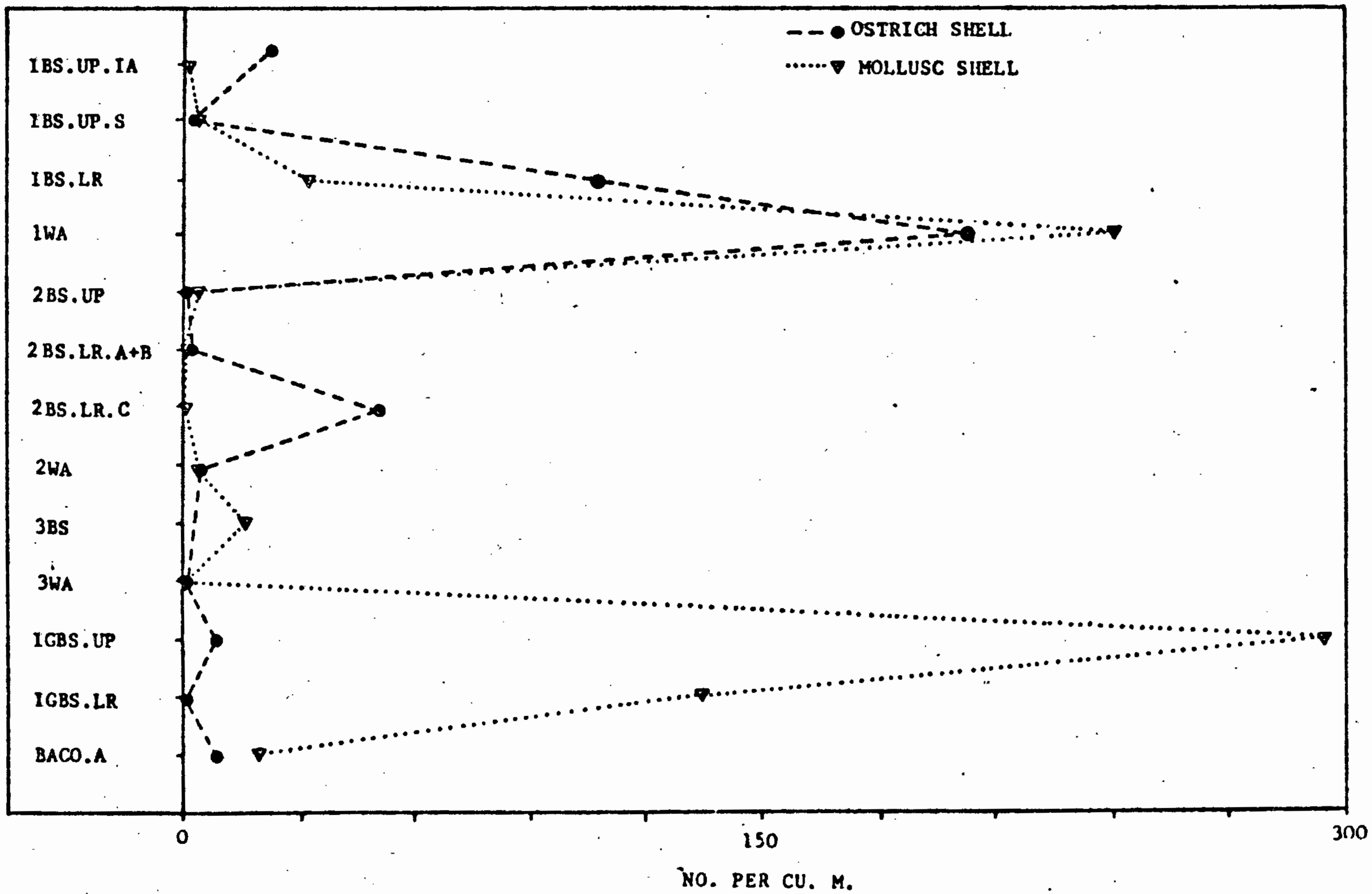


FIG.85 DENSITY VALUES : MOLLUSC + OSTRICH SHELL

BORDER CAVE. EXC. 3A REAR



(a) The present data are incomplete in that it was decided not to interpolate the 1RGBS.A+B values into the sequence of readings from Exc.3A Rear (Table 1).

(b) The 3WA values are considered to be unreliable because the sampled area was dominated by atypical orange sediments with abnormally high readings for the calcined organic fractions (3.3.2).

(c) The BACO.A values were based on debris derived from a rather limited deposit area and volume, with the result that they may not represent viable random samples (Appendix 59).

(d) The 'Early L.S.A.' and M.S.A. 'flakes+ values may not be strictly comparable because of shifts in typological emphasis as evidenced, for example, by the possibility that stone and bone points were functionally equivalent.

Deleting the problematical 3WA and the irrelevant 1BS.UP.IA, it is deduced:

(a) That all categories reveal extremely large abundance fluctuations for the sedimentological reasons previously cited.(2.11.2). The most important minimum/maximum stratum value ratios are: 'flakes' = 0,5%; charcoal nodules = 1,5%; macrofauna = 1,5% microfauna = 11,4%.

(b) That the microfaunal value shifts are inversely related to the other non-shell categories in all levels with the single exception of the 3BS.LR. This evidence clearly indicates that some agent with an aversion to man was responsible for the accumulation of the rodent remains.

(c) That owls are almost certainly implicated in view of their feathers and coprolites in the superficial strata (Fig. 71; Appendix 42). If this is so then it may be further deduced that this species was a very much more constant inhabitant of the cave than man, in view of the values cited in (a).

(d) That the data demonstrates a marked similarity in the value trends for 'flakes+', charcoal nodules and macrofauna. This finding is in good accord with the intimate and invariable association of these categories which was observed during actual excavation.

(e) That quantitative comparisons between these three categories would not be meaningful because:

   I. The charcoal nodules represent only one fraction of the fired wood vestiges.

   II. Only a low and variable proportion of the macrofauna has actually survived (6.2.5).

(f) That value extremes are consistently concordant in these three categories, with details being as follows:

I. Low values relate to: 1BS.UP.S; 2BS.UP; 2BS.LR.B and 3BS.UP.

II. High values relate to 1WA; 2BS.LR.A; 2BS.LR.C + 2WA; 3BS.LR and 1GBS.LR.

(g) That the actual amplitudes in levels having high values differ enormously, with:

I. The most marked of these being associated with 2BS.LR.C + 2WA.

II. The least marked of these being associated with 2BS.LR.A and 3BS.LR.

(h) That when microfaunal values are contrasted with the other three categories it appears that:

I. The lowest and least consistent human occupation intensity correlates with the 1BS.UP.S.

II. The highest and most consistent human occupation intensity correlates with the 2BS.LR.C + 2WA.

(i) That when comparisons are made with other data sources, it is seen that:

I. The levels with low values identified in (f) all correlate with marked typological breaks (Fig. 30).

II. The 2BS.LR.C + 2WA corresponds to a time when climate was similar to that today (Appendix 33).

(j) That very low mollusc shell and ostrich eggshell values are seen to be associated with levels previously shown to differ markedly in terms of other indices (e.g. 1BS.UP.S relative to 2WA). The implication seems to be that a low density of shell fragments may not in itself be particularly significant.

(k) That high mollusc shell values are confined to 1BS.LR + 1WA and 1GBS.UP + LR. The reason for this is not known, but it may indicate that some particular environmental parameter was similar at the times when these two stratum groupings accumulated.

(l) That high ostrich eggshall values are confined to 1BS.LR + 1WA. This correlates precisely with the advent in those levels of beads based exclusively on this material.

An investigation was carried out in order to determine if and how V values, based on spatial shifts in number or mass on a square by square basis, varied between the various categories within each stratum in Exc.3A Rear. The primary groupings in question were: stone artefacts, charcoal nodules, macrofauna and microfauna. Pertinent data are fully listed in Appendix 60. Results are given graphically in Figure 86.

It should be stressed that the values obtained for a given category reflect horizontal fluctuations in absolute abundance, and are thus dependent on both dispersion characteristics and stratum configuration. It follows that differences between levels within that category are perhaps of no significance, since these may be due to the last-mentioned variable. What is of potential importance are the consistent serial relationships when one or more categories within a single stratum are compared.

The analysis was undertaken on the basis of the following hypotheses:

(a) That the absence of any impediment to free movement over the deposit surface would tend to result in a fairly even distribution of stone artefacts, charcoal nodules and macrofauna within an undisturbed stratum.

(b) That the probability is that the number of suitable owl roosts at any one time would have been relatively limited, with a consequent tendency for owl pellets plus contained microfauna to be more localized on the cave floor, if we assume that the rodent remains were indeed introduced by means of that agency.

(c) That dispersion due to the scuffing effect of human feet would tend to have had the following effect on the magnitude of the predicted discrepancy between values for the microfaunal and the 'cultural' categories, granting the validity of (b) :

I. Low hominid occupation densities would have induced high value differences.

II. High hominid occupation densities would have induced low value differences.

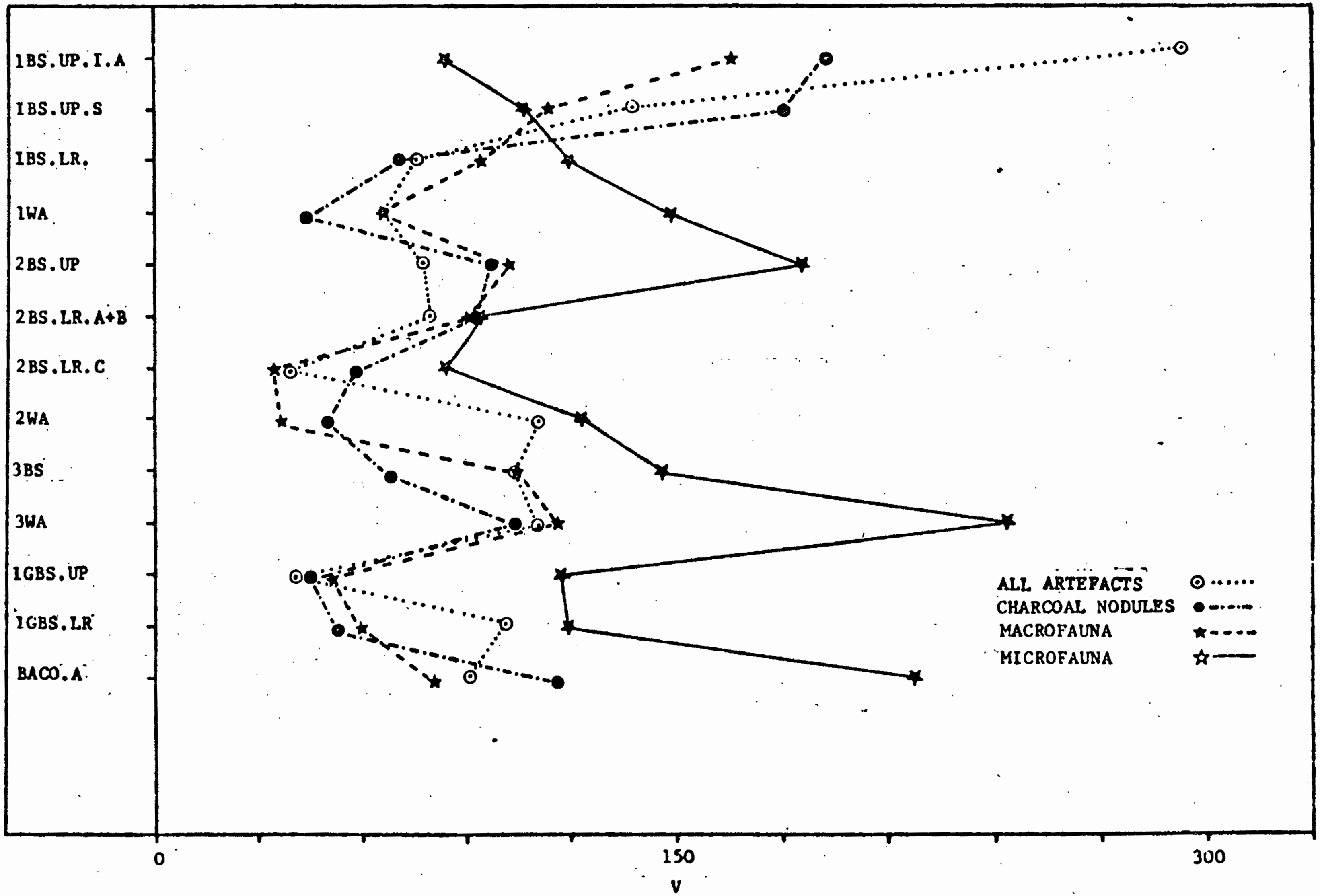
Deleting the problematical 3WA and the irrelevant 1BS.UP.IA, it is deduced:

(a) That values for the 'cultural' categories show fairly close and consistent affinities in all levels, thereby corroborating hypothesis (a).

(b) That values for the microfaunal category tend to be relatively higher than those relating to (a), thereby corroborating hypothesis (b).

(c) That localized displacements caused by the IA pits are largely responsible for the high V values for the 'cultural' categories in 1BS.UP.

FIG. 86 SPATIAL VARIABILITY: COMPARISONS
BORDER CAVE. EXC. 3A REAR



(d) That amplitude differences between the microfaunal and 'cultural' categories provide no significant support for the last hypothesis, perhaps because this effect was largely offset by more rapid sedimentation in levels with high occupation densities.

(e) That particular owl roosts on the cave roof, as represented by underlying microfaunal concentrations, can often be traced through many successive levels, thereby suggesting that some resting sites had a temporal stability to be measured in terms of millennia. An example is provided by the marked rodent bone densities which centre on about squares Q21-22 between 1BS.UP.IA and 2BS.LR.A+B (Appendix 37).

6.3 Physical and Chemical

6.3.1 A chronology

Border Cave yielded a fair amount of data relating to long-term environmental oscillations in northern KwaZulu. Direct correlation of these are best made with the global marine record, rather than by reference to incomplete continental sequences (Appendix 54). To this end an approximate temperature curve, as fully detailed below, was first constructed for the Upper Pleistocene (Beaumont et al., n.d.). Oxygen isotope zonation follows the numbering scheme formulated by Emiliani (1955). This has occasionally been supplemented by the regional terrestrial terminology of van der Hammen et al. (1967). The Stage 5 and Last Interglacial boundaries are here taken to coincide (Suggate, 1974; Butzer, 1976). Procedures were as follows:

(a) A broad outline of ice-volume shifts over the past 130 Kyrs. was first obtained by way of the $\delta^{18}O$ stratigraphy obtained by Shackleton and Opdyke (1973) on the basis of core V 28-238. This exceptional sequence is however not regarded as definitive, because of the possibility that brief excursions have been partly obliterated, as a result of limitations to resolution imposed by:

- I. Ocean mixing. Inherent to the oxygen isotope method and said to be of the order of $\sim$ 1 Kyr. (Hayes et al., 1976).
- II. Bioturbation. Potentially serious in this case because of the low deduced sedimentation rate of $\sim$ 1,7 cm/10^3 yrs. (Shackleton and Opdyke, 1973).

(b) That information was therefore supplemented by the following specific data sources:

I. For all intervals postdating $\sim$ 40 Kyrs. B.P. Recourse was to data derived from pollen sequences which have been securely and concordantly dated by the radiocarbon method.

II. For warm intervals predating $\sim$ 40 Kyrs. B.P. Recourse was to data derived from fossil strandlines which have been securely and concordantly dated by the ^{230}Th and ^{231}Pa methods.

III. For cold intervals predating $\sim$ 40 Kyrs. B.P. Recourse was to data derived from cores with sedimentation rates which were sufficiently high to partly offset distortion (b).

Salient findings to emerge from this structured literature survey were:

(a) Stage 1. Temperatures very high (maximum recorded) (Shackleton and Opdyke, 1973). The lower boundary is conventionally set at $\sim$ 10 Kyrs. B.P. (van der Hammen _et al._, 1967).

(b) Stage 2. Temperatures very low (minimum recorded) (van der Hammen _et al_ 1967). Intense cold dates to between $\sim$ 13 and $\sim$ 26 Kyrs. B.P. with a minimum at $\sim$ 20 Kyrs (van der Hammen _et al_, 1967).

(c) Denekamp. Temperatures fairly high, with two maxima, which are less marked than (e) (Bortolani _et al_, 1977). Dates to between $\sim$ 29 and $\sim$ 32 Kyrs. B.P. (van der Hammen _et al._, 1967).

(d) Cool interval. Temperatures fairly low (van der Hammen et al., 1967; Bortolani _et al._,1977). Dates to between $\sim$ 32 and $\sim$ 38 Kyrs. B.P. (van der Hammen _et al._, 1967)

(e) Hengelo. Temperatures fairly high, with two maxima, which are more marked than (c) (Bortolani _et al._, 1977). Dates to between $\sim$ 38 and $\sim$ 40 Kyrs. B.P. (van der Hammen _et al._, 1967; Bloom _et al._, 1974).

(f) Cool interval. Temperatures fairly low and perhaps similar to (d). (van der Hammen _et al._, 1967). Dates to between $\sim$ 40 and $\sim$ 60 Kyrs. B.P. (inferred from (g)).

(g) Warm interval. Temperatures fairly high and perhaps similar to (c). (Sancetta _et al._, 1973). Dates centre on $\sim$ 61 Kyrs B.P. (Konishi _et al._, 1970; James _et al._, 1971; Bloom _et al._, 1974).

(h) Stage 4. Temperatures very low and perhaps similar to (b). (Sancetta _et al_, 1973). Dates to between $\sim$ 64 and $\sim$ 75 Kyrs. B.P. with a minimum at $\sim$ 73 Kyrs. B.P. (McIntyre _et al._, 1972).

(i) Stage 5a. Temperatures high, but not as marked as (a). (Shackleton and Opdyke, 1973). Dates centre on $\sim$ 82 Kyrs. B.P. (Mesolella _et al._, 1969; Bloom _et al._, 1974).

(j) Stage 5b. Temperatures low; almost full glacial (Dansgaard et al., 1972). Appears to span ~6 Kyrs., with a minimum at ~90 Kyrs. B.P. (Duplessy et al., 1970; Kennett and Huddlestun, 1972).

(k) Stage 5c. Temperatures high and perhaps similar to (i) (Shackleton and Opdyke, 1973). Dates centre on ~105 Kyrs. B.P. (Mesolella et al., 1969; Bloom et al., 1974).

(l) Stage 5d. Temperatures fairly low; two-thirds full glacial (Sancetta et al., 1972). Dates centre on ~110 Kyrs. B.P. (Sancetta et al., 1972 and 1973; Steinen et al., 1973).

(m) Stage 5e. Temperatures very high and equivalent to (a). (Shackleton and Opdyke, 1973). Dates to between ~116 and ~127 Kyrs. B.P., with a maximum at ~125 Kyrs. B.P. (Sancetta et al., 1972; Hays et al., 1976).

The generalized temperature curve which was derived from the above data is given in Figure 87. Tentative correlations of the Border Cave sequence with this are based on the following evaluations :

(a) Certain temporal inferences can be derived from a consideration of the radiocarbon determinations for levels above the 1WA. One interpretation of these is that the 1BS.UP.S does indeed represent a viable unit (1.4.1) which formed between ~650 B.P. (LJ-2891) and ~ 28,500 B.P. (L.J.-?) (Appendix 50). This substantial period is represented by a maximum of ~25cm of deposit in the relevant square T22, thereby demonstrating that extremely low rates of sediment formation prevailed then (Appendix 4). The available readings for that stratum further suggest that accumulation was largely subsequent to ~13 Kyrs. B.P. (Pta-721), which implies that unit surface was almost static between ~13 and ~28 Kyrs. B.P. (Appendices 49 and 50). It is evident that the approximate temporal limits for this virtual nonsequence correspond closely with stage 2 (van der Hammen et al., 1967). On that basis it is deduced that stadial conditions appear to have militated against sedimentation at this site (cf. Appendix 54. Table 3). The 1BS.UP.S has previously been shown to be typified by very low values for cultural debris and very high values for microfauna introduced by owls (6.2.6). A further conclusion is thus that cold intervals seem to correlate with times of low occupation intensity by man. By analogy it is inferred that low temperatures and slow sedimentation also relate to 2BS.UP 2BS.LR.B and 3BS (6.2.6). That this is in fact so in the case of the uppermost of those levels is shown by the marked hiatus revealed by the C-14 dates for 1BS.LR relative to 2BS.UP (Appendix 49).

