LITHIC OCCURRENCES AND STRATIGRAPHIC PROBLEMS AT TURTLE ROCK (HERVEY RANGE), NORTH QUEENSLAND

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INTRODUCTION

This paper looks at a number of aspects of the knapping or reduction sequences represented amongst the substantial quantities of lithic material which were collected during three successive excavation campaigns from 1977 to 1979 at Turtle Rock (Hervey Range), North Queensland. It presents the first detailed description of this material, and it also considers the principal stratigraphic problems encountered during those and subsequent excavation campaigns in 1981 and 1983, at least as far as these problems might effect attempts at understanding the site's lithic occurrences and at reconstructing their associated human behaviours. Preliminary accounts of work on Turtle Rock have appeared in Campbell (1978a, 1982a, 1982b, 1984), Campbell et al. (1982), Coventry et al. (1980) and Mardaga-Campbell et al. (1982). The excavations themselves were carried out mainly as third-year undergraduate student training exercises.

FIELD METHODS

The location of Turtle Rock is shown in Figure 1 in relation to local topography and to other archaeological sites now known in the vicinity. Both site catchment analyses and systematic excavations have been carried out at Turtle Rock. The two hours' walking limit from Turtle Rock for its site catchment is also shown in Figure 1; this assumes that the site may have acted at times as a base camp (cf. Jarman 1972; Roper 1979), which is something one cannot be certain about but which may have been true at times, judging from the quantities of material and the occurrence of more than one well made hearth (see below). An earlier description of the field methods employed in our studies was given in Campbell (1978a). This present paper is primarily concerned with the results of the excavations, though it also addresses the issue of how the lithic material might have got to the site, whether from within the hypothetical site catchment or from beyond.