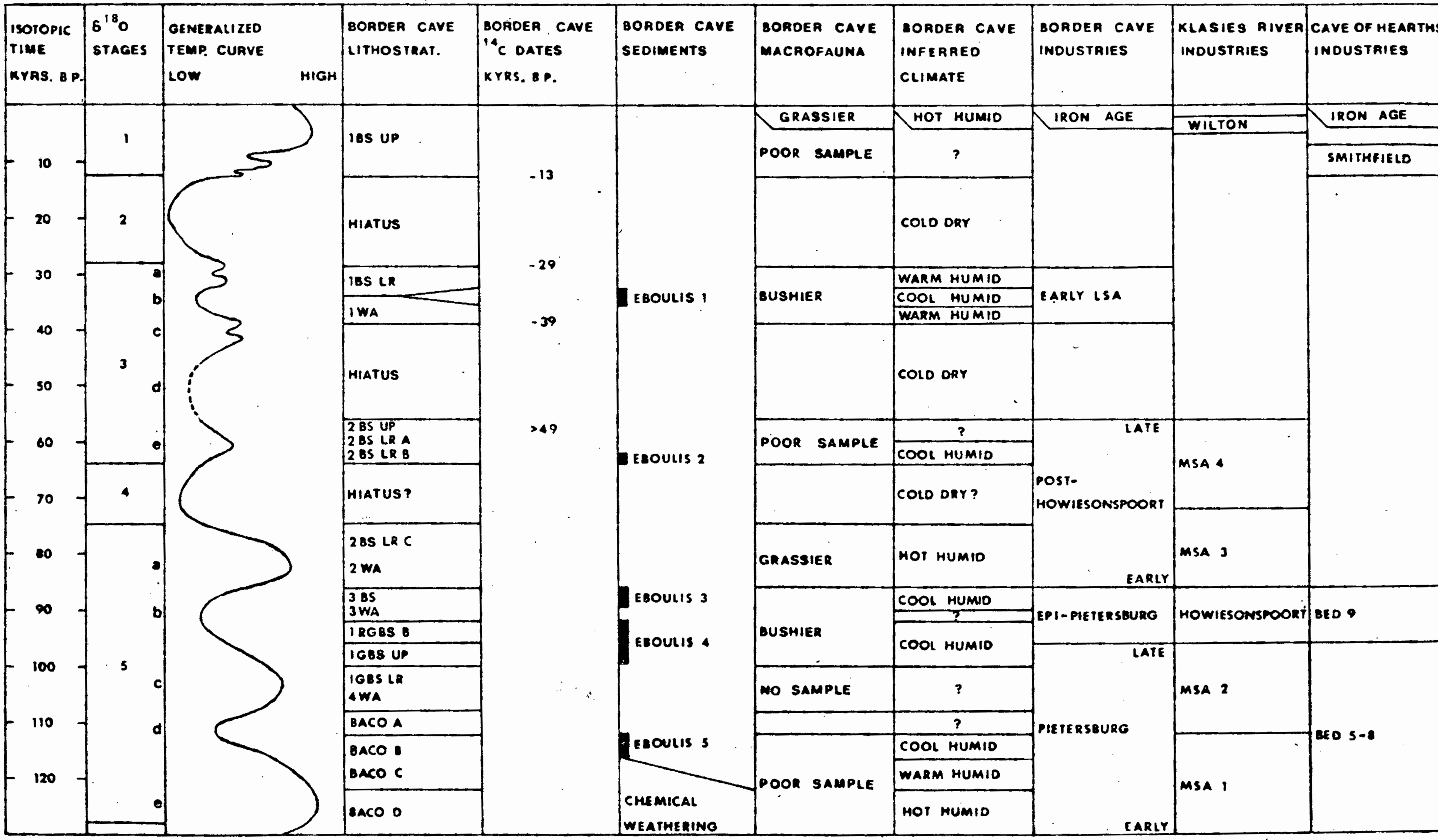


FIG. 87 TENTATIVE CLIMATIC AND CULTURAL CORRELATIONS

By reference to Fig. 87 it is considered probable that the culturally sterile upper zone of the 2BS.UP (1.4.3) probably correlates with the cooler phase which prevailed between ~40 and ~60 Kyrs. B.P. It follows from this placement that the terminal M.S.A. represented at Border Cave would predate 60 Kyrs. B.P. (Beaumont et al., n.d.). Alternatively, if the potentially infinite single reading of ~45,000 B.P. (Pta-1190) for the 1WA (Appendix 49) is viable (5.5.2), then the onset of the 'Early L.S.A.' would refer to that time-level and the terminal M.S.A. would be displaced to substage 5a and have an age of ~82 Kyrs. B.P.

(b) The inferred datings based on these two alternatives are complemented by the macrofaunal evidence presented by Klein (Appendix 33). His analysis of the ~139,000 bone fragments recovered from Exc. 3A Rear has revealed that the sampled strata are dominated by a wide variety of big game ungulates, which do not differ markedly from the historic lowveld species range, except in containing a small minority of extinct forms. This finding is taken to confirm that the cave was only occupied with any marked intensity on those occasions when climatic parameters were broadly similar to those which sustain the present savanna mosaics. However, statistically significant temporal fluctuations in the proportion of animals preferring bushier versus grassier settings further suggest that these milder intervals differed notably in amplitude. On this basis it would seem that grass cover was markedly depleted in 'Early L.S.A.' and M.S.A.2 relative to M.S.A. 3 levels, while values for the latter equate broadly with those that marked the climax fauna of this region in historic times (Appendix 33). A consideration of this evidence in terms of our temperature curve indicates that only one interstadial fits the deduced joint requirements of being both immediately older and much more marked than that spanned by the Hengelo-aged 1BS.LR. This is the final warm oscillation of the Last Interglacial which dates to ~82 Kyrs. B.P., which implies that all or part of M.S.A. 3 must correspond to substage 5a. The authors preference, based on the association of 2BS.LR.B with a cryoclastic zone (Eboulis 2) and with low values for cultural items (6.2.6.), is that aggregates from :

I. 2BS.UP and 2BS.LR.A. ie. M.S.A. 3 late, refer to the warm interlude at ~61 Kyrs. B.P.

II. 2BS.LR.C and 2WA, ie. M.S.A. 3 early, refer to the warm interlude at ~82 Kyrs. B.P.

This scheme would then be compatible with the first alternative in (a) and would imply that Pta-1190 is indeed aberrant (5.5.2.).

(c) Additional non-chronometric evidence is provided by Butzers' analysis of sediment samples obtained from the 1970-71 excavations (Appendix 54). This study has revealed that the < 63 μ fraction (Fig. 3) :

I. Averages ~ 40% for Exc. 3A Rear and ~ 30% for 1BS.UP.S.

II. Shifts systematically from ~29% in 1GBS.LR to ~75% in BACO.D.

Basal BACO values are seen to be exceptionally high and that finding is here taken to document a shift from mechanical to chemical weathering, induced by a markedly warm and humid external climate, which is tentatively correlated with substage 5e. That this inference could be correct is supported by one of the implications of (b), namely that outside conditions similar to those at present correspond with very high readings for the 'cultural' categories (6.2.6.). If Appendix 59 data is used to compare 2BS.LR.C + 2WA with BACO.C+D in terms of 'flakes +', it becomes evident that :

I. Values for the former relative to the latter average ~ 25%, assuming that no attrition of BACO C+D has taken place, which is clearly not the case insofar as the bone fraction is concerned, as has been mentioned previously (1.4.11).

II. Values for the former relative to the latter average ~ 50%, assuming that a 50% attrition of BACO C+D has taken place, which may be overly generous in view of the low bone/sediment proportion in sediments away from the drip-line.

Even if we accept alternative (II) it is patent that the readings for basal BACO reflect warmer conditions than do those relating to 2BS.LR.C + 2WA. Reference to Fig. 87 indicates that this situation could only have occurred during substage 5e at ~ 116 - ~ 127 Kyrs. B.P.

(d) Supplementary data can be deduced from the cyclic and classic éboulis zones which overlie BACO C+D (1.4). These are taken to correlate with brief cold pulses which were nevertheless sufficiently humid to be able to initiate cryoclastic action (Appendix 54). The casual observations made during excavation preclude any precision as to their relative amplitudes. In fact, even if abundance data was available, its interpretation would be problematical, in view of the probability :

I. That éboulis zones accumulated at differing rates, as deduced from the density of associated cultural debris, with the result that their limits may range between sharp and diffuse.

II. That spall frequency may depend on two unrelated variables, namely the intensity and/or duration of the cold event itself and of the roof weathering which preceded it.

Despite these limitations it was nevertheless obvious that Eboulis 3, which correlates best with the lower sublevel of the 3BS (1.4.5), was by far the most marked cryoclastic horizon in Exc. 3 (Fig 13). This horizon immediately predates substage 5a in terms of the correlations effected in (a) and (b), thereby suggesting that it relates to the dramatic temperature drop which has been dated to ~ 90 Kyrs. B.P. (eg. Dansgaard et al., 1972). Similar spall levels and rockfalls in invariable association with aggregates closely comparable to our 'M.S.A.2' have been recorded at a large number of sites in Southern Africa (Beaumont and Vogel, 1972; Wendt, 1972; Butzer, 1973). The apparent inference is that these reflect a widespread and synchronous event, which may be of particular use at sites where temporal placement is somewhat ambiguous, as may be the case at Die Kelders (Tankard and Schweitzer, 1974).

The present evidence is clearly insufficient to provide a definitive chronostratigraphy within the M.S.A., but the A2-3 grade evidence (Oakley, 1969) gleaned at Border Cave is nevertheless best construed to mean :

(a) That M.S.A. 3 dates to ~ 60-80 ± 10 Kyrs. B.P.

(b) That M.S.A.2 dates to ~ 80-100 ± 10 Kyrs. B.P.

(c) That M.S.A.1 dates to ~ 100-125 ± 10 Kyrs. B.P.

Particular importance attaches to the C-14 readings in that these clearly demonstrate the presence of a significant hiatus at the end of the known M.S.A., thereby permitting the possibility of an as yet poorly documented M.S.A-L.S.A. transition in the ~ 40-60 Kyr. B.P. range, as would seem to be demanded by the persistence of previous trends and forms into the 'Early L.S.A.', and as apparently represented by the Stratum 5 aggregate, dated to > 40,950 B.P. (Pta-354), at Rose Cottage Cave (Appendix 62).

These interpretations are complemented and corroborated by four independent lines of investigation at Klasies River Mouth, namely :

(a) All M.S.A. strata at that site contain food remnants of a varied marine fauna (Voigt, 1974; Klein, 1974), albeit perhaps less abundantly in content units postdating Wymers' M.S.A.II (Klein, 1976). Recent palaeo-sea level estimates (eg. Bloom et al., 1974), when plotted against the local offshore data (SOEKOR. Bathymetric map. Unpublished), suggest that those occupations relate largely to successive high stands (Beaumont et al., n.d.), that brought the sea to within viable exploitation range of the cave (< 6 km on basis of L.S.A. midden locations), which would imply that the M.S.A.I - M.S.A.IV sequence there dates to between ~62/82 and ~125 Kyrs. B.P.

(b) The aspartic acid racemization technique has been applied to bone from various levels at Klasies River Mouth-1. Four fragments gave the following results, with 'calibration' being by way of a C-14 dated stratum at Nelson Bay Cave (Bada and Deems, 1975) :

I. 65 Kyrs. B.P. for Level 13, associated with M.S.A.IV.

II. 89 Kyrs. B.P. for Level 16, associated with M.S.A.II.

III. 90 Kyrs. B.P. for Level 18, associated with M.S.A.I.

IV. 110 Kyrs. B.P. for Level 19, associated with M.S.A.I.

The results are seen to be in fair accord with those deduced in (a), despite the dubious procedure of calibration by means of data from another site. Presumably the rapid sedimentation rates prevalent at Klasies River Mouth, as evidenced by the relatively unfragmented nature of the macrofauna (Klein, pers. comm.), sufficed to greatly reduce the degree of temperature distortion induced by fire (5.2.2.).

(c) Shackleton has carried out some 200 oxygen isotope determinations on shells from the M.S.A.I, M.S.A.II, Howieson's Poort, and L.S.A. levels (Butzer, n.d.). Deduced correlations are as follows :

I. M.S.A.I = Substage 5e.

II. M.S.A.II = Substage 5c or 5a.

III. Howieson's Poort = Between full glacial and full interglacial.

Result (III) was interpreted as indicating stage 3 or a cooler portion of stage 5. The former alternative can be excluded in view of the >50 Kyr. age for aggregates of 'M.S.A.2'-type as revealed by the C-14 readings detailed elsewhere (Beaumont and Vogel, 1972b). This implies, in turn, that M.S.A.II belongs to substage 5c and that the Howieson's Poort relates to substage 5b, a deduction in precise accord with the inferred age for Eboulis 3 at Border Cave.

(d) Butzer (n.d. Table 1) has proposed the following correlations between the deep-sea isotope stratigraphy and the sea-level record at Klasies River Mouth :

I. Erosion of the cave by a +7m stand. Substage 5e (early).
II. KRM-1. Levels 18-20. M.S.A.I. Substage 5e (late) - 5d (early).
III. KRM-1. Levels 16-17. M.S.A.II (early). Substage 5d (late).
IV. KRM-1. Level 15. M.S.A.II (mid). Substage 5c (early).
V. KRM-1. Level 14. M.S.A. (mid). Substage 5c (mid).
VI. KRM-1A. Levels 22-23. M.S.A.II (late). Substage 5c (late).
VII. KRM-1A. Levels 10-21. Howieson's Poort. Substage 5b.
VIII. KRM-1A. Levels 1-9. M.S.A.III. Substage 5a.
IX. KRM-1. Level 13. M.S.A.IV. Stage 4. (~70 Kyrs.).

Border Cave and Klassies River Mouth have thus provided concordant datings which demonstrate :

(a) That a fairly detailed and reliable chronology is now available for that portion of the M.S.A. which postdates 100 Kyrs. B.P.

(b) That there is some factual justification for the assumption that similar aggregates were snychronous over extensive areas then (6.1.1).

Only qualitative data are currently on hand concerning the amplitude of the environmental shifts being documented in the deposits at Border Cave. Precise temperature measurements may however become available should D and ^{18}O analyses based on the preserved wood prove to be feasible (5.7.2). Evidence drawn from elsewhere does nevertheless permit of the following tentative climatic reconstructions for the Nsoko area :

(a) Major warm events. Apparently represented by 2BS.LR.C, 2WA and BACO B-D (2.11.2 and 6.2.6). Mean temperature of ~21°C and annual range of ~9°C (1.2). Rainfall ~700 mm with ~75% received in summer (1.2). Frost sporadic as indicated by an average annual low of ~2.5°C (1.2). Grasses almost exclusively represented by drought-resistant C_4 types (Vogel, 1976). Hypsithermal conditions (s.s) may well have induced a thick forest mantle on the Lebombo slopes and dispersed game by providing more watering points (Street and Grove, 1976). Despite this cave occupation intensity appears to have climaxed then (Fig. 60), perhaps because of a regional increase at that time in total ungulate biomass (Appendix 33), with a consequent reduction in band dependence on the seasonal hunting of buffalo (Table 5).

(b) Major cold events. Apparently represented by 1BS.UP.S, 2BS.UP (top), 2BS.LR.B and 3BS.UP (2.11.2 and 6.2.6). Subcontinental mean temperature reductions by ~8,0-9,5°C at such times have been deduced on isotopic grounds by Talma et al. (1974:140). Even lower local values may have resulted from the concurrent weakening of the Agulhas Current, caused by a 10° latitudinal displacement of the Subtropical Convergence to a position off or north of Durban (Bé and Duplessy, 1976:421). The likelihood is thus that average annual temperature was ~11-12°C, with a seasonal range of > 9°C, due to increased continentality (Butzer, 1976). Total yearly rainfall would probably have been lower than present receipts (van Zinderen Bakker, Sr, 1976), largely as a result of a marked reduction in summer thunderstorms (Street and Grove, 1976), which was only partly offset by an increase in cyclonic weather patterns in winter (van Zinderen Bakker, Sr, 1976). Under such conditions it is not improbable that the extant floral regime was largely replaced by macchia (van Zinderen Bakker Sr, 1976), with a resultant reduction in species diversity and herbivore biomass (eg. Klein, 1974:271). Such distributional changes in the biota may well have rendered the area marginal to man, as is indeed indicated by the minimal cultural content of the listed levels. The closest modern analogue to such a climatic regime may perhaps be the Patagonian xerophytic scrub desert which occupies areas inland of Bahia Blanca.

(c) Minor cold events. Apparently represented by 1BS.LR, 1WA, 2BS.UP (base), 2BS.LR.A, 3BS.LR, 1GBS.UP, 1GBS.LR? and BACO.A? (2.11.2 and 6.2.6). Climatic parameters are presumed to be transitional between the previous two extreme states. The occurrence of _Acacia_ cf. _karroo_ thorns, _Encephalartos_ cf. _lebomboensis_ seeds, fine fibre, and 'tobacco-like' vegetation in the 1BS.LR.1WA, 2BS.UP (base) and 2BS.LR.A suggests some degree of floral continuity with state (a) (Table 4). These affinities are further confirmed by the similar diversity of large mammal species in both groupings as is evident in Table 1 of Appendix 33. That states (a) and (c) did differ is shown by the decrease in grass/increase in bush cover revealed by the significantly higher browser/grazer proportions in the 'Early L.S.A.' and M.S.A.2 levels (Klein, 1977). These floral changes resulted presumably from the mid-winter temperature depression of

$>8^{o}C$ below present values inferred by Butzer on the basis of the associated cryoclastic zones (Appendix 54).

It will, in conclusion, be seen that there are certain differences in the environmental and temporal frameworks deduced by the author in 6.3. and by Butzer in Appendix 54. It should be stressed that the available evidence does not preclude either of those two alternatives, which owe their origin to varying emphases and data sets. Only further facts will resolve these present discrepancies, of which the most serious relate to those levels underlying 1GBS.LR. These are variously interpreted as representing :

(a) High occupation density and rapid accumulation spanning only substage 5e ie. ~127-116 Kyrs. B.P.

(b) Cave habitation ranging between the onset of stage 6 and early substage 5d ie. ~195-110 Kyrs. B.P.

A choice between these two scenarios will only be possible subsequent to:

(a) The determination of browzer/grazer proportions for viable faunal samples from BACO.A-D. This could quite easily be done by lowering an area of Horton's Pit down to bedrock (Fig. 3).

(b) The detailed typological and morphometric comparison of aggregates from BACO C+D at Border Cave and Levels 18-20 at Klasies River Mouth-1. A casual inspection of the latter material at the S. Afr. Mus. did however suggest that M.S.A.I had at least some of the features predicted (6.1.2) for assemblages older than basal BACO.

7. A PERSPECTIVE

It should be stressed at the onset that no attempt is made in this chapter to explore to their ultimate limits every ramification of the evidence amassed in the present investigation. Our intention is rather to deal succinctly with the more obvious deductions which can be drawn when the current data is viewed in terms of a wider temporal and spatial perspective.

7.1 Iron Age

Of note is the dearth of Early I.A. aggregates in the 1BS.UP despite their established presence ~75 km to the east at Ndumu and ~120 km to the north-west at Lion Cavern (Dart and Beaumont, 1969; Vogel and Marais, 1971). A number of entirely empty pits which were presumably constructed for storage purposes contrast with ceramic evidence for a sparse and sporadic occupation. This discrepancy is perhaps best explained by positing the terminal use of the cave as a temporary refuge and/or food cache locality at times of unrest. The small sample of sherds (2.5) do not differ perceptibly from modern Swazi wares and appear to range back to ~A.D.1360 (LJ-2890). This finding is in good accord with tribal traditions which trace the birth of the Swazi nation to a time when Dlamini 1 settled below the Lebombos' in ~A.D. 1500 (Reilly, 1976).

Economic activities indulged in by these peoples at uncertain times between then and the present include :

(a) Apparently minor herding as indicated by vestiges of a single sheep or goat, but probably the latter in view of the present distributions of these two species. The 'cattle' droppings remain enigmatic and require further analysis, but the presence of coeval oxen in the nearby highveld is semmingly confirmed by a single molar dated to A.D. 1210 (Y.1828) from Stratum 2 at the Welgelegen Shelter (Schoonraad and Beaumont, 1971).

(b) Possible hoe cultivation of millet and/or sorghum as suggested by the ^{13}C values shown by B.C.4 and certainly established further south by dated specimens at Shongweni (Davies, 1975). Actual seeds reveal that two species of pumpkin were also grown (Appendix 44), a finding in good accord with a report by survivors of the ship Stavenisse, that the indigenes in Natal were growing that cultigen by A.D. 1686 (Davies, 1975 : 651).

(c) A heavy iron bracelet on the right forearm of BC4 probably documents local smelting of that metal five centuries ago (Appendix 49), as may have been anticipated in view of the date of A.D. 630 (Pta-002)for an actual furnace at Ndumu (Vogel and Marais,1971). The glass beads are best construed as evidence for trade, emanating ultimately from the known entrepôts on the Mocambique coast, which are known to have been established by at least the 10th century A.D. (Beaumont and Vogel, 1972 : 72). Two large brass beads, on the other hand, may constitute additional evidence that contact with the metal mining areas of the Transvaal was already established by ~A.D. 1200, as was previously suggested on the tenuous basis of a single copper hair-pin at Welgelegen Shelter (Schoonraad and Beaumont, 1971 : 68).

7.2 Later Stone Age

A number of new 'Early L.S.A.' occurrences predating ~12 Kyrs. B.P. have been reported from Southern Africa during the past few years (Klein, 1972 and 1974; Wendt, 1972 and 1976; Carter and Vogel, 1974; Davies, 1975; Deacon, n.d.). The preliminary accounts of the aggregates suggest an essential typological similarity to the exceptional sequence at Heuningsneskrans Shelter (Appendix 61). Some of the more typical and/or interesting artefact classes are :

(a) Ostrich eggshell beads. These are not common and may at times be absent, possibly because of environmental factors (Appendix 61). Specimens from the 1BS.LR and 1WA at Border Cave and in some of the sublevels at Heuningsneskrans Shelter demonstrate that this form has been manufactured in much the same way for the past ~37/45 Kyrs. B.P. (Appendices 49 and 61). They have been recorded from even earlier contexts at Bushman Rock Shelter (Louw et al.,1969: 43), the Cave of Hearths (Louw et al., 1969: 43), and Pomongwe Cave (Cooke, 1963: 135). However, the possibility cannot be excluded that the beads at those sites are intrusive from immediately overlying L.S.A. strata. Perforation preceded peripheral shaping in all of the items from Border Cave (2.5), while the alternative method of first producing a trimmed disc (Wendt, 1972: 33) only makes its appearance subsequent to ~12 Kyrs B.P. at Heuningsneskrans Shelter (Beaumont, unpublished). In 1BS.LR and 1WA specimens the perimeters appear to have been individually smoothed, but the implication of this evidence is ambiguous (2.5). It may reflect either a genuine lack of technical sophistication or a local scarcity of the abrasive rock-types which are most suited for making grooved stones. The earliest known occurrence of this tool-type is near the base of Layer D, dated to ~20 Kyrs B.P., at Apollo 11 Cave (Wendt, 1976: 6).

(b) Ground bone points. Invariably rare, but undoubted examples from the 1BS.LR and 1WA at Border Cave (Appendix 6) demonstrate their development by ~37/45 Kyrs. B.P. in northern KwaZulu (Appendix 49).

(c) Notched items. A total of five specimens were recovered from the 1BS.LR at Border Cave (Appendix 6). The wooden items all came from the same spit and square, which suggests that they all belonged to a single individual (Appendix 8). Engravings on them fall into the 'sign' category of Hahn (1971 : 255) and are interpreted as 'ritual makings' by Marshack (Appendix 8).

(d) Bored stones. Both the 1BS.LR and the 1WA at Border Cave yielded fragments (Appendix 6). One of them had presumably decorative incised lines radiating from the outer edge of the orifice on one side (Fig. 23).

(e) Backed pieces. Extremely sparse or entirely absent on the basis of the evidence at Border Cave (Appendix 7), Shongweni Cave (Davies, 1975), Heuningsneskrans Shelter (Appendix 61), Nelson Bay Cave (Deacon, n.d.), and Apollo 11 Cave (Wendt, 1976). Retouch is apparently largely confined to the micro-bladelets (Deacon, n.d.) and may thus have an incidence dependent on the availability of suitable raw materials (Beaumont and Vogel, 1972).

(f) Scrapers. This class is uncommon and sometimes absent from pertinent assemblages at Border Cave (Appendix 7), Shongweni Cave (Davies, 1975), and Heuningsneskrans Shelter (Appendix 61). At the last-mentioned site they constitute the only formal tool category and show a similar incidence of the straight-edged and convex-edged subclasses (Appendix 61).

(g) Scaled pieces. A major category at Border Cave (Appendix 7) and Heuningsneskrans Shelter (Appendix 61). Also recorded as being obtrusive at Shongweni Cave (Davies, 1975) and Apollo 11 Cave (Wendt, 1976).

(h) Microbladelets. Here taken to refer to often slender blades (5.5) with a length of < 25mm (Hassan, 1972:55). Apparently largely struck from small and refined plain platform cores of conical shape. Very characteristic of all relevant aggregates, but by no means common at some localities (eg. Heuningsneskrans Shelter). Specimens there were exclusively based on locally rare chalcedony, which suggests that cryptocrystalline and comparable raw materials may have been necessary for their successful production.

The following dates indicate the antiquity of the rather amorphous aggregates which are characterised by some combination of these various artefact classes :

(a) Border Cave. 1BS.LR and 1WA (Appendices 49 and 50). ~33,000 ± 2000 B.P. (LJ-2892) - 38,600 ± 1,500 B.P. (Pta-704)/

$45{,}000\ ^{+2{,}750}_{-2{,}200}$ B.P. (Pta-1190).

(b) Shongweni Cave. Lower Occupation (Davies, 1975). 11,870 ± 130 B.P. (Pta-682) - 22,990 ± 310 B.P. (Pta-966).

(c) Heuningsneskrans Shelter. Strata 3b-3h (Appendix 61). ~11,500 ± 500 B.P. / < 12,590 ± 130 B.P. (LJ-3150) - ~32,500 B.P.

(d) Rose Cottage Cave. Stratum 4 (Appendix 62). > 6,850 ± 45 B.P. (GrN-5299) - 29,430 ± 520 B.P. (Pta-211).

(e) Nelson Bay Cave. Units 14-16 and 18 (Klein, 1974; Deacon, n.d.). > 11,950 ± 150 B.P. (UW-177) - 18,660 ± 110 B.P. (GrN-5889).

(f) Apollo 11 Cave. Layers D and E? (Wendt, 1972 and 1976). 12,510 ± 120 B.P. (Pta-1021) - 39,800 ± 1700 B.P. (Pta-1041) /

$46{,}400\ ^{+3{,}500}_{-2{,}500}$ B.P. (KN-1. 847).

(g) Sehonghong Shelter. Layer 9 (Carter and Vogel, 1974). 13,000 ± 140 B.P. (Pta-884) - 20,240 ± 230 B.P. (Pta-919).

Present evidence provides no reliable basis for a temporal or spatial subdivision of these assemblages, given the variability induced by environmental factors (particularly raw material). The author is therefore of the opinion that such occurrences should all be provisionally referred to the Robberg Industry (Klein, 1974), with a suitable paratype locality being Heuningsneskrans Shelter (Appendix 61). An indication as to the geographical extent of this complex is provided by the closely comparable aggregates (with basal dates only) from :

(a) Matupi Cave, Zaïre (van Noten, 1977). >40,700 B.P. (GrN-7246).

(b) Kisese II Shelter, Tanzania (Inskeep, 1962; Beaumont, n.d.) $> 31{,}480 {}^{+1{,}640}_{-1{,}350}$ B.P. (NPL-38) / ~45,000 B.P.

An interesting problem which arises is the nature of the relationship between the Robberg and the Albany/'Early Smithfield'. Fig. 2-5 of Appendix 61 detail the shifts in various morphometric parameters within the I2 subclass at Heuningsneskrans Shelter. Groupings necessitated by small samples have unfortunately led to a loss of resolution in some key levels (eg. 2b and 3a). However, it is evident that the indices as a whole do not show marked or consistent breaks coinciding with the approximate typology boundary between these two industries at the stratum 3a/3b interface. The unbroken flake evidence would rather seem to indicate the possibility of a dimensional and ratio continuum which underwent more rapid change in some respects at a time roughly concordant with a shift in scraper frequency and variety. This would, in turn, seem to correspond with the advent of the temperature amelioration marking the end of the Upper Pleniglacial s.s. at ~12,4 Kyrs. B.P. (van der Hammen et al., 1967:88). It was on the basis of this metrical evidence that the author included both the Robberg and the Albany into a single 'Early L.S.A.' technocomplex (Beaumont and Vogel, 1972).

The following conclusions arise when comparisons are made between the Upper Palaeolithic of Eurasia and the 'Early L.S.A.' of sub-Saharan Africa:

(a) An essential similarity is overlain by the following differences:

I. Industries in the former region show a wider range of stone tool-types, resulting from a greater emphasis on secondary retouch, as is evidenced, for example, by contrasting the Robberg and Dabba (McBurney, 1960 and 1967).

II. Industries in the latter region show precocious advances in certain alternative technologies, particularly the modification of stone by grinding (Beaumont and Vogel, 1972:155). The microbladelets are remarkably refined and diminutive, with a mean length of ~15 mm, which raises the possibility that they could have been knife composites (Clark, 1970:155), perhaps developed in order to compensate for the local paucity of unflawed cryptocrystalline materials like flint (Dart and Beaumont, 1971).

(b) Onset dates are similar, with key readings being :

I. South Africa. Robberg present by ~38/45? Kyrs. B.P. at Border Cave (Appendices 49 and 50).

II. East Africa. 'Early L.S.A.' present by >31/ca.45 Kyrs. B.P. at Kisese II (Inskeep, 1962; Beaumont, n.d.).

III. North Africa. Dabba present by ~41 Kyrs. B.P. at Ed Dabba (Beaumont and Vogel, 1972: 156).

IV. Near East. Upper Palaeolithic present by ~39 Kyrs. B.P. at Mugharet et-Tabūn (Bien and Pandolfi, 1972).

V. Eastern Europe. Aurignacian present by >40/~44? Kyrs. B.P. at Istállóskő Cave (Vogel, 1971; Switsur and West, 1973).

VI. Western Europe. Upper Palaeolithic present by ~34 Kyrs. B.P. at sites in France (Vogel, 1971 and n.d.).

VII. Australia. Non-Levallois present by ~33 Kyrs. B.P. at Lake Mungo (Bowler et al., 1970 and 1972).

It is deduced from the temporal evidence at these various sites :

(a) That there is insufficient time in areas north of the Sahara for a development of the Upper Palaeolithic from the immediately preceding Mousterian/Levalloiso - Mousterian as indicated by dates for the latter complex of ~43 Kyrs. B.P. at Haua Fteah and of ~41 Kyrs. B.P. at Mugharet et-Tabūn (Vogel and Waterbolk, 1963 and 1967).

(b) That the readings of >49/ca 61 Kyrs. B.P. for the terminal M.S.A. in the 2BS.UP (base) at Border Cave provides enough time in the correct age range for the M.S.A.-L.S.A. transition implied by the typological and metrical evidence (6.1.2.).

Our present conclusion is therefore that Mode 4 techniques originated in some as yet unknown portion of sub-Saharan Africa. Diffusion from that single centre appears to have taken place fairly rapidly over vast areas of the Old World subsequent to ~43 Kyrs. B.P. That tentative date coincides approximately with the onset of the Hengelo amelioration, which presumably facilitated a breaching of the Sahara (Fig. 98). In terms of this postulate it is to tropical Africa that we must look for the source of those innovations typical of the Upper Palaeolithic. The finding of 'art mobilier' at Apollo 11 Cave in a context dated to >20 Kyrs./ca 27 + 1 B.P. is, according to this scenario, essential rather than unexpected (Wendt, 1976). No hominids have as yet been found in certain association with the Robberg, but it seems likely that these will prove to be similar to and perhaps extreme versions of the 'large Bushman/'Bush-Boskop' peoples which are apparently linked to the Albany on the basis of finds at the Matjes River and Oakhurst shelters (Beaumont and Vogel, 1972:157).

7.3 Middle Stone Age

The Chapter 6 chronology for the M.S.A. has the following implications with regard to the advent of the typological classes mentioned below:

(a) Ground stone. Such objects in pertinent contexts include :

I. One fragment with facets in association with the 'Post-Howieson's Poort' at Montagu Cave (Keller, 1973).

II. Seven items of varied shape in association with the Tshangula at Pomongwe Cave (Cooke, 1963).

III. One small bored stone in association with the Tshangula at Khami Waterworks (Cooke, 1955).

IV. Three small bored stones in association with the late Bambata at Zombepata Cave (Cooke, 1971).

These data reveal that methods of modifying stone by means other than flaking were already being developed at or before 100 Kyrs. B.P. in Southern Africa. Of particular note is the finding that bored stones range back by way of the 1BS.LR and 1WA specimens to well within the Last Interglacial.

(b) Ground bone. 'Daggers' based on warthog tusk were recovered from within and between the 1BS.LR and 1RGBS.A at Border Cave (Appendix 6). The implication is that these artefacts were being produced between ~37 and ~90 Kyrs. B.P. in northern KwaZulu. It is of note that those dates largely coincide with a degeneration in flaking skill as reflected by a reversion of I2 subclass Rel. T values subsequent to the 3BS+3WA (Fig. 91).

(c) Trimmed points 2 (large). Our unifacial and bifacial point category appears to span much of the M.S.A., but is largely confined to 'M.S.A.1.' aggregates (Fig. 30). Specimens are sometimes extremely refined and include rare double-pointed and shanked forms (Cooke, 1955:154; Clark, 1959:174-175). None were noted to occur in the Cave of Hearths Bed 4 aggregate and on that basis the lower dating limit of this class is set a ~130 Kyrs. B.P. (Sampson, 1972:84).

(d) Trimmed points 2 (small). Diminutive (L=<30mm) and rare 'pressure-flaked' points have been found associated with Late

'M.S.A.1" and 'M.S.A.2' at Border Cave (Fig. 88). Those recovered from the latter context in 1941-2 include hollow-based and tanged types (Beaumont, unpublished). Samples are too small for any objective test but the writer's impression is that the specimens have a size distribution differing from 'large' Trimmed points 2. Confirmation of this would support the view that these artefacts are probably arrowheads, despite an estimated age of ~80 - ~100 Kyrs. B.P. (Cooke et al., 1945 : 12 and 18; Beaumont and Vogel, 1972:160).

(e) Backed pieces 2. Retouch on most segments is centred on the arc ends, but some show bulb vestiges which make them directly comparable to Abri Audi and Châtelperron types (Cooke et al., 1945:12). Production heyday was between ~80 and ~100 Kyrs. B.P., but occasional and degenerate specimens persist to ~60 Kyrs. B.P. at Border Cave (Appendix 7). Possibly relevant is the fact that maximum relative abundance and variety coincide with levels having I2 subclass Rel. T values of <21% (Appendix 22).

(f) Modified butts (Points). At Border Cave one item came from the 3BS but the rest are confined to the 2BS.LR.C and 2WA (Appendix 7). A single specimen was also recovered from a remarkably rich late 'M.S.A.1' locality in the Komati Valley of north-west Swaziland (Beaumont, unpublished). This data suggests that the class has a temporal span of ~80- ~110 Kyrs. B.P. (Beaumont et al., n.d.). The implement at the latter site equates with true 'Emireh' points, but those at Border Cave correspond more closely to the 'Emireh-type' category of Garrod (1955).

(g) Simple burins. This class is usually rather uncommon and unsophisticated in the M.S.A. (Fig. 88). They appear to occur most abundantly in assemblages dating to between ~80 and ~100 Kyrs. B.P. (e.g. Stapleton and Hewitt, 1927 and 1928).

(h) Punched blades. Undoubted specimens are also fairly typical of 'Second Intermediate' aggregates in Southern Africa (Clark, 1970: 124). Metrical data cited in this dissertation suggests that these are indigenous rather than of extraneous origin (2.9.14). Some specimens are incredibly delicate in view of an antiquity which ranges between ~80 and ~100 Kyrs. B.P. (Fig. 88).

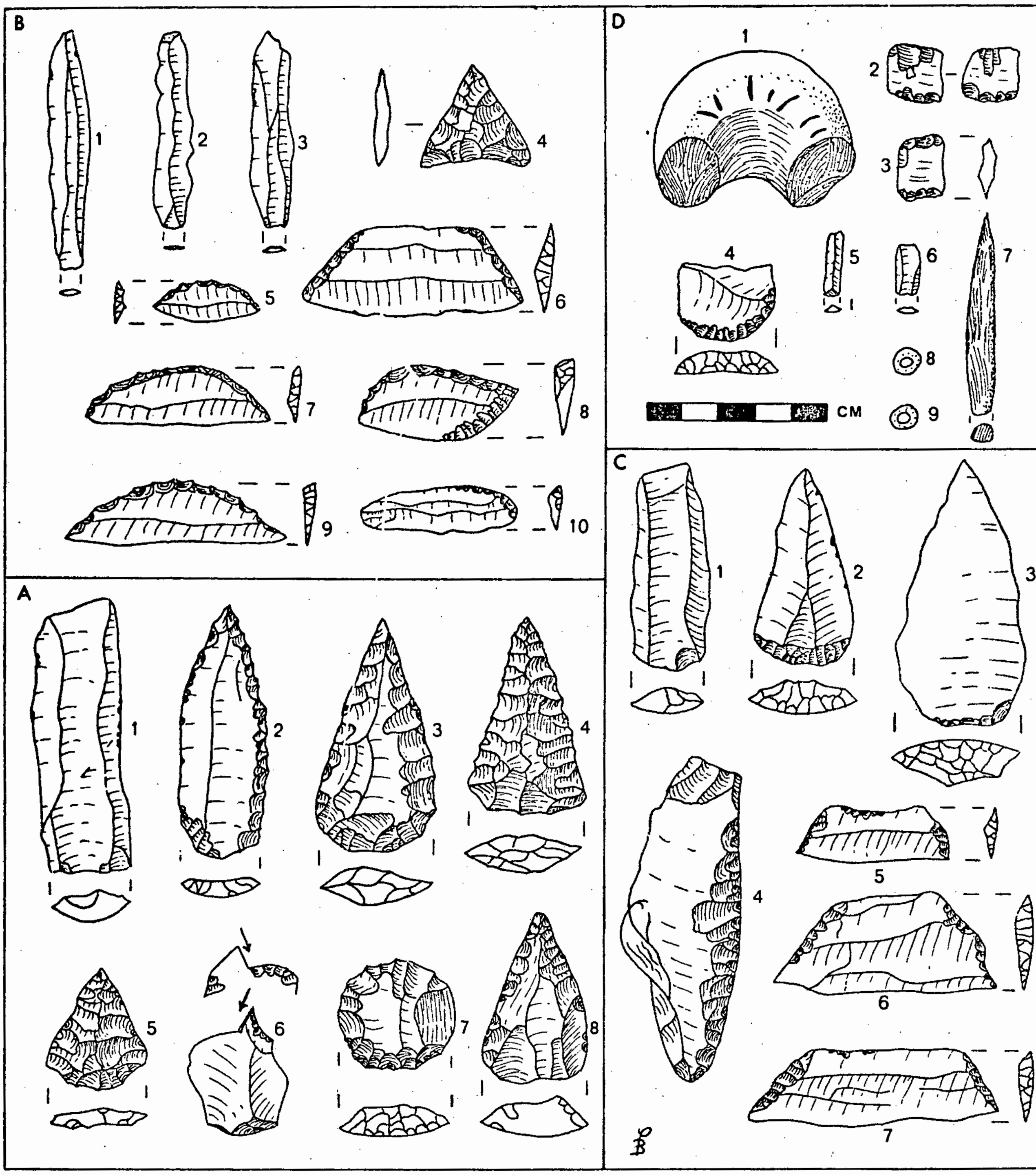
FIG. 88 A SELECTION OF ARTEFACTS FROM THE FOUR PROVISIONAL STONE AGE INDUSTRIES AT BORDER CAVE.