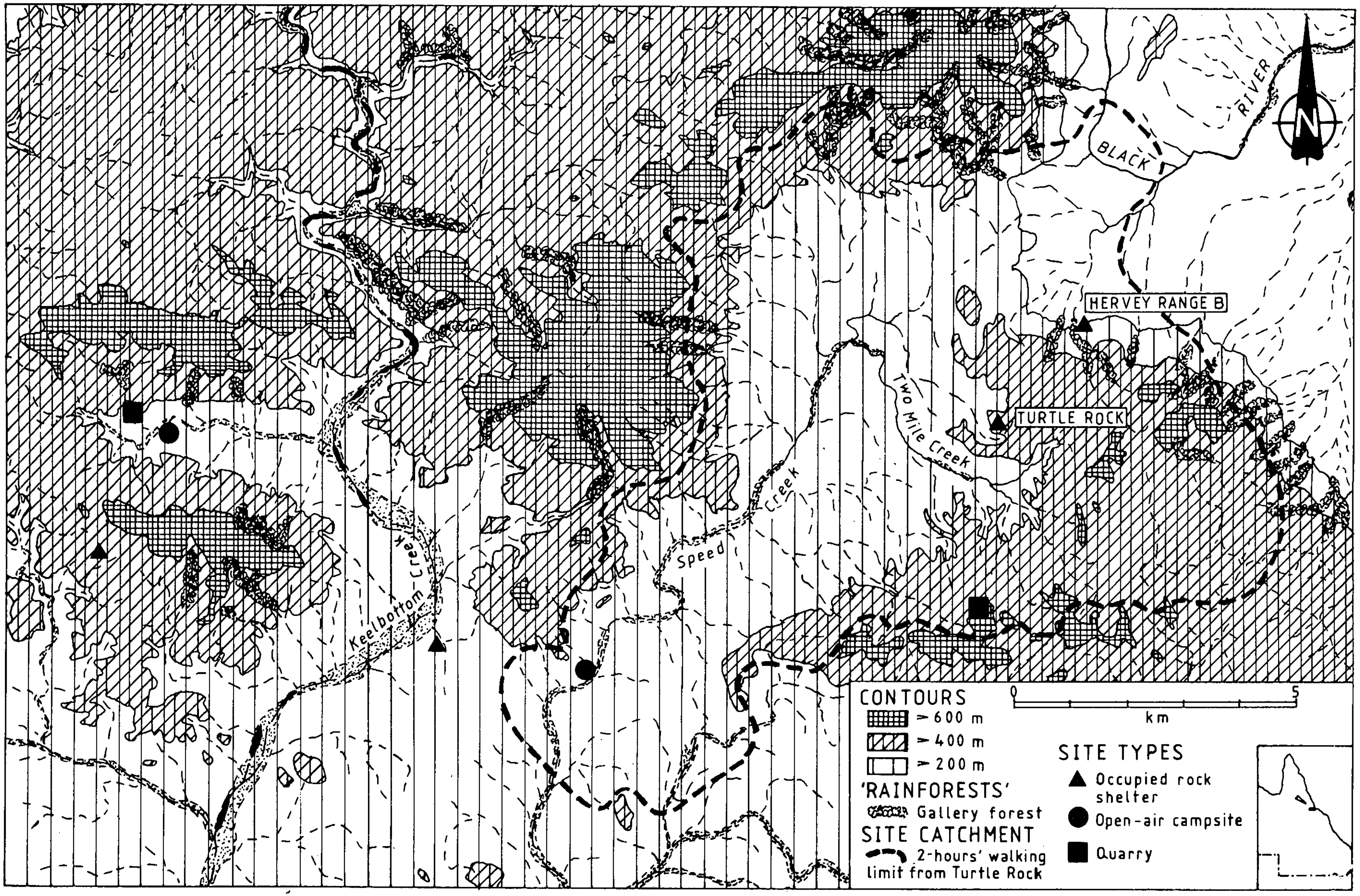

Figure 1. Map of Turtle Rock showing site catchment in relation to local topography and neighboring archaeological sites.