A. M.S.A.1. ~100-~125 Kyrs. B.P. 1: Blade. 2: Trimmed point 1. Convergent. 3 and 4: Bifacial points. 5: Bifacial arrowhead? 6: Burin (beaked). 7: Convex-edged scraper. 8: Unifacial point.

B. M.S.A.2. ~80-~100 Kyrs. B.P. 1-3: Punched blades. 4: Hollow-based arrowhead? 5-10: Backed pieces, one with invasive retouch along the 'cutting edge'.

C. M.S.A.3.~60 (>49) -~80 Kyrs. B.P. 1: Blade. 2 and 3: Modified butt points; dorsal and ventral views. 4: Straight-edged scraper. 5-7: Backed piece 2. Trapeze.

D. 'Early L.S.A.' >28 - <39? Kyrs. B.P. 1: Broken bored stone with incised notches bordering orifice. 2 and 3: Scaled pieces. 4: Convex-edged scraper. 5 and 6: Microbladelets. 7: Ground bone point. 8 and 9: Ostrich eggshell beads.


B
D
CM
C
A

The following conclusions arise when comparisons are made between the Middle Palaeolithic of Eurasia and the M.S.A. of sub-Saharan Africa :

(a) An identical prepared core base is overlain by very marked differences which may be summarized as follows :

I. Industries in the latter region show the local development of a variety of tool-types which are generally regarded as characteristic of Mode 4 occurrences in Eurasia (Clark, 1971; Beaumont and Vogel, 1972). This is by no means a new or novel comment as anyone familiar with the local literature will know. Malan (1957:224) emphasized that to equate the M.S.A. fully with the Middle Palaeolithic would be to ignore the many Upper Palaeolithic elements in the M.S.A. And of course 'second Intermediate' industries have for half a century been regarded as showing 'neoanthropic' affinities, variously interpreted as indicating either a fusion or a transition between the M.S.A. and the supposedly succeeding 'Late L.S.A.' (Goodwin, 1928:417-418; Burkitt 1928:81-88; Malan, 1952:194; Mason, 1962:289).

II. Industries in the latter region show markedly sequential changes in technology and typology (Figs. 30-48). Mousterian aggregates, by contrast, appear to be relatively static, with only local variations in proportional modes, within the same basic range of tool-types (e.g. Mellars, 1973: 257 - 258). Shifts in Southern Africa are seemingly so consistent that they can occasionally be of aid in the temporal placement of assemblages which are of uncertain affinity. The Orangian, for example, is recorded as being typified by a variety of traits, including trimmed points with rounded and thinned butts, which would suggest an ascription to early 'M.S.A.3' rather than to the older 'Pietersburg Complex' (Sampson, 1974:169).

III. Industries in the latter region are bereft of handaxes, which are in fact already marginal in terminal E.S.A. industries of late Middle Pleistocene age, as represented by the Charaman of Rhodesia (Cooke, 1966).

IV. Industries in the latter region show a larger degree of unidirectional preparatory flaking emanating from the butt, in contrast to the centripedal detachments supposedly typical of the classic Levallois (Crewe, 1972).

V. Industries in the latter region show, probably in consequence of (IV), a tendency to have a higher proportion of 'endstruck' flakes (Isaac and Keller, 1967:17-18).

(b) Temporal spans differ somewhat, with key readings being :

I. Southern Africa. M.S.A. (as defined here) ranges between ~60 and >125 Kyrs. B.P. on the basis of data from Border Cave and Klasies River Mouth (Beaumont et al, n.d.; Butzer, n.d.).

II. Near East. Levalloiso-Mousterian ranges between ~40 and <125 Kyrs. B.P. on the basis of data from Mugharet et-Tabūn and Abri Zumoffen (Garrod and Kirkbride,1961; Vogel and Waterbolk,1963).

III. Western Europe. Mousterian (s.s.) ranges between ~34 and <125 Kyrs. B.P. on the basis of data from La Quina and Weimar-Ehringsdorf (Oakley, 1969: 306-310; Vogel, 1971).

It is deduced from the temporal data at these various sites :

(a) That readings for the onset and end of the M.S.A. would seem to predate those relating to the Middle Palaeolithic.

(b) That the technological metamorphosis which the M.S.A. underwent between ~60 and >125 Kyrs. B.P. provides the link between the discrete Middle and Upper Palaeolithic traditions which occur in other regions of the Old World.

Two interesting problems deserve consideration at this point, namely :

(a) Groningen readings have revealed a >6/ca. 10 Kyr. difference in the terminal dates for the Mousterian s.s. in Eastern and Western Europe (Vogel, 1971). Acceptance of this evidence implies that Upper Palaeolithic elements in the final Mousterian at some sites in Western Europe could well be due to acculturation (Beaumont and Vogel, 1972:162; Evin et al., 1973:521; Vogel, n.d.).

(b) An important M.S.A. sequence in the Gademotta Formation of central Ethiopia has been described by Wendorf et al. (1975). Ash levels overlying two occupation floors have produced stratigraphically consistent K/Ar readings based on sanidine of 149 ± 13 Kyrs. B.P. (UAKA 73-132) and 181 ± 6 Kyrs. B.P. (UAKA 73-131). These determinations have been widely cited as viable evidence that the M.S.A. ranges back in East Africa to at least 180 Kyrs. B.P. However, the typological changes described at that site are precisely those which are known to have taken place between 'M.S.A.1' and M.S.A.2' in South Africa (2.6). The authors, quite correctly in this writers opinion, consider it improbable that these concordant shifts could have been significantly out of phase in those two regions. They therefore resort to the view that the age discrepancy results from the use of chronologies founded on inherently false ^{230}Th and ^{231}Pa readings. But these are known to be in excellent accord with radiocarbon measurements in the 30-40 Kyr. B.P. range (e.g. Bloom et. al., 1974) and extrapolations from palaeomagnetic interfaces in cores with good evidence for constant sedimentation (e.g. Shackleton and Opdyke, 1973). Our deduction is that it is more likely that the K/Ar results are in fact both ~40% too old, which is not improbable in view of the 1330 Myr. half-life value of the isotope ^{40}K. The implication of this alternative is that no unequivocal isochronic evidence exists as yet relative to the lower dating limit of the M.S.A. Nevertheless, what the evidence does demonstrate is that precisely the same artefactual trends apparently took place in that technocomplex in areas as far apart as the Cape and Ethiopia.

The remarkable developments in tool-making detailed previously were accompanied by the advent of equally advanced economic, ethical and aesthetic systems, as revealed by :

(a) Pigment. Extraneous colouring matter is such a regular component of the entire M.S.A. that there can be no doubt that it was systematically collected, as opposed to the sporadic finds in earlier contexts, which could reflect fortuitous association or casual interest (Beaumont and Vogel, 1972). Fragments appear to occur in two distinct states, namely :

I. As ground pencils, often with multiple facets, that are clearly the result of rubbing on some abrasive surface.

II. As plain items, usually with hackly fractures, representing damage inflicted during extraction and/or pounding to powder form.

These contrasting forms may imply differing applications, which would almost certainly include body decoration, either for casual everyday use or perhaps exclusively for ritual occasions, as is suggested by the frequent association of ochre with burials, including the infant interment at Border Cave (Dart, 1968; Boshier and Beaumont, 1972).

(b) Mining. The resultant demand for particularly desirable varieties of haematite was apparently sufficiently intense to have generated the very early onset of actual mining, as evidenced by the Lion Cavern locality at Ngwenya in western Swaziland (Dart and Beaumont, 1971). At that ancient specularite working the artificial bedrock was directly overlain by a rich 'M.S.A.1" aggregate which included stone mining tools(Beaumont, 1973b). Associated charcoal dates range back to 43,200 $^{+1350}_{-1200}$ B.P. (Grn-5313) (Vogel, 1970), but the true age of the site is estimated at ~110 Kyrs. B.P. (Beaumont, 1973b).

(c) Notched objects. Such items in M.S.A. context include :

I. The single bone fragment from the 2WA stratum at Border Cave (Appendix 8).

II. The single haematite fragment from Howieson's Poort (Stapleton and Hewitt, 1928 and 1929).

III. The two bone fragments from Layer G at Apollo 11 Cave (Wendt, 1976:7).

These engravings, whether they be the 'signs' of Hahn (1971:255) or the 'ritual markings' of Marshack (Appendix 8) suggest the possibility of shamanistic rites, and by implication of conceptual thinking, in areas of Africa prior to ~100 Kyrs. B.P.

(d) Burial. Border Cave 3 came from a shallow but indubitable grave immediately underlying 'M.S.A.2' and with a consequent age of >100 Kyrs. B.P. No certain interment as old as this has as yet been documented anywhere else on earth (e.g. Oakley, 1969). Some possible implications relating to the history of religion as outlined by Jonsson in Appendix 64.

(e) Pendant. A single perforated Conus shell was found in the infant burial (Cooke et al., 1945) and may be taken to indicate personal adornment (Boshier and Beaumont, 1972). That this may be an isolated occurrence is suggested by the seashell fragments recovered from Layer F at Apollo 11 Cave (Wendt, 1972:9). This admittedly tenuous data may thus have a bearing on the pervasive use of nacre objects as ornaments during the Upper Palaeolithic times in Western Europe (Boule and Vallois, 1957).

(f) Middens. M.S.A. association with these are known to occur on :

I. The east coast, at Revés Duarte and Kassimatis, near Maputo (Barradas, 1965).

II. The south coast, at Die Kelders and Klasies River Mouth (Klein, 1974-76).

III. The west coast, in the vicinity of Saldanha Bay (G. Avery, pers. comm.).

At Klasies River Mouth evidence for the systematic exploration of aquatic foods is present in all M.S.A. levels ranging back to the maximum of the Last Interglacial (Voigt, 1974; Klein, 1976; Butzer, n.d.). That such occurrences may reflect a formative phase in the utilization of the seas resources is suggested by the following contrasts with the fauna from middens postdating 12 Kyrs. B.P.:

I. The former contain a higher proportion of forms which could have been obtained to some varying extent by scavenging (e.g. whales, dolphins, and two species of seal)(Klein, 1974).

II. The former contain a lower proportion of bones ascribable to fish and flying birds, which suggest that angling and fowling were beyond mans technical capability then (Klein, 1975).

The evidence in general, as outlined above, is taken to clearly reveal that the subcontinent was a focal region of cultural innovation and development during at least the first half of the Upper Pleistocene.

7.4 General

The cultural overview concludes with the following additonal comments and tentative correlations relating to the available data :

(a) The Border Cave evidence suggests that stone age peoples in that area made little use of their floral and faunal surroundings other than as a source of food. No pre-1WA level produced enough shell to represent anything like a single ostrich egg and there is thus no sound basis for assuming the use of those objects as containers during the M.S.A. (3.6.2). Possibly shaped wood was found to be extremely uncommon in absolute terms and relative to the number of unmodified fragments representing unspent fuel (4.2). Fibre showed no attempt at manipulation into cordage (4.7) and appears to have been exclusively used as bedding material (e.g. Davies, 1975; Wadley, 1976). Of interest are the thorn awls found in levels ranging between ~33 and ~80 Kyrs. B.P. (Appendix 7). The persistence of this tradition has been noted at Shongweni in strata younger than ~12 Kyrs. B.P. (Davies, 1975:653).

(b) The evidence adduced in 6.3.1 implies that Southern Africa now has a culture - and chrono - stratigraphy for the Upper Pleistocene as complete as any yet established elsewhere in the Old World (e.g. Oakley, 1969). This framework certainly requires amplification, but it is also true to say that only one major gap occurs, namely the one which spans $\delta^{18}O$ stage 4 (~40 - ~60 Kyrs. B.P.). Two occurences which are regarded by the author as probably falling within that range are :

I. The sample of atypical 'Early L.S.A.' recovered in 1962 from thin 'floors' in the Stratum 5 yellow sands at Rose Cottage Cave and uncertainly dated to between > 29,430 ± 520 B.P. (Pta-211) and > 40,950 B.P. (Pta-354) (Appendix 62).

II. The sample of diminutive 'M.S.A.' recovered by Malan *et al.* (1943)from a brown sand horizon 51-91 cm below the modern surface at Wonderwerk Cave and recently dated to 38,600 ± 1,080 B.P. (SI-3562)(Butzer *et al.*, n.d.).

The Border Cave typological trends may be used to predict that these assemblages will, when described, be found to be typified by :

I. A Tool 1 only class composition confined to scrapers (Fig. 30).

II. A Tool 1 + 2 class composition dominated by scaled pieces (Fig. 30).

III. A low (~0,5%) proportion of formal tools to flake minimum number (Fig. 31).

IV. A low (~3,5%) proportion of blade + point class items (Fig. 32).

V. A moderate (~30%) proportion of dihederal + polyhedral flakes (Fig. 33).

VI. A moderate (~20%) proportion of radial prepared cores (Fig. 35).

(c) Our data would seem to raise certain fundamental problems of interpretations and terminology, if it is granted that the definition of stone age industries should be based on stylistic criteria, reflecting cultural traditions 'which on theoretical grounds may be limited in time and space' (Kleindienst, 1965:834). These may be summarized as follows :

I. The systematic shifts in various morphometric parameters within the M.S.A., as detected in the exceptionally long sequence at Border Cave, can be best construed to mean that this complex was founded on a single unbroken technological continuum (Beaumont and Vogel, 1972). It follows from this that any temporal subdivision of it in terms of the lifespan of particular formal tool forms may well reflect the result of autochthonous developments in flaking capability rather than a real succession of valid cultural entities (e.g. 7.3 comments on Backed pieces 2). However, it needs to be stressed that this interpretation still requires further investigation by way of as yet unavailable studies directed at revealing whether and to what extent morphometric breaks do in fact occur at interfaces between intrusive and pre-existing traditions of comparable age elsewhere e.g. Haua Fteah (McBurney, 1967).

II. When the detailed composition of a given typological category held in common by approximately coeval aggregates is considered on a continental basis, it is obvious that there are indeed spatially distinctive stylistic clusters which must reflect true cultures and/or culture groups in the sense that these terms are used in the Iron Age (Clark, 1968:291ff.). There are, for example, marked shifts in forms and frequency within the Trimmed points 2 class, as i evidenced by the typical short triangulars of the 'Pietersburg' (Fig. 88), slender lanceolates of the Lupemban (e.g. Clark, 1963), and tanged bifaces of the Aterian (Clark et al., 1973; Haynes and Haas, 1974:375). Southern African occurrences certainly ascribable to the same 'phase' show by contrast a far greater degree of uniformity, although differences do apparently exist, as is suggested by the seemingly exclusive presence of 'double-pointed lanceheads' in the Stillbay (Malan, 1939) and the relatively marked complement of oblique Trimmed points 1 in 'M.S.A.1' aggregates from Swaziland (Beaumont, unpublished). However, it does then become relevant to consider on what practical basis these relatively minor dissimilarities are to be evaluated and defined, particularly in view of the possibility that at least some of them may be due to inadequate formal tool sample sizes and/or the result of distortions induced by the use of differing raw materials. It is the authors opinion that the actual or potential effects of these two variables on local industries are in need of further investigation before embarking on any further proliferation of perhaps synonymous terms by way of 'regional' terminologies.

(d) Fig. 89 details a 'most possible' correlation of the sequences at most of the major cave sites in Southern Africa in terms of the temporal framework proposed in 6.3.1. Details are based on the following sources :

I. Border Cave : Text.

II. Shongweni Cave : Davies, 1975.

III. Bushman Rock Shelter : Louw <u>et al</u>., 1969.

IV. Cave of Hearths : Mason, 1962; Sampson, 1972.

V. Heuningsneskrans Shelter : Appendix 61.

VI. Mwulu Cave : Tobias, 1949; Sampson, 1972.

VII. Olieboompoort Cave : Mason, 1962; Sampson, 1972.

VIII. Rose Cottage Cave : Appendix 62.

IX. Boomplaas Cave : Deacon and Brooker, 1976; Deacon <u>et al</u>., 1976.

X. Cape St. Blaize Cave : Goodwin and Malan, 1935; Keller, 1969.

XI. Howiesons' Poort Shelter : Stapleton and Hewitt, 1927 and 1928; J. Deacon, pers. comm.

XII. Klasies River Mouth Caves : Wymer and Singer, 1972; Sampson, 1972; Butzer, n.d.

XIII. Montagu Cave : Goodwin, 1929; Keller, 1970a+b and 1973.

XIV. Nelson Bay Cave : Klein, 1972 and 1974; Butzer, 1973a, Deacon, n.d.

XV. Peers Cave : Keith, 1931; Jolly, 1948; Anthony, 1967; Sampson, 1972.

XVI. Lion Cavern : Beaumont, 1973b.

XVII. Apollo 11 Cave : Wendt, 1972 and 1976.

7.5 <u>Technology</u>

Border Cave was excavated with the ultimate intention of obtaining data to test certain hypotheses concerning the essential nature of the technological shift which has led with time from pebble tool to neutron bomb. Our entirely provisional findings in this connection are as follows :

(a) The consistent nature of the various morphometric patterns isolated in 2.9, when viewed in terms of an occupation record

FIG 89 SOME MAJOR UPPER PLEISTOCENE CAVE SITES IN SOUTHERN AFRICA: TENTATIVE CORRELATIONS

ABS. AGE KYRS. B.P.	TECHNO-COMPLEX	NATAL		TRANSVAAL					O.F. STATE	CAPE							SWAZILAND	S.W. AFRICA
		BORDER C.	SHONGWENI C.	BUSHMAN ROCK S.	C. OF HEARTHS	HEUNINGS-NESKRANS S.	MWULU C.	OLIEBOOM-POORT C.	ROSE COTTAGE	BOOMPAAS C.	CAPE ST. BLAIZE C.	HOWIESONS POORT	KLASIES R. MOUTH C.	MONTAGU C.	NELSON BAY C.	PEERS C.	LION CAVERN	APOLLO 11
			UP.		10			3	2	BLD 3	?	?	L.S.A. 1&2	1	1-10&17	WILTON		C}
				3-		1a-b			3	BLA								
			LR.1	27		2a-b				BRL					11-13			
			LR.4			3a-b				CL					14-16&18}			D
20						3c-d				BWA								
	L.S.A. (s.s.)		LR.7			3e-f			4	LP								
						3g-h				YOL								
										BP								
		1BS.LR																E?
40		1WA							5	OLP?								
		2BS.UP								BOL?								
60		2BS.LRA-B											M.S.A. IV					
		2BS.LR C											M.S.A. III		GL1?	?		
80		2WA																
		IRBS								OCH				2 UP.				
		3BS							6&8			1?						
		IRGBS			9				9	LOH		4	H POORT	2 LR.	H. POORT	H. POORT		F
100	M.S.A.	IGBS.UP																
		IGBS.LR		28-43	6-8}		3	2					M.S.A. II}		M.S.A.	STILLBAY	M.S.A.	G?
		BACO.A					2											
120		-			5}		1				C1-4		M.S.A. I}					H?
		BACO.D																
140				>43?	4}													
>150	E.S.A.				1&3			1						3&5		BASAL		

which ranges over ~80 Kyrs, is regarded as excellent support for the view that 'technological history is not casual' (Muhly and Wertime, 1973:112).That evidence also appears to promise it will ultimately be found possible to construct a viable model of the often complex relationships between many of the typological, raw material and technological parameters in any given stone age aggregate. However, this is a long-term goal and it would clearly be premature to discuss the possible nature of those interactions until such time as the present data have been considerably amplified by way of comparable analyses at other sites.

(b) Untrimmed flake class make-up for aggregates spanning a large stretch of the stone age was determined in order to establish the broad outline of temporal shifts :

I. In T, B. and P subclass proportions within the flake matrix (e.g. Mason, 1967).

II. In dorsal preparation proportions within the I subclass (e.g. Mason, 1967).

The following procedures were adopted in assessing the significance of the resultant information :

I. Data were only considered to be viable if based on good random samples drawn from contexts where the entire artefact range can be expected to occur (i.e. occupation sites).

II. Maximum B and P subclass values in any given stratum grouping were regarded as most representative, in view of evidence that these categories may be inhibited by environmental factors (2.6.3).

Preliminary analyses gave the following readings for locally available aggregates (in %):

I. Klipplaatdrif. 'Earlier Acheul' (Mason, 1962) : I1=~80; I2=~20; B=0; P=0 (Beaumont, 1969:70).

II. Montagu Cave 'Late Acheulian' (Keller, 1973) : I1=~20; I2=~75; B= 5; P=0 (Appendix 63).

III. Border Cave. Readings for the various stratum groupings given in Fig. 90 are derived from proportions listed in Appendix 11.

Data for these three localities was then placed in a crude temporal framework based on :

I. Klipplaatdrif. A broad similarity to aggregates in Olduvai Bed IV was taken to suggest a minimum date of ~600 Kyrs. B.P. (Leakley, 1971; Hay, 1975).

II. Montagu Cave. A broad similarity to aggregates at Olorgesailie MSS was taken to suggest a minimum date of ~250 Kyrs. B.P. (Isaac, 1975: 504 and 533).

III. Border Cave. Data for the various content units was based on the chronology presented in this dissertation (6.3.1).

The present information, although extremely scant, is taken to suggest that (Fig. 90) :

I. The marked shift in the I1/I2 proportion which took place in the E.S.A. deserves attention at sites and/or in areas where there is better stratigraphic control.

II. The fairly gradual introduction of Points, as was apparently the case for Blades, would suggest a date of ~160 Kyrs. B.P. for the very onset of the M.S.A., as perhaps represented by aggregates like the lowermost one at Peers Cave.

(c) That 2.6 and 2.9 trends are not merely of local relevance and can be used to effect correlations of subcontinental extent is suggested amongst other evidence, by the following particular comparison, between the data from Border Cave and Montagu Cave :

I. The equivalence of 1RGBS and 2.LR is suggested by the subsequent decline in Backed pieces 2 frequency and the concordant increase in I2 L means which took place at both sites (Figs. 30 and 42; Appendix 63; Deacon, 1976).

II. The equivalence of 1RGBS and 2.LR is further supported by the remarkably similar morphometric values for these aggregates when the same untrimmed flake subclass and raw material category is compared (Table 6). Slight deviations from dimensional identity in this instance are believed to be due to the 'distortion' introduced by the silcrete fraction in the sample from Montagu Cave.

The obvious deduction which can be drawn from this single comparison is that Border Cave metrical trends may reflect norm shifts which were synchronous over vast areas of Southern Africa.

(d) The archaeological record bears ample witness that increased efficiency is the independent variable which fuels mans' technological complex in its varied typological manifestations. How precisely to extract pertinent information from the vestiges which remain at most stone age sites was a problem first considered by the author more than a decade ago. Deductions made at that time were:

I. That any practicable approach would have to be based on the untrimmed flakes since these alone met the key criteria of being both abundant enough to sustain metrical study and sufficiently enduring to permit the tracing of specific changes throughout much of prehistoric time.

FIG.90 CHANGES WITH ABSOLUTE TIME IN UNTRIMMED FLAKE SUBCLASS PROPORTIONS

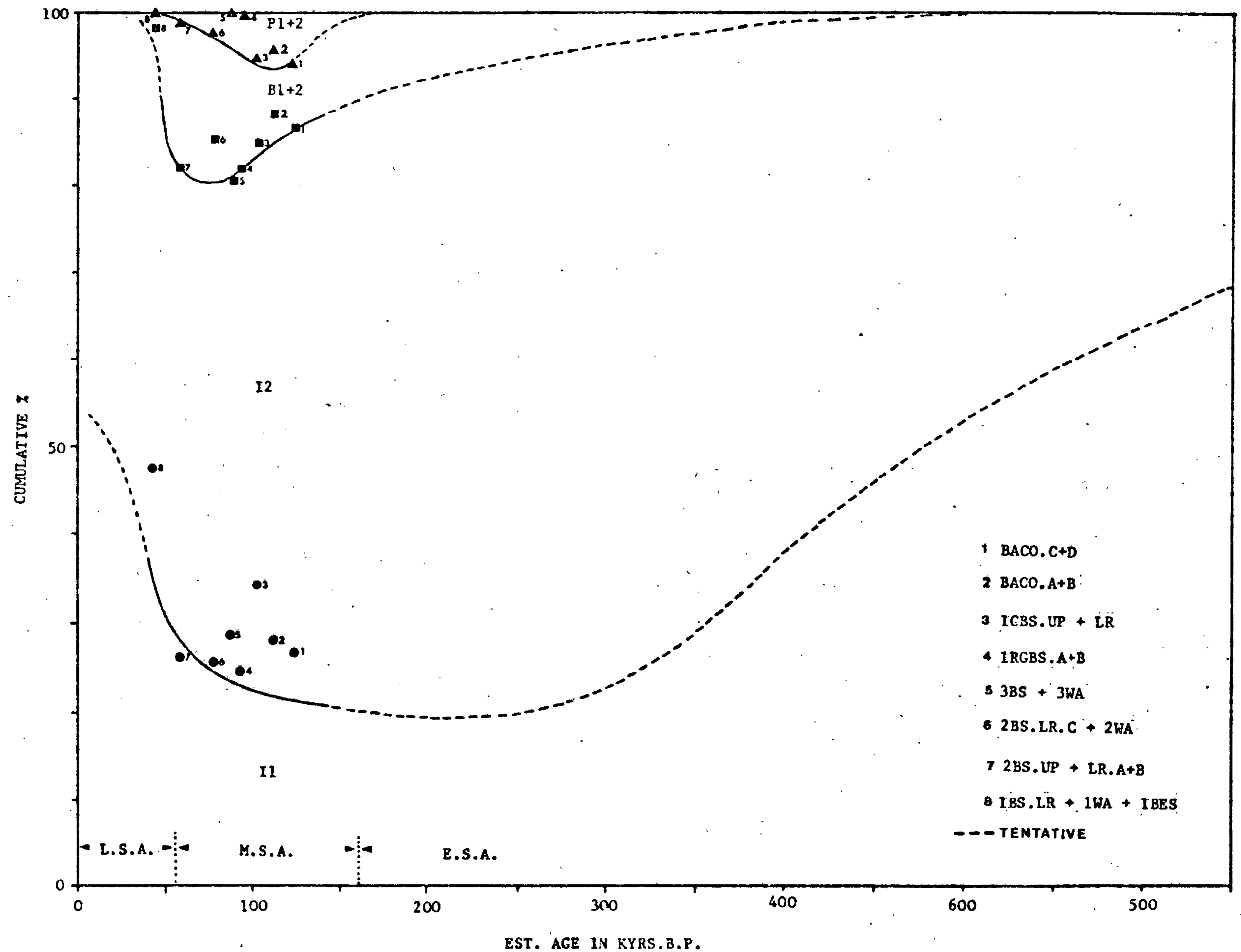


Table 6. I2 subclass values for two typologically similar aggregates.

Site Stratum	Raw Material	Sample	Analysis	L mm	B mm	T mm	B -% L	T -% L	T -% B
Border C.	Chalc.	107	$\bar{x}$	17,8	14,4	2,9	89,5	17,7	20,0
1RGBS	only		Sx	9,10	6,05	1,65	33,4	8,40	6,85
			$S\bar{x}$	1,15	0,70	0,20	4,25	0,95	0,80
Montagu C.	Chalc.+	105	$\bar{x}$	20,2	15,7	3,5	85,7	18,4	22,8
2.LR	Sil.		Sx	8,95	5,50	1,40	34,2	7,00	7,60
			$S\bar{x}$	0,90	0,55	0,15	3,35	0,70	0,75

Abbreviations

Chalc. = chalcedony; Sil. = silcrete.

II. That the only promising parameter within that category was relative thickness, which was considered likely to have undergone reduction with time, as improved flaking techniques aimed at increasing edge cutting efficiency were introduced and refined.

III. That this index would have to be further confined to members entirely shaped by the then prevailing technology, thereby excluding those fraction in which thickness is partly determined by cortex dorsal surfaces of fortuitous configuration.

The following temporal shifts were anticipated in the development of pertinent subclasses by analogy with certain distinctive features of all modern systems :

I. That flaking techniques would tend to replace each other in a confluent manner, with the cumulative effect being that of a smooth 'envelope curve' (e.g. Fig. 91). A brief discussion and evaluation of this trait, first identified by the RAND Corp. in the late 40's, may be found in Kahn and Wiener (1967:34-36).

II. That Rel. T changes were likely to follow an exponential pattern, because of the cumulative structure of science and technology, as first diagnosed by de Solla Price (1961) in a chapter quaintly entitled 'Diseases of science', and subsequently discussed extensively by many writers (e.g. Toffler, 1974).

III. That Rel. T values based on dissimilar rock types would only begin to differ as each material in turn approached the lower limit to which its inherent composition and texture permitted thickness reduction before excessive breakage set in during primary preparation.

Postulate (I) implies that all specimens belonging to the same untrimmed flake subclass and raw material category in a given aggregate will appear to have been produced by means of a single detachment technique. The following procedures were adopted in order to test this deduction :

I. I2 metrical data for various aggregates were separated into two size fractions on the basis of average length.

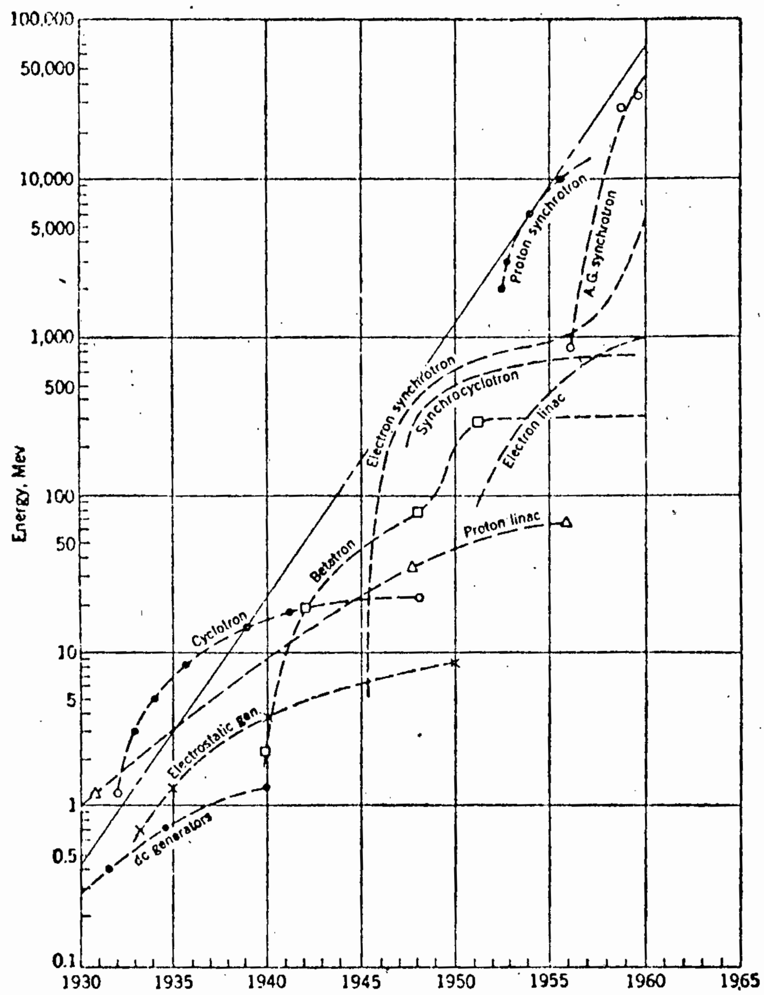


FIG.91. THE RATE OF INCREASE OF OPERATING ENERGY IN PARTICLE ACCELERATORS

From M. S. Livingston and J. P. Blewett. *Particle Accelerators*. New York: McGraw-Hill Book Company, Inc., 1962.

II. The differences between each in terms of parameter means was then expressed as a percentage (shorter category = 100%).

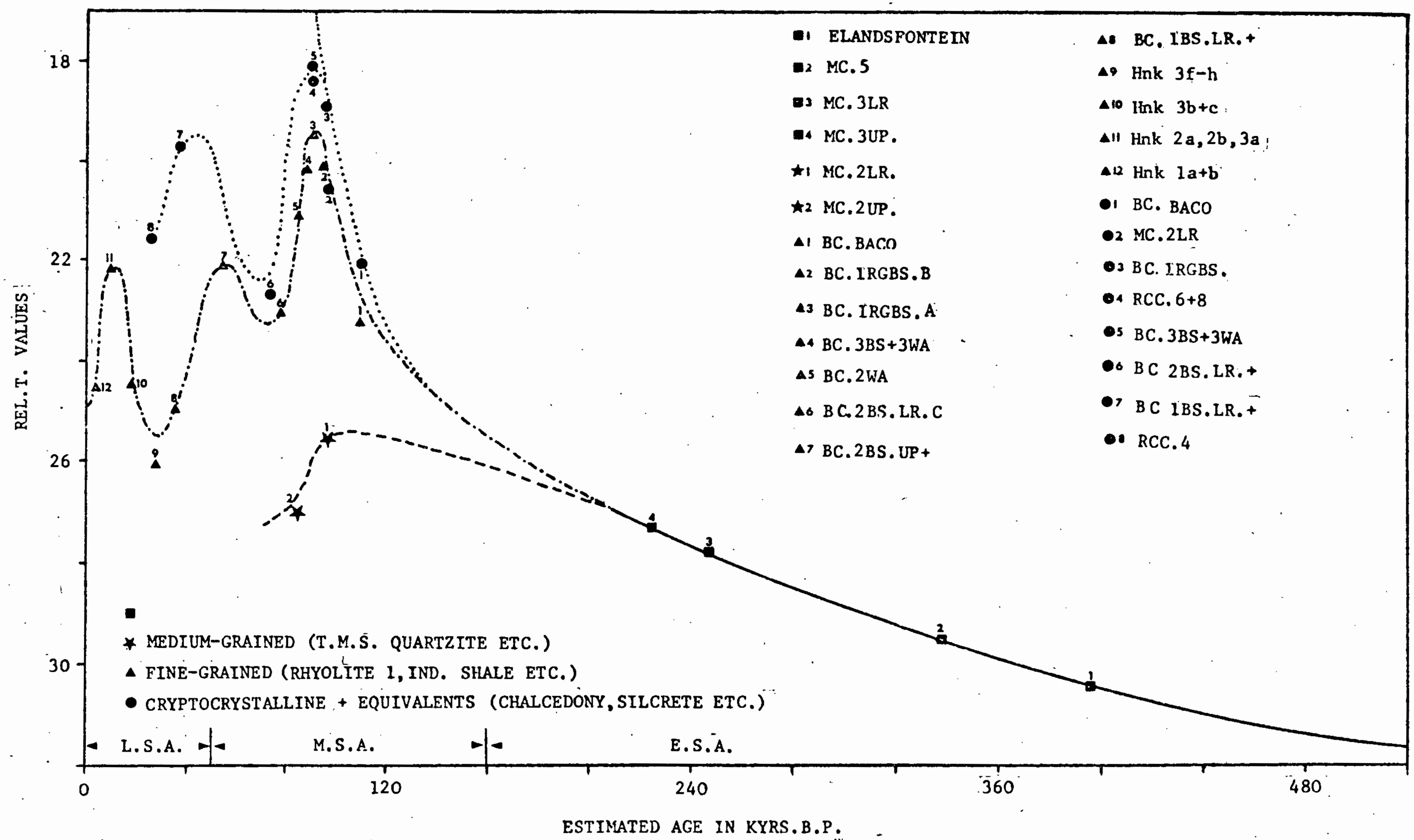
Rel. T readings were found in all cases to remain constant irrespective of flake size, as is clearly shown by the single example presented in Table 2. This ratio does thus appear to represent a fundamental and constant expression of the then prevailing flaking technology which is capable of producing viable results irrespective of sampling procedure (e.g. excavated/collected).

In order to make further progress with this investigation it became necessary to first review the temporal framework (Vogel and Beaumont, 1972). With the subsequent development of a reasonably reliable absolute chronology for the Upper Pleistocene, it has become possible to place the Rel. T data for various sites into the perspective shown in Fig. 92. Some comments on this are as follows :

I. The available information clearly provides some provisional support for postulates (I) - (III). It should be stressed that the E.S.A. portion of the figure is largely speculative and assumes a ~400 Kyr. B.P. age for the only slightly contaminated surface collection from Elandsfontein (Appendix 65; Klein, 1973). Of note is the precise correspondence between the lithostratigraphy and the Rel. T values for the Acheulian sequence at Montagu Cave (Appendix 63; Keller, 1973).

II. Fig. 92 reveals that the Rel. T shift rate accelerated markedly between ~130 and ~90 Kyrs. B.P. The unsustainable rise and subsequent fall in values centred on the 'Second Intermediate' would seem to accord precisely with an 'overshoot' situation as found in systems theory (e.g. Forrester, 1968). According to that interpretation the more sophisticated flaking capability being developed by M.S.A.1 times was increasingly offset by higher breakage proportions in granular raw material categories (Fig. 34). This trend led in turn to an ever greater switch-over to relatively rare cryptocrystalline rock-types which are less susceptible to such damage (Fig. 34). By ~90 Kyrs. B.P. a state was apparently reached in which the gains in artefact efficiency as represented by Rel. T were outweighed by the

FIG.92 I2 SUBCLASS REL.T. VARIATIONS WITH ABSOLUTE TIME: A PRELIMINARY INTERPRETATION.



increased mean energy expenditure involved in retrieving those raw materials (Dart and Beaumont, 1971:11). Values then began to fall and oscillations were generated within the system, i.e. the cybernetic phenomenon of hunting set in, as would seem to occur in comparable situations at present (Fig. 93). Of note is the finding that the fluctuations in two of our raw material groupings are markedly out of phase and follow differing courses subsequent to $\sim$60 Kyrs. B.P. (2.9.14).

III. Conversion of the Rel. T shift from $\sim$24% at $\sim$125 Kyrs. B.P. to $\sim$19% at $\sim$90 Kyrs. B.P. into absolute efficiency values is still in progress. This is being done on an experimental basis by comparing the number of cuts required to complete a given task by flakes which differ only in Rel. T. Our very preliminary results suggest that the change is measurable but by no means marked, with a doubling time of the order of tens of millennia, as compared to those for modern systems, which appear to average $\sim$25 yrs. (e.g. Cayless, 1975; Lupton, 1975). It will undoubtedly require a vast amount of additional data before the current evidence in this connection is honed to a satisfactory state of precision and placed within a sound conceptual framework. The few present facts are thus best regarded as a first tentative step towards quantifying the tempo of technological change, as deduced from the artefactual record in areas which were once the transient focus of innovation and development (Isaac, 1972).

IV. It should be noted that previous remarks pertain to shifts of an exclusively technical nature. Stylistic changes with time, on the other hand, appear to correspond to predicted stages in cultural system ontogeny, as was demonstrated in a pioneering study by J. Deacon (1972). Border Cave formed tool sample sizes were consistently too small to permit of any viable additional research in connection with this vital aspect (Appendix 7).