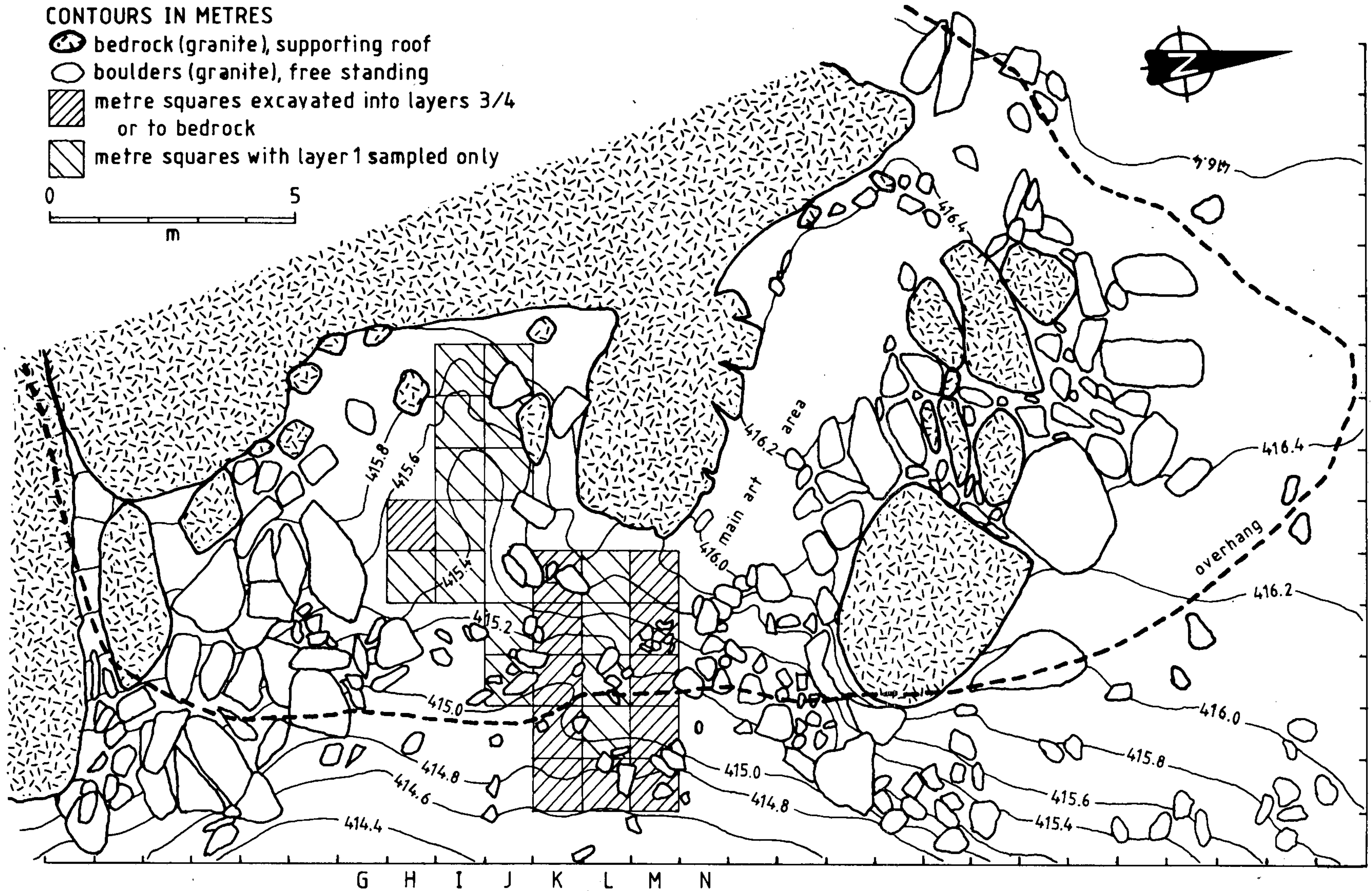

Figure 2. Plan of Turtle Rock and floor area sampled.

A plan of the site and the excavations is shown in Figure 2. The floor contours shown are at intervals of 0.2m. Elevation readings were tied in with a local benchmark. Complete surface sampling and excavation of the loose surface deposits, which we termed 'layer 1', was carried out within the shaded gridded area marked on the plan. Two main trenches (K and M) were selected and excavated parallel to each other and running from inside to outside the shelter. These were positioned in an area which was already suffering sheet erosion and disturbance by cattle and horses, but which it was assumed might have been a central area of human activity in the past. The sides of the shelter's floor were covered with more boulders and vegetation than the central entrance area and this cover seemed to be protecting less disturbed deposits which it was felt would be better left undisturbed. In order to try to solve some stratigraphic problems which arose in 1979 and 1981, a connecting square (L17) was excavated between the main trenches in 1983. The sounding which was excavated in square H12 in 1978 revealed two burials (one a primary flexed burial of an adolescent male and the other a secondary bundle burial of a large adult). These were left in place, but they were unfortunately subsequently disturbed, damaged and partly removed by vandals. Hints of other burials were found when sampling the surface of adjacent squares. No further excavation was undertaken in the burial area and no further vandalism has occurred.

After the loose surface layer, which was normally less than 5cm thick, had been removed, the underlying deposits of the main trenches were excavated by 5cm spits numbered from the top down. Sedimentary changes or layers were recorded and also numbered from the top down. The precise positions of all finds larger than 1cm (greatest dimension), whether on the surface of the area sampled or found below in the excavation itself, were recorded in three dimensions. They were each bagged separately. Despite the obvious disturbance of about half of the surface of the site, this detailed recording was done both as a student exercise and to allow possible reconstructions of just how far finds might have been moved either recently or during Aboriginal use of the site. Finds smaller than 1cm were recovered in 2mm and 4mm mesh sieves. Plans of boulders larger than 10cm were also recorded, as were any stones which seemed to form part of a hearth.

STRATIGRAPHY AND HORIZONTAL DISTRIBUTION OF FINDS

The bedrock at Turtle Rock is granite. Poor preservation conditions for organic material in most parts of Turtle Rock probably mean that important archaeological evidence is missing for the reconstruction of a more complete picture of human behaviour and cultural-ecological change at this site, as complete as for instance at the dry limestone shelter near Chillagoe known as Walkunder Arch Cave (see Campbell et al. in press). Further, the discovery in 1978 of burials at Turtle Rock in the small proportion of the site which does have reasonable preservation conditions (at least for bone and shell material less than about 2,000 years old), has precluded extensive excavation in that area. However, abundant stone material has been preserved, as well as sufficient charcoal for radiocarbon dating, in the principal area excavated. We do not think that the fact this site has burials necessarily has anything to do with the comparatively low frequencies of animal bones and shell found in the main excavations for the five principal reasons below.

(1) The area of the main excavations is exposed to the full ravages of the local climate including heavy summer rains with occasional severe cyclones and very dry winters (i.e. bone and shell fragments would swell and contract each year, not to metion being washed or blown away), whilst the area with the burials is well protected and remains dry even in the wettest weather.