7.6 Phylogeny

Few human remains of probable or certain early Upper Pleistocene date have as yet been found in Southern Africa. This is probably a direct

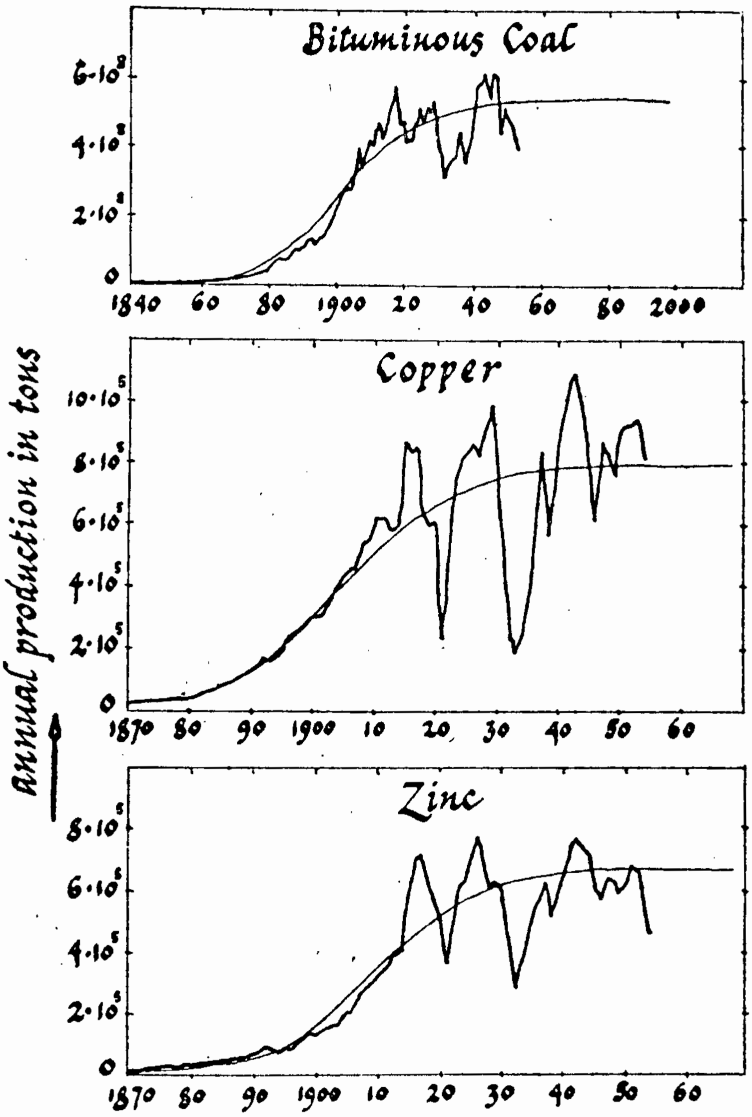


FIG. 93. LOGISTIC GROWTH OF RAW MATERIAL PRODUCTION, SHOWING OSCILLATION ON ATTAINING CEILING CONDITIONS

From D. de Solla Price. 1963. Little science, big science. New York : Columbia Univ. Press.

result of the paucity of extensive excavations at pertinent localities with good bone preservation. The evidence is, despite this ephemeral deficiency, highly consistent and significant in what it does reveal, as is patent from the facts at three key localities:

(a) Border Cave hominid associations have already been discussed (6.2.1) and the following dates apply in terms of the proposed chronology (6.3.1):

I. B.C.1 + 2: >49/ca. 115± 10 Kyrs. B.P.

II. B.C.3 : >49/ 105 ± 5 Kyrs. B.P.

III. B.C.5 : >49/ 90 ± 5 Kyrs. B.P.

These four fragmentary finds are all unequivocally ascribable to a.m.H.s., with those traits typical of the Neanderthalers being entirely absent (de Villiers, 1973 and 1976). Statistical tests reveal that B.C.1 differs very significantly from recent African sample means, mainly as a result of its greater skull size, particularly with regard to crannial breadth (Appendix 28). However, the remains as a whole do show a number of morphological similarities to modern indigenous populations, which suggests that the fossil series may, in view of the present dating evidence, be regarded as a still largely undifferentiated basal stock, from which both the Khoisan and South African Negro peoples, amongst others, ultimately arose (Tobias, 1972: de Villiers, 1973 and 1976; Beaumont et al., n.d.).

(b) The Springbok Flats skeleton was recovered from a confined area in a 30 cm. thick calcareous zone underlying ~1 m of superficial red earth at Tuinplaas Quarry (Broom, 1929; van Riet Lowe, 1929; Keith, 1931:143-144). The surface sands contained 'advanced' Pietersburg artefacts throughout their uppermost ~60 cm. (van Riet Lowe, 1929), which suggests that the hominid remains were either buried from or are older than a late 'M.S.A.1' occurrence with an inferred age of ~110 ± 10 Kyrs. B.P. A consistent series of F and N readings by both the B.M. and U.C.L.A. confirms its association with a fauna which includes Pelorovis (Broom, 1929; Protsch, 1973). D^2 values demonstrate that the probably like-aged B.C.1 and Tuinplaas crania 'are not markedly dissimilar and could represent variant of the same population', but that both differ at the $X^2_{,95}$ = >11 level from recent Khoisan and South African Negro remains (Appendix 28).

(c) Excavation of the 22m. thick M.S.A. and L.S.A. sequence at Klasies River Mouth produced various in situ hominid fragments in the M.S.A.II strata dated to ~100-115 Kyrs. B.P. (Wymer and Singer, 1972; Klein, 1976; Butzer, n.d.). These include :

I. An almost chinless lower jaw with large teeth (Singer and Smith, 1969).

II. A more gracile lower jaw with small teeth (Singer and Smith, 1969).

III. A partial zygomatic of fully modern appearance (Rightmire, n.d.).

IV. A partial frontal showing only slight supraorbital development, and nasal roots which are broad and flat, as in many modern Negroes (Rightmire, n.d.).

The differences between (I) and (II) were regarded as being beyond the range of sexual dimorphism by Singer and Smith (1969). But Wells (1972:7) found this claim for two distinct but coeval populations somewhat unconvincing in view of known mandibular variability.

Here therefore is compelling evidence that a.m.H.s. with a M.S.A. tool-kit already occupied sub-Saharan Africa during the Last Interglacial, thereby supporting similar but less certain associations at Peers Cave (e.g. Keith, 1931) and Kanjera (Oakley, 1974; Davis, n.d.). This finding does however raise the problem of how these large-brained peoples (Keith, 1931:146; de Villiers, 1973) relate to the following more 'primitive' hominids which have in the past been linked to the M.S.A. and/or early Upper Pleistocene (e.g. Oakley, 1969) :

(a) The Florisbad facio-calvarial fragment was recovered from the margin of a fossil spring cone which had broken through Peat 1, but accounts differ as to which of these two units it was in true association with (Dreyer, 1938; Oakley, 1954 and 1957). Both were definitely sealed by the directly overlying Green Sand and there is thus no doubt that the remains are older than a middle-late 'M.S.A.1' aggregate of 'Mazelspoort'/Vlakkraal' type found in a zone ~10-15 cm. below the base of Peat 2 and with an estimated age of ~115 ± 5 Kyrs. B.P. (Wells et al., 1942; Sampson, 1972). The deposit from the eye and related levels which immediately postdate Peat 1 yielded an artefact sample largely based on lava and lydianite (Dreyer, 1938:73), which included a possible cleaver and long retouched blades that differed from the overlying aggregate in being more heavily patinated and by a complete absence of convergent flaking (Dreyer, 1938). A recent examination (Beaumont, n.d.) of this material, which Dreyer (1938:72)associated with the skull, supports the view that it is most probably 'Fauresmith', and thus older than the M.S.A. onset at ~160 Kyrs. B.P. (7.5). Peat 1, on the other hand, has yielded an amorphous assemblage based almost exclusively on dolerite (Meiring, 1956:207), that includes adjacent platform cores, irregular flakes, and polyhedrons, namely the so-called 'Florisbad Chopper Culture' (Meiring, 1956:230),which may be assigned to some uncertain preceding phase of the E.S.A. (Sampson, 1972:101). This typological evaluation is thus in good accord with unpublished evidence that Peats 1 and 2 are separated from each other by an entire landscape cycle (Appendix 54). The fauna, of which ~90% came from either in or immediately above and below Peat 1 (Hoffman, 1955:167), and which is thus in only approximate association with the cranium, includes 24 large mammal species, of which at least 6 and perhaps 8 are now extinct (Cooke, 1964; Deacon, 1976:62). That assemblage has been regarded as younger than Elandsfontein and comparable to Chelmer, where the bone level underlies a Bambata (Stillbay) occurrence (Bond and Summers, 1951; Cooke, 1964). The whole sequence clearly falls beyond the limits of C-14, as is confirmed by a measurement of >48,900 B.P. (GrN-4208) for Peat 1 (Vogel, 1970:460) and a new reading of >42,600 B.P. (Pta-1108) for Peat 2 (J. Vogel, pers. comm.). Dreyer's '_Homo helmei_', although undoubtedly archaic (Rightmire, n.d.), as indicated by comparisons with Steinheim and Kabwe (Dreyer, 1936; Singer, 1958), has nevertheless a 'generally a.m._H.s._ character' (Howells, 1974:33), thereby suggesting the possibility that it was from a non-Neanderthal (Tobias, 1968:185) ancestral form like this that modern man arose (Beaumont, n.d.) at some time during the late Middle Pleistocene of Africa (Dreyer, 1935).

(b) Omo 1 and 2 were found at sites which are ~2,7 km. apart, but both can be certainly ascribed to the upper levels in Member 1 of the Kibish Formation(Leakey _et al_., 1969). The former was found on a minor disconformity between Beds 5 and 6, while the latter probably comes from either the top of Bed 5 or the base of Bed 6, and strict contemporaneity cannot therefore be proven (Leakey _et al_., 1969). A mollusc shell sample from Bed 6 produced a $^{230}Th/^{234}U$ date of 130,000 ± 5,000 B.P. (L-1303-J), thus confirming the Middle Pleistocene age of Member 1 (Butzer et al., 1969:26), given that readings based on that material produce results that are less than or equal to their true age in 95% of all cases (Thurber, 1972:432). Approximately coeval artefacts are limited to a small and amorphous sample which includes a few faceted flakes (Butzer, pers. comm.). Both hominids are here ascribed to 'early' H. sapiens, and show a number of likenesses to Florisbad (Rightmire, 1976 and n.d.).

(c) The Saldanha skull and mandible were found on the present surface at Elandsfontein near Hopefield in 1953 (Drennan, 1953; Singer, 1954, Drennan and Singer, 1955). Stratigraphic evidence supports their association with a fairly refined Acheulian aggregate (Mabbutt, 1957; Singer and Wymer, 1968; Butzer, 1973b). However, a recent inspection of the collection as a whole (Beaumont, n.d.) did not confirm its claimed affinities with the 'Fauresmith' (cf. Singer and Crawford, 1958; Malan, 1962). N,F, and U assays indicate that the cranium is contemporaneous with the older and major fraction of a contiguous fauna (Oakley, 1957; Protsch, 1973), that comprises ~45 large mammal species, of which 21 are now extinct (Cooke, 1964; Klein, 1973 and 1974). This assemblage is particularly comparable with the animal bones from Olduvai Bed IV (Cooke, 1964; Klein, 1973), which ranges in time between ~600 and ~800 Kyrs. B.P., on the basis of palaeomagnetic evidence and extrapolated sedimentation rates (Hay, 1975). The middle reaches of Bed IV, with a revised probable age of ~700 Kyrs. B.P. (Pilbeam, 1975), yielded a number of postcranial fragments (O.H.28), which have been tentatively assigned to 'Sinanthropus' (Day and Molleson, 1973). Hominids of that grade presumably precede Elandsfontein in time, thus making it more likely that the latter relates to uppermost Bed IV, which would imply a most probable date for it of at least ~400 - 500 Kyrs. B.P. (Beaumont, n.d.). This estimate would then be compatible with the finding (Klein, 1976 and 1977) that faunal aggregates of Last Interglacial age have a non-extant species proportion of ~10%, thereby suggesting a much greater antiquity for Saldanha where the equivalent value is ~46%, on the assumption of a roughly constant extinction rate during the Middle and Upper Pleistocene. There is no doubt that the cranium is closely related to that of 'Rhodesian Man' (e.g. Singer, 1957 and 1958).

(d) The Broken Hill skull was recovered in 1921 from the base of a ~25m deep accumulation of cave earth and animal bones in a solution cavity at No. 1 Kopje near Kabwe in Zambia (Mennell, 1929; Clark et al., 1947). A small and selected sample of overlying artefacts represent either the Charaman (Proto-Stillbay) or Bembesi (Sangoan) phases of the local E.S.A. (Clark et al., 1947 and 1968; Cooke, 1968), but there is no conclusive evidence to preclude the hominid from being contemporaneous with nearby Acheulian occurrences (Clark, 1959). Faunal remains, mainly from ~15m and more above the cranium (Mennell, 1929:664), and at least in part perceptibly younger than it in terms of nitrogen content (Oakley, 1957:77), comprise ~24 large mammal species, which include only 6 extinct forms (Leakey, 1959; Cooke, 1964; Klein, 1973). The low incidence of the latter may well be due to the skull being significantly older than the bulk of the fauna and/or the species array being in part indigenous to the overlying 'Rhodesian Stillbay' (Mennell, 1929; Clark et al., 1947; Singer, 1958). Deductions are that the cultural debris indicate that the hominid is certainly earlier than the M.S.A. onset at ~160 Kyrs. B.P., while the fact that all of the extinct forms also occur at Elandsfontein may suggest a similar age to that inferred in (c) (Klein, 1973). An antiquity of that order precludes the cranium from being a Neanderthal (Weidenreich, 1943; Rightmire, 1976), and supports an ascription to a terminal H. erectus grade (Coon, 1967; Bilsborough, 1973), as represented elsewhere by the broadly coeval Petralona remains (e.g. Hemmer, 1975).

The key conclusions which relate to our present findings are:

(a) That it now transpires that the known population succession in sub-Saharan Africa is bereft of any tangible evidence for Neanderthals or 'Neanderthaloids' (Rightmire, 1976). It would rather seem that:

I. Florisbad and Omo have no clear analogues elsewhere in the Old World and represent either 'early' H. sapiens or primitive a.m.H.s. (e.g. Boule and Vallois, 1957; Howells, 1974).

II. Elandsfontein and Broken Hill lie close to and probably on the nether side of the sapiens-erectus morphospecies divide as usually defined (Coon, 1967; Le Gros Clark, 1969).

(b) That peoples of robust but undoubted a.m.H.s. morphology with some Khoisan-Negro affinities already occupied South Africa by at least ~100 Kyrs. B.P. Evidence for this contention, based on in situ remains, at more than one locality, is considered to comply fully with the more rigorous criteria as to legitimacy which its significance demands (Howells, 1974:33).

It now becomes relevant to consider to what extent the latter data is compatible with the following major phylogenetic models which have been proposed for modern man (e.g. Howells, 1967:281 f.f.) :

(a) 'Long' Presapiens : This scheme postulates that a.m.H.s. in essentially modern form extends back to deep within the Middle Pleistocene and was largely founded on the Kanjera skulls (e.g. Leakey, 1973). Investigations subsequent to the recent relocation of the site have shown that the hominids actually come from a level directly overlying the faunal horison (Davis, n.d.), a finding in good accord with their much younger age as deduced from new U assays (Oakley, 1974).

(b) 'Short' Presapiens : This scheme postulates a sapiens lineage in Europe extending back to Steinheim and/or Swanscombe by way of Fontechevade I and II (Vallois, 1954). However, it is now often held that the cranial portions at the last-mentioned locality are too fragmentary to permit of any firm deductions being based on them (e.g. Vandermeersch et al., 1976).

(c) Preneanderthal : This scheme postulates the evolution of a.m.H.s. from a generalized Neanderthal stock in the Near East subsequent to the Last Interglacial (e.g. Howell et al., 1966). Contraverting this reconstruction are absolute and relative datings which demonstrate that vestiges such as Tabūn, Skhūl , and Qafzeh lie too close to the local onset of the Upper Palaeolithic to be regarded as true 'transitional' forms (Howells, 1967:255; Vallois and Vandermeersch, 1975; Oakley et al., 1975; Jelinek, n.d.).

In view of the inability of these models to accord fully with the new data from south of the Limpopo we here propose a scheme which is essentially similar to (b), but in which the early evolution of a.m.H.s. is regarded as having been entirely confined to sub-Saharan Africa. Such a synthesis involves deriving the precise age of the hominids from Steinheim and Swanscombe, which necessitates in turn a correlation of the deep-sea $\delta\,^{18}O$ record with the climato-stratigraphy for Western Europe. This may be effected, as detailed below, by way of the reliably calibrated ice-volume oscillations spanning the entire 'cold' Pleistocene which have been shown to be embodied in Equatorial Pacific core V28-238 (Shackleton and Opdyke, 1973) :

(a) Stage 6. ~128-195 Kyrs. B.P. (Shackleton and Opdyke, 1973). Full glacial conditions approximating to Stage 2 (Shackleton and Opdyke, 1973). Probably correlates with : Mallorquin hemicycle C; Padul zone N; Rhine Middle Terrace IV; Saale-Warthe; Riss 2 (Florschütz _et al._, 1971; Butzer, 1974 and 1975; Beaumont, n.d.).

(b) Stage 7. ~195-250 Kyrs. B.P. (Mesolella _et al._, 1969; Butzer, 1975). A bimodal interglacial of only moderate amplitude (Florschütz _et al._, 1971; Shackleton and Opdyke, 1973; Butzer, 1975). Probably correlates with : Mallorquin cycles X1 and X2; Padul zones L and M; Rhine sequence palaeosols; Saale 1-2; Riss 1-2 (Florschütz _et al._, 1971; Butzer, 1974 and 1975; Beaumont, n.d.).

(c) Stage 8. ~ 250-300 Kyrs. B.P. (Shackleton and Opdyke, 1973). Full glacial conditions approximating to Stage 4 (Shackleton and Opdyke, 1973). Probably correlates with : Mallorquin hemicycle D; Padul zone K; Rhine Middle Terrace IIIb;Saale-Drenthe; Riss 1 (Florschütz _et al._,1971; Butzer, 1974 and 1975; Beaumont, n.d.).

(d) Stage 9. ~300-350 Kyrs. B.P. (Butzer, 1974 and 1975). Full interglacial conditions approximating to Stage 5e (Florschütz _et al._, 1971; Shackleton and Opdyke, 1973). Probably correlates with : Mallorquin cycles W1-W4; Padul zones H, I, J; Rhine sequence palaeosols; 'Upper'Holstein; Mindel-Riss (Florschütz _et al_, 1971; Butzer, 1974 and 1975; Beaumont, n.d.).

(e) Stage 10. ~ 350-370 Kyrs. B.P. (Shackleton and Opdyke, 1973). A brief cold interlude of glacial amplitude (Shackleton and Opdyke, 1973; Šibrava, 1974). Probably correlates with : Mallorquin hemicycle E; Padul zone G; Rhine Middle Terrace IIb/IIIa; 'Intra-Holstein' (Florschütz _et al._,1971; Butzer, 1974 and 1975; Beaumont, n.d.).

(f) Stage 11. ~370-440 Kyrs. B.P. (Shackleton and Opdyke, 1973). Full interglacial conditions approximating to Stage 5e (Shackleton and Opdyke, 1973; Berggren and van Coevering, 1974:140). Probably correlates with : Mallorquin cycle V; Rhine sequence palaeosols; 'Lower' Holstein; Mindel-Riss (Butzer, 1974; Beaumont, n.d.).

(g) Stage 12. ~ 440-470 Kyrs. B.P. (Shackleton and Opdyke, 1975). Full glacial conditions more intense than Stage 2, with upper boundary being U/V interface/Termination V (Shackleton and Opdyke, 1973; Berggren and van Coevering, 1974:140). Probably correlates with : Mallorquin hemicycle F; Elster 2; Mindel 2 (Berggren and van Coevering, 1974; Beaumont, n.d.).