(2) The area of the main excavations slopes down out of the shelter whilst the area with the burials is flat (see below for details of actual slope).

(3) The bedrock is granite and the acid environment which it helps to create is much more severe in the main excavation area than in the burial area, even though the burials themselves lie in pits which were dug into decomposing bedrock.

(4) The function of the site itself may well have changed from a knapping and camping site (if two hearths make it a campsite) more than 3,000 years ago to having become a cemetery after ca. 2,000 years ago (see below for 14C dates).

(5) Abundant animal remains are known, in any case, to occur with human remains at other sites in the vicinity such as in the neighbouring granite rock shelter known as Hervey Range B (Brayshaw 1977) and although we have opted not to test this fully at Turtle Rock, the same would seem to be the case here.

The skewed distribution of animal bone fragments in the main excavations at Turtle Rock towards the interior of the shelter is shown diagrammatically in Figure 3 in contrast to the more central distribution of stone material and wood charcoal near the hearths and the overhang's dripline. The interior of the shelter is on the left of each histogram and the exterior on the right.

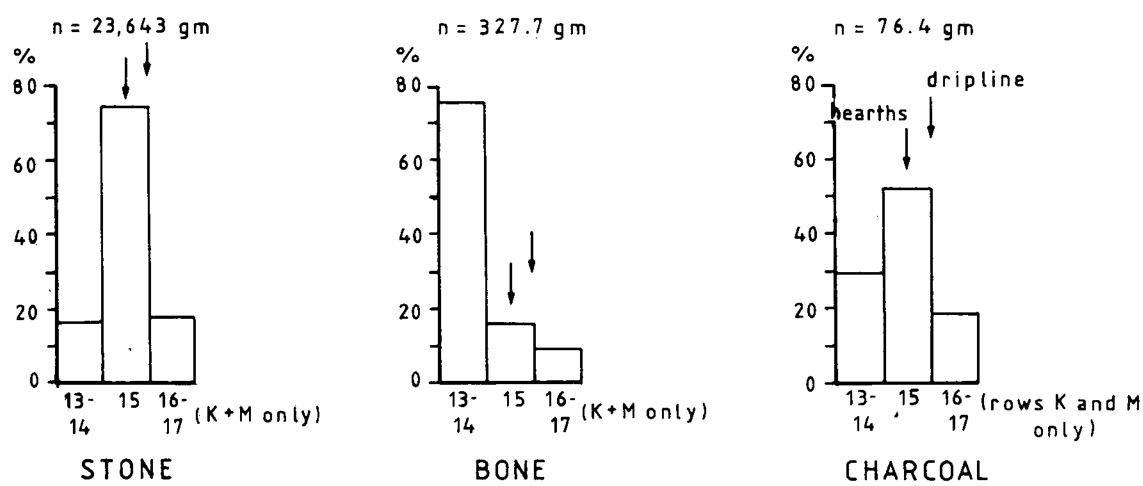

Figure 3. **Frequencies of stone artefacts and manuports, animal bone fragments and wood charcoal fragments in trenches K and M in relation to the location of hearths and overhang dripline.**

Selected sections of the main trenches are shown in Figure 4. The section along line M/N is the north face of trench M, and section J/K is a mirror image of the south face of trench K for ease of comparison with M/N. The deposits slope downwards varying angles of between 10o and 20^{o} from inside the shelter on the left to outside on the right. Essentially two stratigraphic units are present, each of which we have subdivided into two layers. Granite boulders occur in every layer except basal layer 4, which is itself mainly decomposing granite bedrock.

Layer 1 is a loose surface scatter of stone artefacts, manuports, small granite fragments and finer light reddish brown sediments (5YR 6/2) which are being derived from the underlying deposits of layer 2, as well as exposed parts of layer 3 in the interior of the shelter where layer 2 has been scuffed away in recent years by cattle and horses seeking shade or a dry spot.

Layer 2, a sandy silt, is organically the richest of any of the layers in that it has a lot of minute charcoal particles which help to give it a grey to dark brown appearance (7.5YR 7/0 - 7.5YR 4/3). Layer 2 is especially rich in stone artefacts and manuports, and it has a small amount of very fragmentary bone and shell.

Layer 3 is a coarse sand derived largely from the granite bedrock and ranging in colour from pink to reddish yellow (7.5YR 7/4 - 7.5YR 6/6), and it is fairly rich in stone artefacts and manuports, even though it has virtually no bone or shell, and very little charcoal. Layer 3f grades into layer 4, a light red very coarse granite matrix (2.5YR 6/6), which is archaeologically sterile and which is effectively bedrock.

Judging both from the nature of the deposits and the results of radiocarbon dating wood charcoal samples, it would appear either that very little sedimentation has occurred at the site or that sedimentation was rapid for a short time only, and that a number of major phases of erosion have occurred both in the prehistoric and the more recent past. Both parts of layer 3 (4110 ± 120 BP, Beta-2474) in trench K and part of overlying layer 2 (4270 ± 110 BP, SUA-1656) in trench M would appear to be about 4,000 years old, whilst part of the interface between layers 3 and 2 in trench K is only about 3,400 years old (3400 ± 90 BP, Beta-2476). Further, roughly the last 3,000 years would appear to be missing, or perhaps compressed into the top of layer 2 and surface layer 1 in this central part of the site. The loss of the last 3,000 years is probably a direct result of interference from horses and cattle. Something of those last 3,000 years, or rather the last 2,000 years, is still represented in the more sheltered area containing burials (1850 ± 110 BP, Beta-2475 on wood charcoal) which has a low ceiling and which may have seen a fundamental change in the use of the site, as has been suggested above.

Figures 5 to 7 show the horizontal distribution of finds in the central area of the shelter. This kind of plotting has long been standard practice in Europe and Africa whatever the problems of a particular site (e.g. Campbell 1977, Hahn and Owen 1985, Leakey 1971, Lumley 1969, Sampson 1968, Van Noten 1978). In fact, it would now be more normal in those continents not only to keep 3D records, but to draw the shapes of specimens whilst they are still in place and to photograph virtually everything (e.g. Franken and Veil 1983 - other authors just cited were