In terms of these tentative correlations the two fossil skulls would have the following temporal co-ordinates :

(a) Swanscombe. Recent investigations there reveal that the Lower Loam, with _in situ_ Clactonian (Waechter, 1971), probably does not predate Subzone Ho IIb (Hubbard, 1972), and that climatic conditions deteriorated during its alluviation (Gladfelter, 1975:245), as evidenced by a pollen sequence shift from a high value for _Corylus_ to a spectrum dominated by _Gramineae_ (Hubbard, 1972; Conway, 1972:81). This change appears to correspond with the expansion of subarctic grassland and the partial replacement of thermophile trees by _Pinus_ and _Betula_ noted in equivalent biostratigraphic horizons at sites such as Hoxne (West, 1956), Marks Tey (Turner, 1970) and Münster Breloh (H. Müller, cited by Turner, 1975). The widespread and concomitant nature of that trend would seem to support the suggestion of a 'revertance' during Ho IIc (cf. Turner, 1970 and 1975), which may then equate with our proposed $\delta^{18}O$ stage 10 intra-Holsteinian interlude at ~350 - 370 Kyrs. B.P. (e.g. Šibrava, 1974). Subsequent and perhaps related decalcification of the Lower Loam surface (Conway, 1972), may represent postdepositional leaching or sub-aerial weathering (Kerney, 1971; Conway, 1972), but can in either event be taken to indicate a hiatus of as yet uncertain duration (Gladfelter, 1975:247), which seems to coincide with a phase of interrupted agradation/active downcutting by the Thames (King and Oakley, 1936). This break reduces temporal resolution but the finding by Conway (1972:84-85) that tundra-steppe conditions prevailed during the accumulation of the Upper Gravels, supports a correlation of the Middle Acheulian industries and 'early' _H. sapiens_ fragments in the underlying Upper Middle Gravel with some post- Ho IIc but pre-eGi pollen zone of the Hoxnian. In terms of this scheme as a whole, only the Later Boyn Hill phase would correspond with the 30m/'Tyrrhenian 1' transgression, which is in turn equated with Mallorquin cycle W1 at the very onset of $\delta^{18}O$ stage 9 (Butzer, 1975: 42 and 63). The inferred age of the skull of ~300 - 350 Kyrs. B.P. in terms of (d) above is seen to be in apparent accord with a recent Th/U measurement of $\geq$ 0,3 M. B.P. for the Upper Middle Gravel (Pilbeam and Isaac, 1975:895).

(b) Steinheim. The female cranium from the Palaeoloxodon antiquus gravels at the Sigrist Pit can be certainly ascribed to the Holsteinian (Howell, 1960; Oakley, 1969:35-37). Stratigraphic considerations are usually taken to suggest an association with the latter portion of that interglacial (Oakley, 1969:302; Kahlke, 1975 : Fig. 1). An age of the same order as that for Swanscombe is therefore taken as probable but not proven (Pilbeam and Isaac, 1975:895). No cultural debris were originally reported from the hominid level, but this is claimed to have latterly yielded artefacts which include 'at least one hand-axe' (Leakey, 1973:495).

Primary information relating to the remains previously discussed is listed in Table 7. Data cited in three of the columns derives from the following specific sources:

(a) Endocranial capacities and probable sex:

I. Border Cave : de Villiers, 1973:233.
II. Tuinplaas : Keith, 1931:146.
III. Florisbad : Singer, 1958:58.
IV. Omo : Leakey *et al.*, 1969:1136.
V. Swanscombe : Coon, 1967:618 and Table 37.
VI. Steinheim : Coon, 1967:618 and Table 37.
VII. Elandsfontein : Drennan, 1953:10.
VIII. Kabwe : Tobias, 1971:100.

(b) Large mammals, excluding Rodentia :

I. Border Cave : Cooke *et al.*, 1945; Klein, 1977.
II. Klasies R. Caves : Klein, 1974 and 1976.
III. Florisbad : Cooke, 1964; Deacon, 1976.
IV. Elandsfontein : Klein, 1973 and 1974.
V. Kabwe : Cooke, 1964; Klein, 1973.

Fig. 94 provides a model for the evolution of modern man which is in most probable accord with the chronometric information presented in Table 7. Finds marked by an asterisk are of uncertain age but are unlikely to be younger than the indicated time-levels in terms of the available dating evidence. It follows from this scenario :

(a) That present data from the western half of the Old World would seem to be best interpreted by way of a Presapiens scheme in which the a.m.*H.s.* donor area is regarded as having been sub-Saharan Africa (Beaumont and Vogel, 1972:161). According to this view a widely dispersed 'early' *H. sapiens* population of Steinheim/Swanscombe type (Le Gros Clark, 1969), gradually separated into two phyletic

FIG. 94 PROPOSED PHYLETIC SCHEME FOR THE EVOLUTION OF MODERN MAN

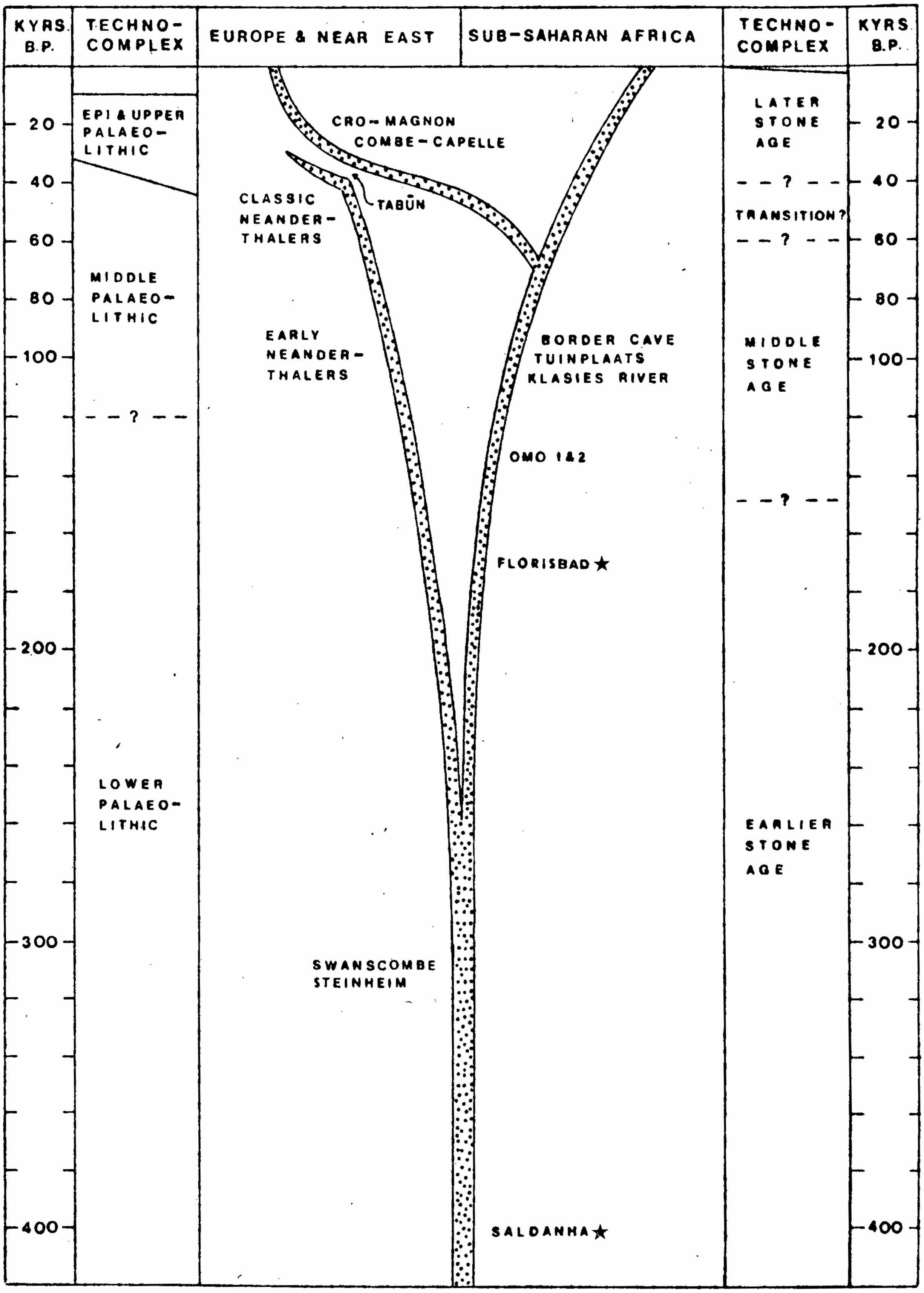


Table 7. Salient data relating to certain hominids from Africa and Europe.

Locality name	Hominid grade	Probable sex	Brain-size ccs.	Cultural associations	L. mammal/pollen associations	Est. age Kyrs. B.P.
Border C. 1 2,3,5.	a.m.H.s.	M	1507	M.S.A. Phase 1+2	$\sim$35 sp. 2-4 ext($\sim$9%)	$\sim$90-115
Tuinplaas	a.m.H.s.	M	1540	M.S.A. Phase 1	-	$\sim$110
Klasies R.C.	a.m.H.s.?	-	-	M.S.A. Phase 1	$\sim$37 sp. 4 ext($\sim$11%)	$\sim$100-115
Florisbad	'early' H.s.	-	>1280?	E.S.A. $\gtrsim$'Fauresmith'	$\lesssim$24 sp. 6-8 ext($\sim$29%)	$\gtrsim$160 <400-500
Omo I II	'early' H.s.	-	$\gtrsim$1435 1435	? Levallois fl.	-	$\gtrsim$130
Swanscombe	'early' H.s.	F	1275	E.S.A. Acheulian	Hoxnian >eGi <HoIIc	$\sim$300-350
Steinheim	'early' H.s.	F	1170	E.S.A. Acheulian?	Holsteinian Late ?	$\sim$300-350
Elandsfontein	'terminal' H.e.	M	1225	E.S.A. Acheulian	$\sim$45 sp. 21 ext($\sim$47%)	>160 $\sim$400-500
Kabwe	'terminal' H.e.	M	1280	E.S.A. $\gtrsim$Charaman	$\sim$24 sp. 5 ext ($\sim$21%)	>160 $\sim$400-500

P.T.O.

Table 7. Abbreviations.

H.s. = *Homo sapiens*; H.e. = Homo erectus; Fl. = flakes; L = large; Sp. = species; Ext. = extinct; Est. = estimated.

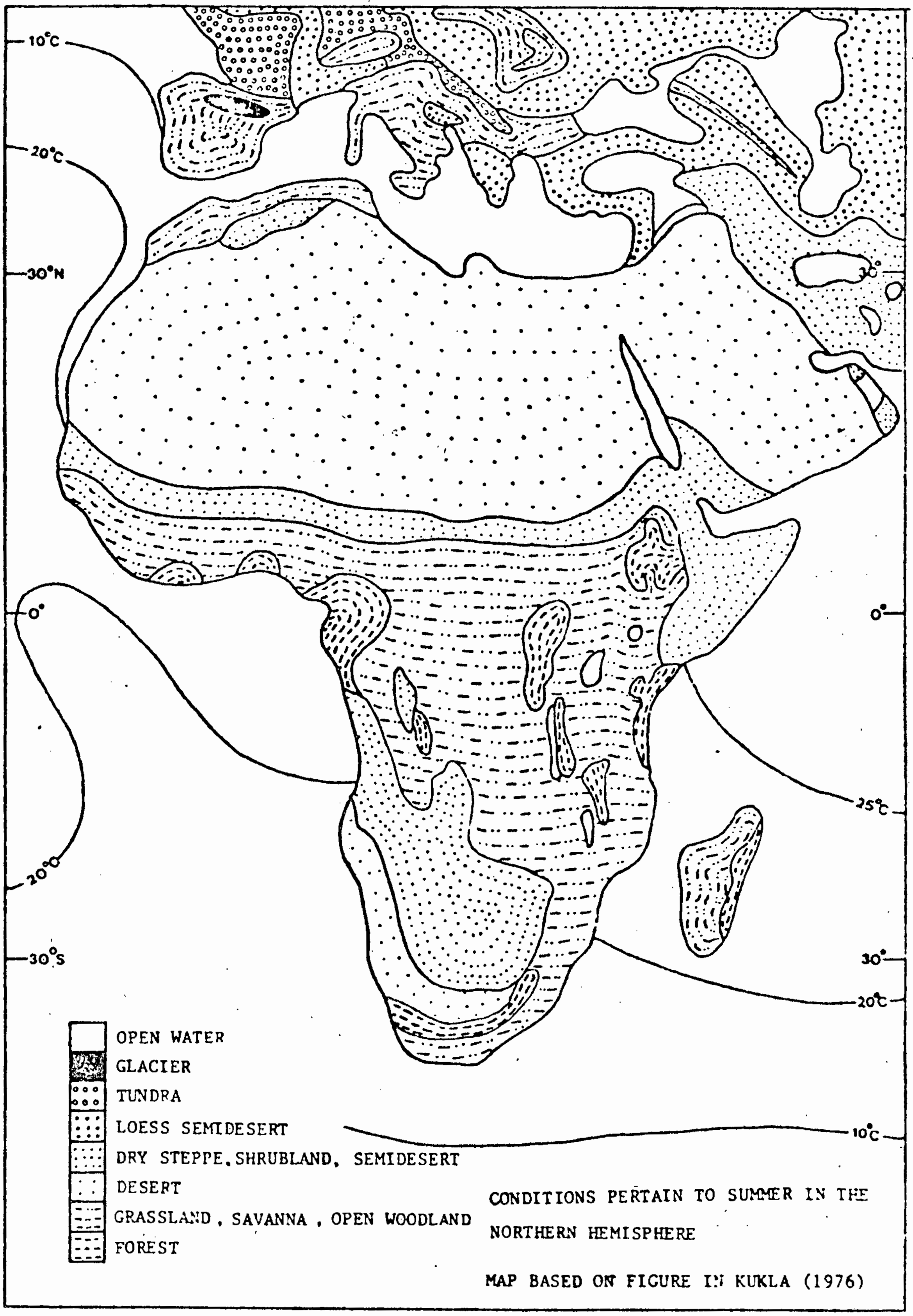
$\geq$ = Remains coeval/same or older/more than; $\leq$ = Remains coeval/same or younger/less than.

lines as a result of the north-south environmental barrier formed by the Sahara (Beaumont, n.d.), which was apparently even more arid and extensive than today during most of the past ~300 Kyrs. (Shackleton and Opdyke, 1973; Kukla, 1976) (Fig. 95).

(b) That data amassed during the past decade concerning climatic fluctuations during the earlier Upper Pleistocene would seem to permit of broad assessments as to when a.m.H.s. diasporas beyond their sub-Saharan confines are most likely to have occurred then. On this basis a northward expansion would have been most possible during the sometimes hypsithermal $\delta^{18}O$ substage 5e (Turner, 1975: 293), and it is perhaps not coincidence that occurrences reminiscent of the 'Lower Pietersburg' are linked to moister conditions in the central Sahara (Clark *et al.*, 1973), or that Amudian/'Pre-Aurignacian' aggregates which compare roughly with M.S.A.1 in age and typology (Sampson, 1972:166), are concentrated at and near the only then extant land exist from Africa (Vogel and Beaumont, 1972:51). Conversely, a dramatic reduction of sea-water barriers during early stadials of the Last Glacial (Kukla, 1976) may have facilitated eastward extrusions at those times into the congenial ecosystems of intertropical Australasia, as is suggested by the reading of 41,720 ± 1000 B.P. (GrN-1338)(de Vries and Waterbolk, 1958; Vogel and Waterbolk, 1963:164) for the *in situ* adolscent a.m.H.s. from the Niah Cave in Sarawak (Howells, 1974:31), perhaps associated with cf. Middle Soan/Indian M.S.A. (de Vries and Waterbolk, 1958; Oakley, 1969).

(c) That the presence of various distinctive elements (e.g. chamfered blades) in Early Dabban contexts dating back to between 40,500 ± 1,600 B.P. (GrN - 3260)(McBurney, 1960; Vogel and Waterbolk, 1963) and 43,400 ± 1,300 B.P. (GrN - 2564)(de Vries and Waterbolk, 1958; McBurney, 1967), prior to the first proven appearance of those forms (Vogel, 1971; Bien and Pandolfi, 1972) in the acculturated Emiran culture of Israel and Lebanon (McBurney, 1967; Azouy and Hodson, 1973), suggests the direction from a final and major wave of a.m.H.s. peoples intruded into the Levant at the onset of the Hengelo (McBurney, 1967; Oakley, 1969). If this is so, then the measurements of 39,700 ± 800 B.P. (GrN - 2534) and 41,000 ± 1,000 B.P. (GrN - 2561) for the Upper Levalloiso-Mousterian at Tabūn and Kebereh (Vogel and Waterbolk, 1963), would raise the possibility of a brief 'Early L.S.A.'/Middle Palaeolithic overlap in areas

FIG. 95 AFRICA 18000 YEARS AGO



immediately east of Suez. 'Transitional' hominids ranging from Tabūn C1 to Skhūl 5, with absolute age of 40,900 ± 1,000 B.P. (GrN - 2729) (Vogel and Waterbolk, 1963) and ~38,000 B.P. (Higgs, 1961; Oakley, 1969), may thus represent the result of absorption and replacement during and after that interlude, which would then imply that the interacting 'pure' populations there differed only at the subspecific level (Thoma, 1965; Howells, 1967:255).

(d) That there appears to be, despite relatively good samples, no significant evidence for crossing between 'classic' Neanderthals and immigrant Cro-Magnon and Combe-Capelle peoples (Stringer, 1974), despite compelling radiocarbon support for major regional overlaps between them in western Europe (Vogel, n.d.), as exemplified by the reading of 29,500 ± 1,400 B.P. (Ly - 366) for a very evolved Late Mousterian site in the Juras (Evin, et al, 1973). This fact can be construed to mean that the differences between those two stocks had reached species status during their protracted separation (Fig. 94), and that evaluation could claim as support the morphological signs of progressive environmental adaptation or functional specialization (Stringer, 1974:327), which the 'classic' Neanderthals show prior to their eventual average extinction date of ~34 Kyrs. B.P. (Vogel, 1971). However, it is here considered more probable that this lack of genetic interchange is an indication of the more extreme physical, numerical and cultural contrasts prevalent there and then between intruder and indigene, relative to the balance which existed between those factors some six millennia earlier in Judea (Howells, 1967:255;Beaumont, n.d.).

(e) That our major findings could possibly have been anticipated in terms of data presented by Bourliere in 1961 (1963). In that paper he showed that game ungulate biomass values differ enormously amongst various vegetation regimes, as indicated by estimates of ~1-1000 kg per sq. km. for desert, steppe, forest, and tundra, as compared to ~4,400-31,000 kg. per sq. km. for savannas (s.1). On that basis he deduced that the last-mentioned veld type must have always constituted a 'preferred zone', which provided desirable 'optimal habitats' at times when man was entirely a hunter and gatherer (Beaumont and Vogel, 1972:162). This biological exhuberance subsequently militated against the early or complete adoption of plant and animal domesticants and concomitant cultural practices south of the Equator, a deficiency which was misconstrued and extrapolated by researches 'enchanted with Europe and the Near East' (Howells, 1967:282) to mean that the subcontinent had been a palaeoanthropological 'cul-de-sac' during the entire Upper Pleistocene (Beaumont et al., n.d.).

(f) We conclude that much still needs to be done to amplify these present findings, which are but a first step in the exploration of the hitherto unperceived primary and formative phases in the physical and cultural evolution of our own species, which took place largely or entirely on the stretching game-rich savanna landscapes of sub-Saharan Africa (Beaumont and Vogel, 1972:162). It was on this 'satisfying and hospitable hearth' that the emergence of modern man took place at a modest evolutionary pace (Howells, 1974:33), rather than during some morphological and technological quantum leap in the Levant subsequent to ~45 Kyrs. B.P. (Howell et al.,1966:126-127: Isaac,1922:398).

7.7 Demography

The authors excavations confirmed the occupation of Border Cave by stone age people on occasions between ~30 and ~130 Kyrs. B.P., but provided no tangible additional data bearing on population parameters during the M.S.A. and 'Early L.S.A.' In fact, it would seem that direct skeletal evidence relating to human numbers in and at a given region and time prior to the Holocene is unlikely to ever prove entirely satisfactory because of one or both of the following factors :

(a) The very low incidence in most habitable regions of even moderately good bone preservation.

(b) The limit to precise temporal resolution ultimately imposed by the statistical uncertainty of isotopic readings.

We may, despite this deduction, obtain some present crude conception of the magnitudes involved by way of the following lines of enquiry :

(a) Estimates of the probable world population immediately prior to the Neolithic onset at an arbitrary 10 Kyrs. B.P. range between ~5 and ~10 M with a median value of ~8 M (Coale, 1974:42-43). This figure would represent the maximum number applicable to $\delta^{18}O$ stage 5e, in view of evidence for relatively more competent hominid predatory patterns in the L.S.A./Upper Palaeolithic (Mellars, 1973; Klein, 1975), if we accept the postulate that population size is a variable dependent on changes in technological efficiency (e.g. Childe, 1936 and 1950).