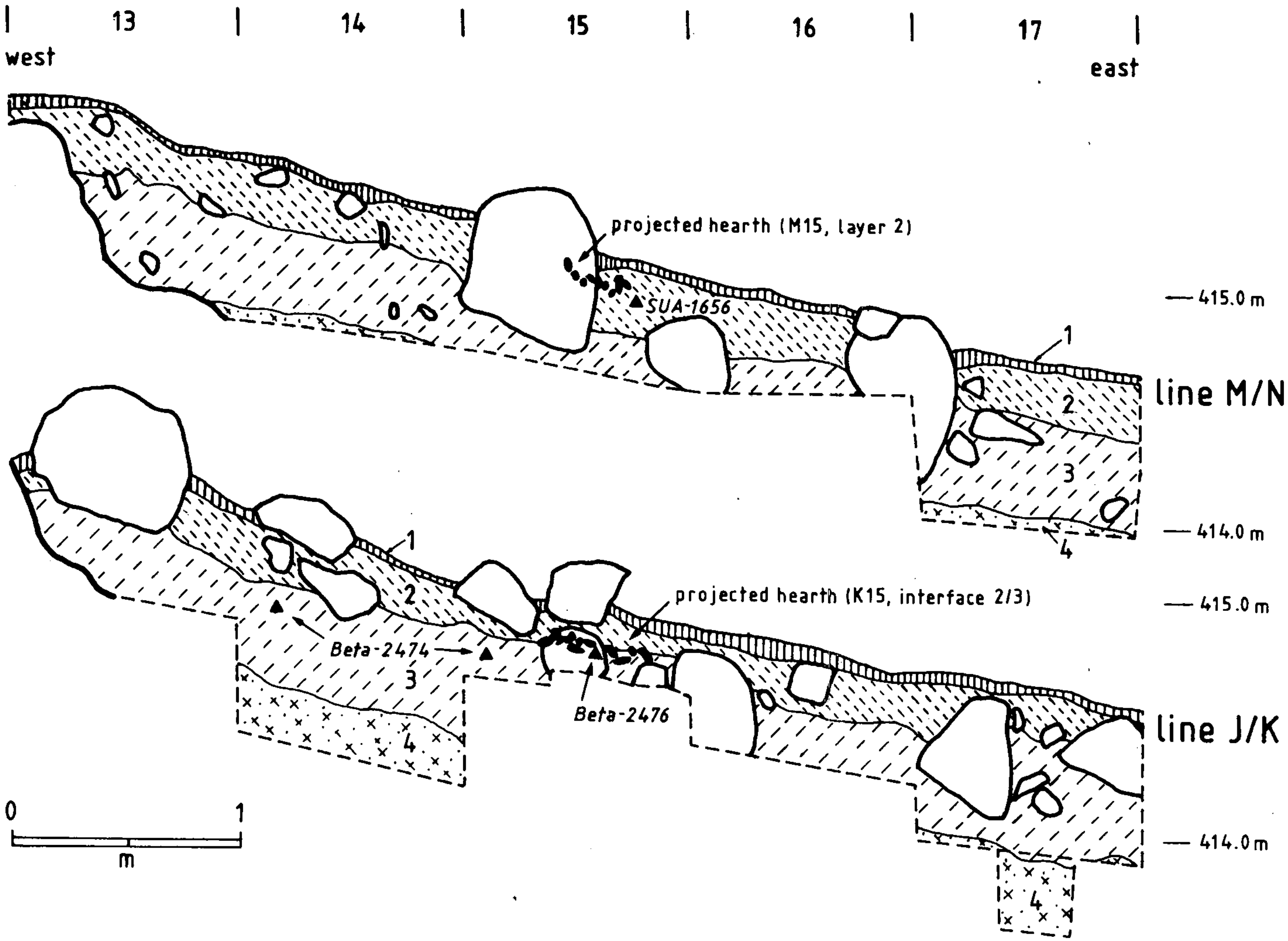

Figure 4. Sections of trenches K and M.

already doing this in selected parts of their sites). Such detailed recording salvages more information from a site which would otherwise be destroyed by excavation, and it allows propositions about human behaviour and archaeological preservation to be tested at a later date which even excavator may not have considered. We hope at a future stage, perhaps after further work at Turtle Rock, to be able to show connecting lines on our plans (Figures 5 to 7) for the refitting of reduction sequences (cf. Franken and Veil 1983, Hahn and Owen 1985). We are now keeping even more detailed records than we did at Turtle rock during our current excavations of fairly well preserved 'living-floors' at Chillagoe (Campbell 1982b, Campbell et al. in press).

Figure 5 shows the distribution of finds on the surface and in layer 1. Although its scatter of material has been disturbed by animals, there is an apparent cluster of 'implements', albeit widely spread, near the dripline which may reflect an ancient activity area. What once might have been a circular arrangement of granite boulders is also still discernible, partly encompassing some of the 'implements'. Whether this was a ceremonial stone arrangementor the base of a hut remains uncertain.

Figure 6 shows the distribution of finds in layer 2, where there is an apparent cluster of 'implements' and cores round or near the hearth in square M15. As may be seen in this plan, the unexcavated baulk (L) runs along a bedrock ridge. This granite ridge and the downward slope of the deposits from M13 to M17 might help to explain the stretched out 'rows' of 'implements' in trench M; both erosion and human activity could have displaced a once tighter cluster. Of course, such apparent 'rows' might also result from the manner in which people were sitting and dropping or tossing their artefacts.

Figure 7 shows the distribution of lithic finds in layer 3 as well as a plan of the hearth in square K15 which occurred at the interface of layers 2 and 3. Although some cores are widely scattered, there is a tight cluster of five cores with associated knapping debris in square M16. 'Implements' are both scattered and grouped into small clusters, one being in and just under the hearth in K15. The downslope 'open' end of the hearth could be the result of erosion, as could the 'rows' of 'implements' in squares K16/K17, or both could be the result of human behaviour (emptying the hearth and dropping and/or tossing 'implements' after use). Again, the bedrock ridge under the baulk (L) could have influenced the variable patterns of human spatial behaviour at the time of occupation as well as on later erosion and ultimate preservation.