(b) A rather novel approach begins with a consideration of world population trends since A.D. 1650 (Carr-Saunders, 1936), bearing in mind that the earlier estimates have an uncertainty of ~20% (Coale, 1974:41). Analysis by G. Baker and the author (Anon., 1976) of this data in terms of doubling times have revealed a marked straight-line relationship (Fig. 96). The formula defining

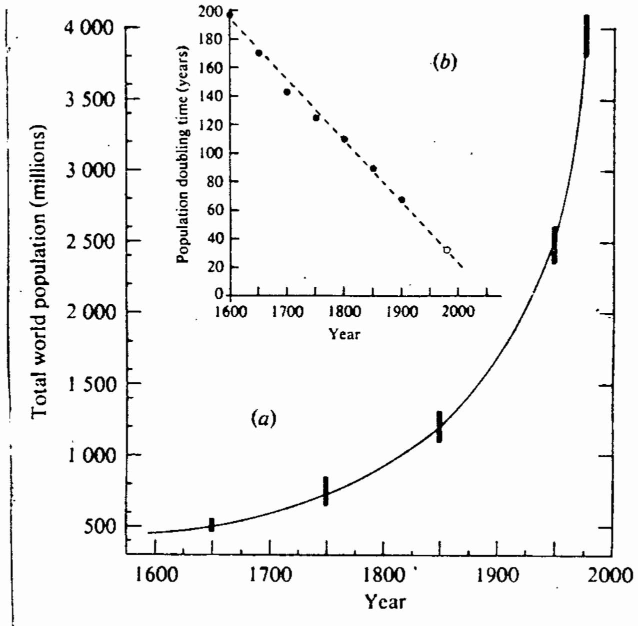


Fig. 96. Trends in world population since A.D. 1650.

(a) Bars encompass the spread in the various estimates.

(b) Temporal shifts in doubling time derive from curve (a).

From EDITOR. 1976. Food production and agriculture : recent world trends. S. Afr. J. Sci., 72, 66-68.

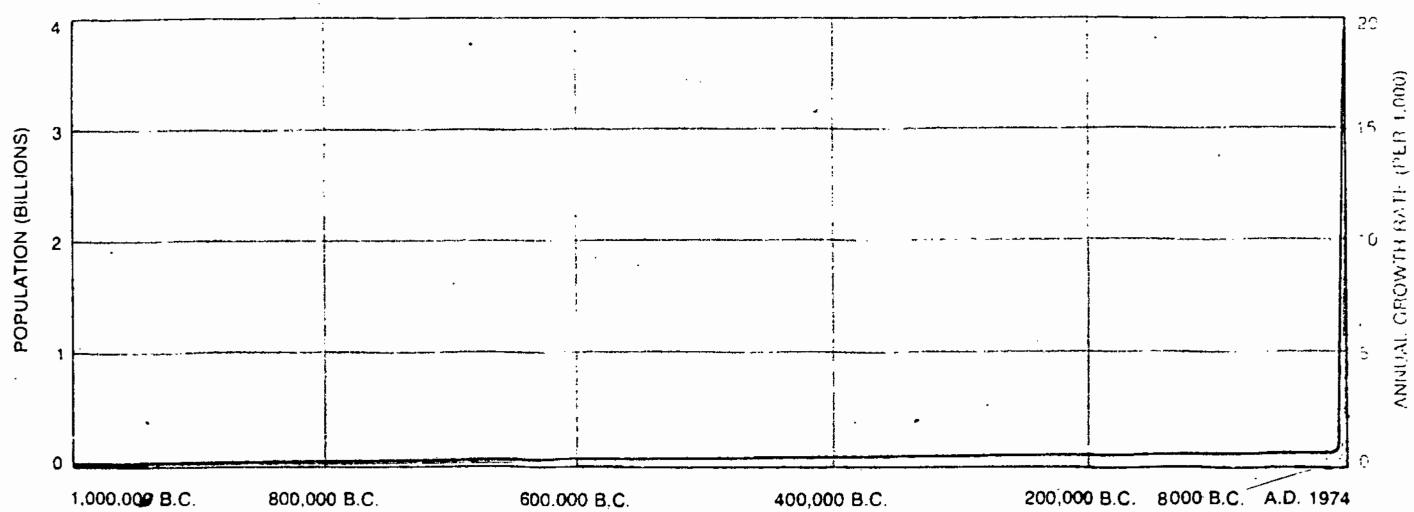


Fig. 97. Overview of human numbers during the past million years. From A.J. Coale. 1974. The history of the human population. Scient. Am., 231 (3), 41-51.

this super-exponential pattern was found to be not dissimilar to one previously derived on theoretical grounds, namely $N = 1,79 \times 10^{11}/(2026,87-t)^{.99}$, where N = world population and t = time in years A.D. (von Foerster et al., 1960; Serrin, 1975).

Four implications of (b) are :

(a) That an infinite world population will be reached, assuming no change in the growth rate, and overlooking the ultimate limits imposed by female physiology, within 60 yrs ie. between A.D. ~2027 and ~2040 (Serrin, 1975; (Anon., 1976).

(b) That world grain reserves have fallen from ~105 days in 1960 to ~30 days in 1976, with a zero value being anticipated within the next decade (Anon., 1976). At that point an 'overshoot' situation is likely to develop, before population begins to fall to some unknown extent, prior to eventual concordance with the food supply (Beaumont, unpub.).

(c) That the world population at 10 Kyrs. B.P. was ~11 M. This estimate lies just outside the range cited by Coale (1974:43), and may be regarded as strong support for the contention that human numbers have followed a consistent growth pattern throughout the Holocene (Beaumont, unpub.).

(d) That the world population at 100 Kyrs. B.P. was ~0,7 M. This estimate appears incredibly low to the modern mind, accustomed as it is to the abnormal present circumstances shown in Fig.97, but is actually no more so than the figure of ~3,8 M recorded for England as recently as A.D. 1348 (Langer, 1964:115).

We conclude that all available evidence points to a world population at the end of M.S.A.1 times of 1?/<12 M. Any increased resolution in this respect may depend on the extent to which artefact absolute efficiency change rates (7.5) can be shown to correlate with the formula of von Foerster et al (1960).

It has been shown that population density is very highly correlated with food resource abundance (e.g. Birdsell, 1953), and on that basis it would seem unlikely that human numbers 100 Kyrs. ago as deduced above in (d) would have been evenly distributed throughout the Old World in view of the following considerations :

(a) That the plant-based component of human diet in recent hunter-gatherer communities appears to range between values of ~10-20% in the arctic and sub-arctic to ~50% or more in warm temperate and tropical regions (Isaac, 1971:279).

(b) That modern ungulate biomass values range from ~1-1000 kgs. per sq. km. for desert, steppe, forest, and tundra to ~4,400-31,000 kgs. per sq. km. for the savannas (s.l.) (Bourliere, 1963).

If (a) and (b) are reasonably reliable evaluations, then it would seem to follow that food resources in earlier times were at a peak in savanna areas, perhaps to an extent of >4 x higher than other ecosystems, on the basis of the quantitative faunal data (Bourlière, 1963). The clear implication, in view of the distribution of savannas in the Old World, is that possibly 50% of the worlds population in M.S.A.1 times was confined to sub-Saharan Africa (Fig. 95).

Additional inferences which can be drawn from the above findings as a whole are :

(a) That man is unlikely to have had a significant impact on his surrounding fauna in the Lower and Middle Pleistocene.

(b) That it was probably only at the onset of Holocene times that population became large enough to begin affecting game numbers adversely.

(c) That bovid extinctions tended in subsequent times to be most marked in areas where biomass values were always inherently low.

M.S.A. hominid remains are at present far too few to produce any remotely viable data as to possible mean longevity at that time (Appendices 28, 30, 32). However, it is considered unlikely that the evidence which may eventually arise in that connection will differ markedly from values which have been obtained for pre-modern samples from elsewhere in the Old World. A major problem in evaluating the latter information is that the child samples are almost always biased, with the young infants being especially underrepresented, at least partly as a result of their relative friability (Brothwell, 1972). The practice in such cases has been to limit ageing to the adults, which are variously defined as those individuals older than ~15/19 yrs. (Angel, 1972; Brothwell, 1972). The lifespans deduced for those samples clearly represent a maximum possible mean age, in view of the ~40-50% juvenile mortality rates documented for all known early populations (e.g. Angel, 1972: 94 and 95).

Some pertinent values based on skeletal remains are :

(a) Overall life expectancy (male and female) (Brothwell, 1972:86) :

I.	British Medieval (Wharram Percy)	: 18,7 yrs.
II.	British Dark Ages (Cannington)	: 18,7 yrs.

(b) 'Adult' life expectancy (females only)(Angel, 1972; Brothwell, 1972):

I.	British Medieval (Wharram Percy)	:	31,3 yrs.
II.	British Dark Ages (Cannington)	:	31,3 yrs.
III.	Greek Early Iron Age (~1,150 B.C.)	:	30,4 yrs.
IV.	British Iron Age ?	:	29,9 yrs.
V.	Greek + Early Bronze Age (~3,000 B.C.)	:	29,6 yrs.
VI.	British Bronze Age	:	29,9 yrs.
VII.	Greek + Early Neolithic (~6,800 B.C.)	:	29,8 yrs.
VIII.	British Neolithic ?	:	28,3 yrs.
IX.	European Mesolithic (~9,000 B.C.)	:	24,9 yrs.
X.	European U. Palaeolithic (~25,000 B.C.)	:	28,7 yrs.

It is evident that the 'adult' female values do not vary much with time and have a mean of ~30 yrs., which may also be regarded as a possible maximum reading with respect to terminal M.S.A.1. From this it follows that overall female life expectancy ~100 Kyrs. ago is unlikely to have been higher than ~20 ± 2 yrs., in view of the ~12,5 yr. difference between the overall and 'adult' values evident in (a) and (b) I and II. (Brothwell, 1972: 83 and 86). Additional demographic data concerning Last Interglacial women which may then be deduced in terms of that average lifespan is (Fig. 98) :

(a) That only about a third of them reached childbearing age.

(b) That the survivors bore a mean number of 6,5 children.

7.8 Social Structure

We regard the following structural features as 'most possible' in stone age times, by analogy with modern hunter-gatherers living in a heterogeneous environment :

(a) Families are seen as nearly independant and uncorrelated subsistence units (Yellen and Harpending, 1972; Dumond, 1975).

(b) Bands are seen as temporally unstable aggregates of families utilizing the same area and linked by kinship and friendship (Yellen and Harpending, 1972; H.J. Heinz, pers. comm.).

(c) Density is seen as having been too low to generate viable political structures of any permanency (Trigger, 1974).

(d) Nucleation is seen as having been minimal, with gene flow over wide areas, as is perhaps evidenced by the similarity of B.C.1 and Tuinplaas (Yellen and Harpending, 1972; Appendix 28).

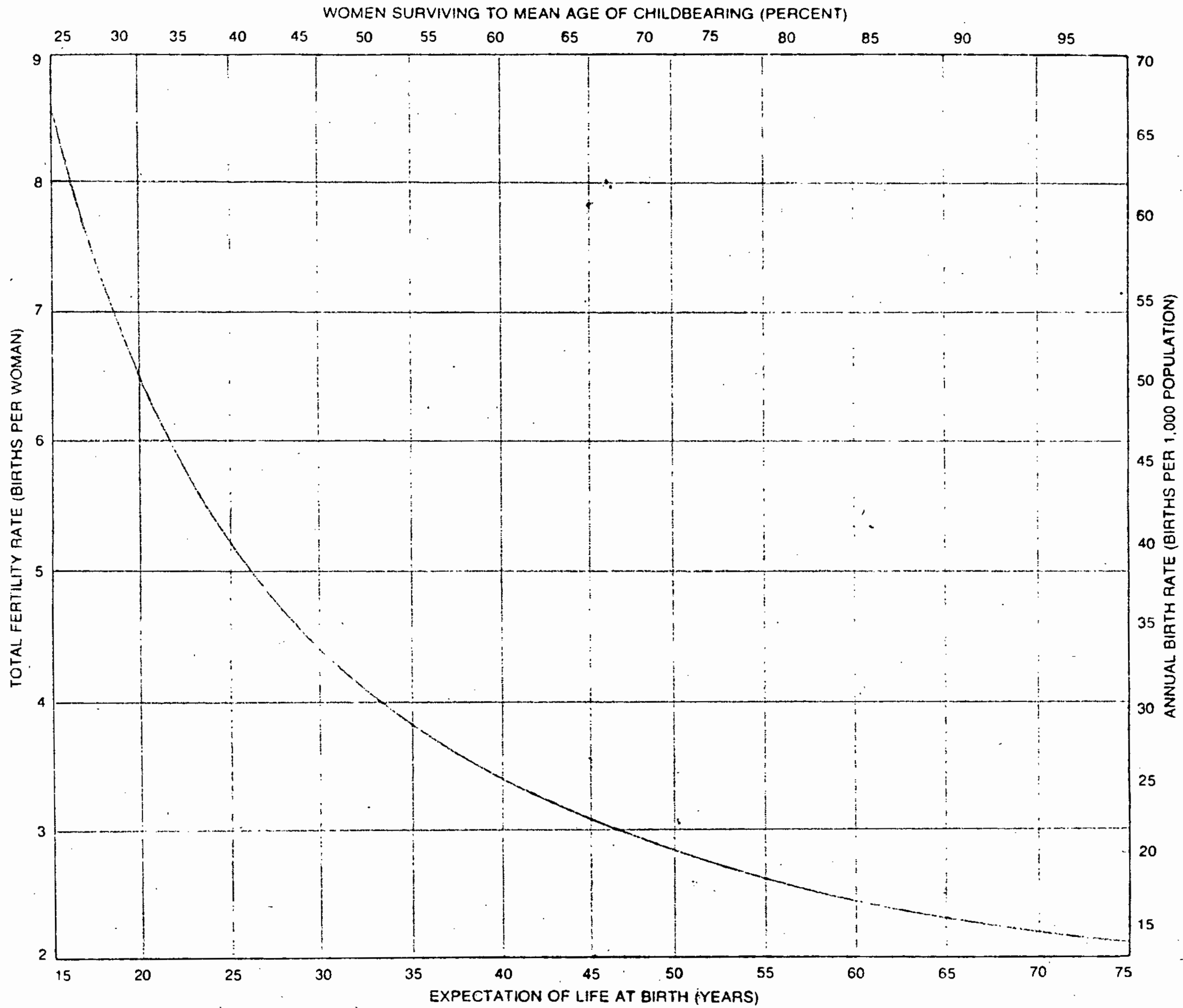


Fig. 98. Demographic relationships which pertain when population growth is zero. From A.J. Coale. 1974. The history of the human population. <u>Scient. Am.</u>, <u>231</u>. (3), 41-51.

Of some interest is the evidence that the 'adult' female/male age proportion is ~80-90% in almost all known populations prior to the present century (Angel, 1972; Brothwell, 1972). This difference in lifespans could perhaps reflect in part on a relatively heavy female work load (Dumond, 1975), which exerted 'tangible pressure, operating on women at an individual level' (Hayden, 1972:213). Such an interpretation may then imply that male dominance and the sexual division of labour were norms which range back to at least the Upper Palaeolithic (Angel, 1972:95).

8. CONCLUSIONS

Major conclusions emanating from the 1970 and later investigations at Border Cave are :

(a) That the cave was utilized subsequent to ~A.D. 1350 as a temporary refuge and/or food cache locality by Late IA peoples who made unincised black-burnished pottery which is not dissimilar to modern Swazi wares (2.5). This assessment would appear to be in good accord with tribal traditions which trace the birth of the Swazi nation back to the time when Dlamini 1 settled below the Lebombo Mountains in ~A.D. 1500 (7.1.).

(b) That amorphous aggregates with a maximum age of ~38/45? Kyrs. B.P. fall within a revised typological definition of the 'Early L.S.A.' (6.1.1). Formal stone tools are extremely rare and confined to scrapers, while geometric microliths are seemingly entirely absent (Appendix 7). Detachment was preponderantly by way of the bipolar technique and small scaled pieces are particularly distinctive ($L\bar{x}$ = ~13 mm). Closely comparable material dating back to >40,700 B.P. (GrN-7246) has recently been described from Matupi Cave in northern Zaïre (van Noten, 1977).

(c) That new data have during the past decade displaced the temporal range of the M.S.A. from an original ~10-40 Kyrs. B.P. to the presently proposed >49 (~60)->125 (~160) Kyrs. B.P. (6.3 and 7.4). One implication of this latest revision is that the M.S.A. came to an end at least ~15 Kyrs. and possibly ~25 Kyrs. prior to the Mousterian termination at ~34 Kyrs. B.P. in Western Europe. (Vogel, 1971).

(d) That the exceptional M.S.A. sequence revealed at Border Cave can, on the basis of formal tool frequencies (2.6.1.), be subdivided into only three well-defined typological entities, which have the following approximate temporal spans (6.3.1) :

I. M.S.A.1. ~100-125 Kyrs. B.P. Equates with the Pietersburg units of Cooke <u>et al</u>. (1945).

II. M.S.A.2. ~80-100 Kyrs. B.P. Equates with the 'Epi-Pietersburg' of Malan (1949a).

III. M.S.A.3. ~60-80 Kyrs. B.P. Equates with the 'Post-Howieson's Poort' of Sampson (1972).

(e) That the technological metamorphosis which the M.S.A. underwent during that time would seem to provide the link between the discrete

Middle and Upper Palaeolithic traditions which occur in other regions of the Old World, as is evidenced by the presence within it of punched blades, simple burins, bored stones and other ground items; Emireh and Emireh-type points, and Châtelperonian or Abri Audi-like knives (7.3).

(f) That these developments in tool-making were accompanied by the advent of advanced economic, ethical, and aesthetic systems as revealed by: the ritual interment of Border Cave 3; the systematic mining of specular haematite at Lion Cavern, Ngwenya; personal ornamentation in the form of ochre and perforated seashells; symbolic notched 'signs' on bones and sticks; and the intensive exploitation of marine resources (7.3).

(g) That it is now patent that the population succession in sub-Saharan Africa is devoid of any tangible evidence for Neanderthals or Neanderthaloids. Recent studies would rather suggest (7.6) :

I. That Florisbad and Omo are 'early' H. sapiens forms which have no clear analogues elsewhere in the Old World and a minimum age of ~115 Kyrs. B.P.

II. That Kabwe and Elandsfontein probably lie close to the sapiens-erectus interface, with a most possible antiquity of ~400-500 Kyrs. B.P.

(h) That peoples of a.m.H.s. morphology already occupied Southern Africa by at least ~100 Kyrs. B.P., as is most clearly shown by in situ finds in M.S.A. contexts at Border Cave, Tuinplaas Quarry, and Klasies River Mouth (7.6). It follows from this evidence that the emergence of modern man could not have taken place according to the widely accepted Preneanderthal model (Howells, 1967:282).

(i) That present evidence from the western portion of the Old World would seem to be best interpreted in terms of a Presapiens scheme, in which the a.m.H.s. donor area is seen as having been sub-Saharan Africa, where game-rich savannes provided an optimal habitat for early man (7.6). According to this scenario a widely dispersed population of Steinheim/Swanscombe type gradually segregated into two lineages as a result of the north-south genetic barrier formed by the Sahara (Fig. 94 and 95).

(j) That a detailed morphometric analysis of dorsally prepared untrimmed flake samples from throughout the sequences at Border Cave and Heuningsneskrans Shelter suggests :

I. That our I2, B2, and P2 plan-form groupings are discrete and intentional artefact categories.

II. That the 'Early L.S.A.' and M.S.A. would seem to represent a single unbroken technological continuum.

III. That changes with time within this appear to show many of the features typical of modern systems.

(k) That unique preservation and the substantial remaining intact deposits should provide (Beaumont, 1973a:46) :

I. Further data regarding for what purpose and to what extent the cave occupants made use of their floral surroundings between ~0 and 80 Kyrs. B.P.

II. Further human remains bearing on the hitherto unperceived and crucial formative phases in the physical evolution of our own species.

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