As for traces of 'living-floors', one could argue that at least the areas with hearths and the deposits around them represent remnants of so-called 'living-floors', i.e. buried actual occupation surfaces in primary context with a litter of debris from various human activities. However, the concept of 'living-floor' has not been widely tested in Australia, though at least a few authors are doing so (e.g. Shawcross and Kaye 1980:120, Campbell et al. in press, and present PhD research by Mardaga-Campbell in the Chillagoe district). The concept is widely applied overseas in Palaeolithic studies (e.g. Bosinski 1979, Franken and Veil 1983, Isaac 1981, Leakey 1971, Leroi-Gourhan and Brezillon 1972, Lumley 1969), although some ethnoarchaeologists in particular are sceptical of the validity of this concept, or rather its implications in terms of specific activity areas (e.g. Yellen 1977:85, 96-97).

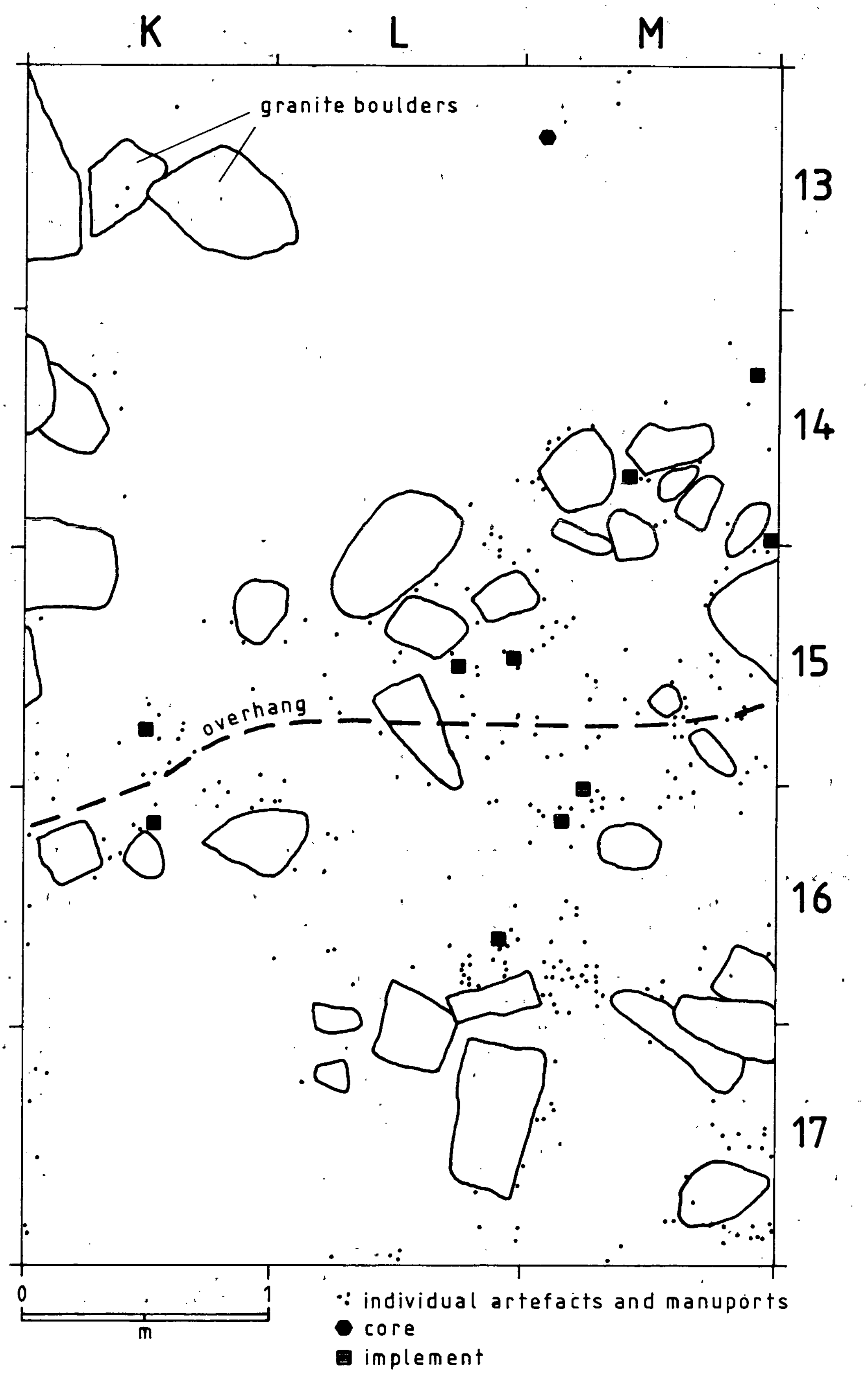

Figure 5. Horizontal distribution of lithic finds on the surface and in layer 1.

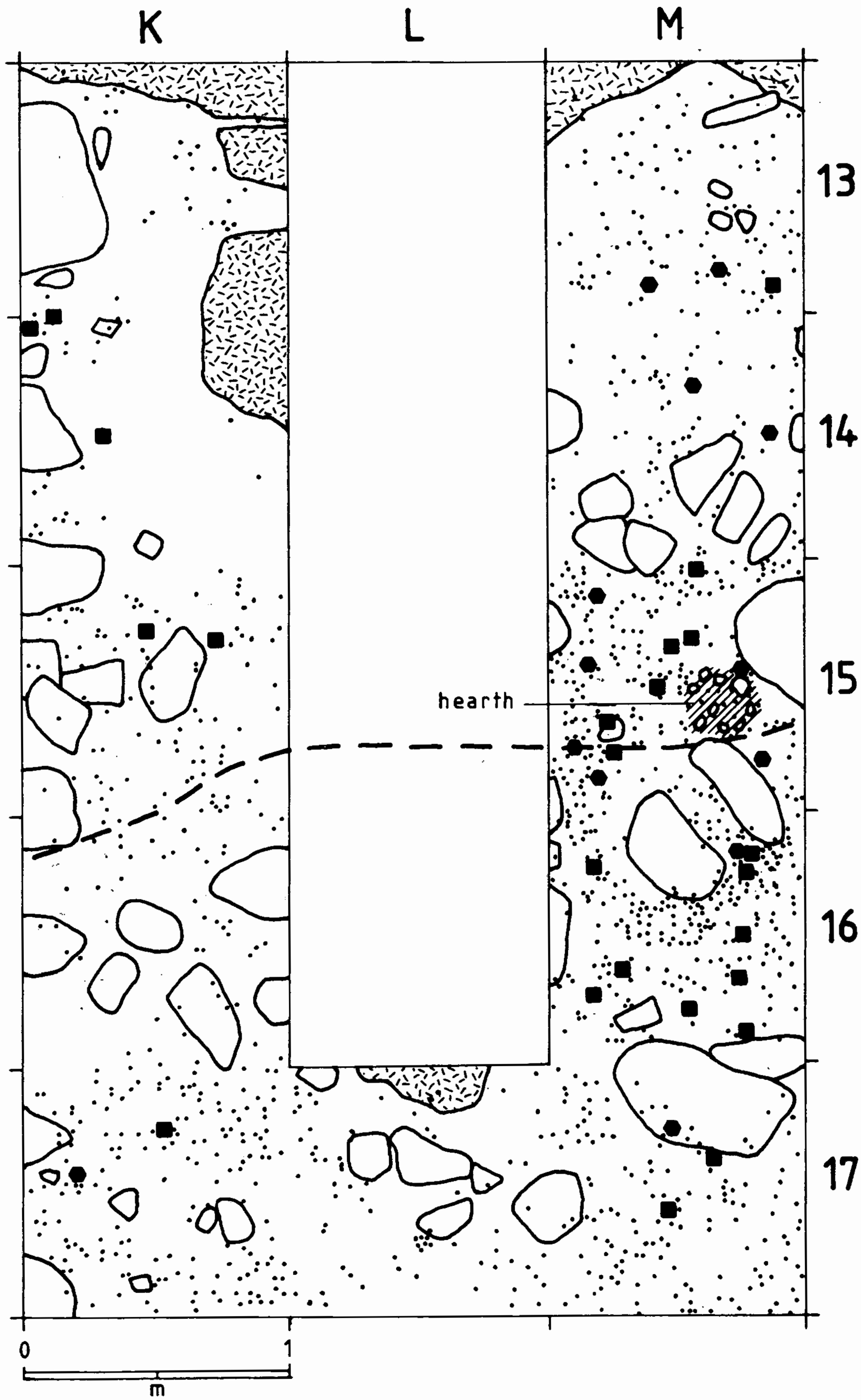

Figure 6. Horizontal distribution of lithic finds in layer 2.

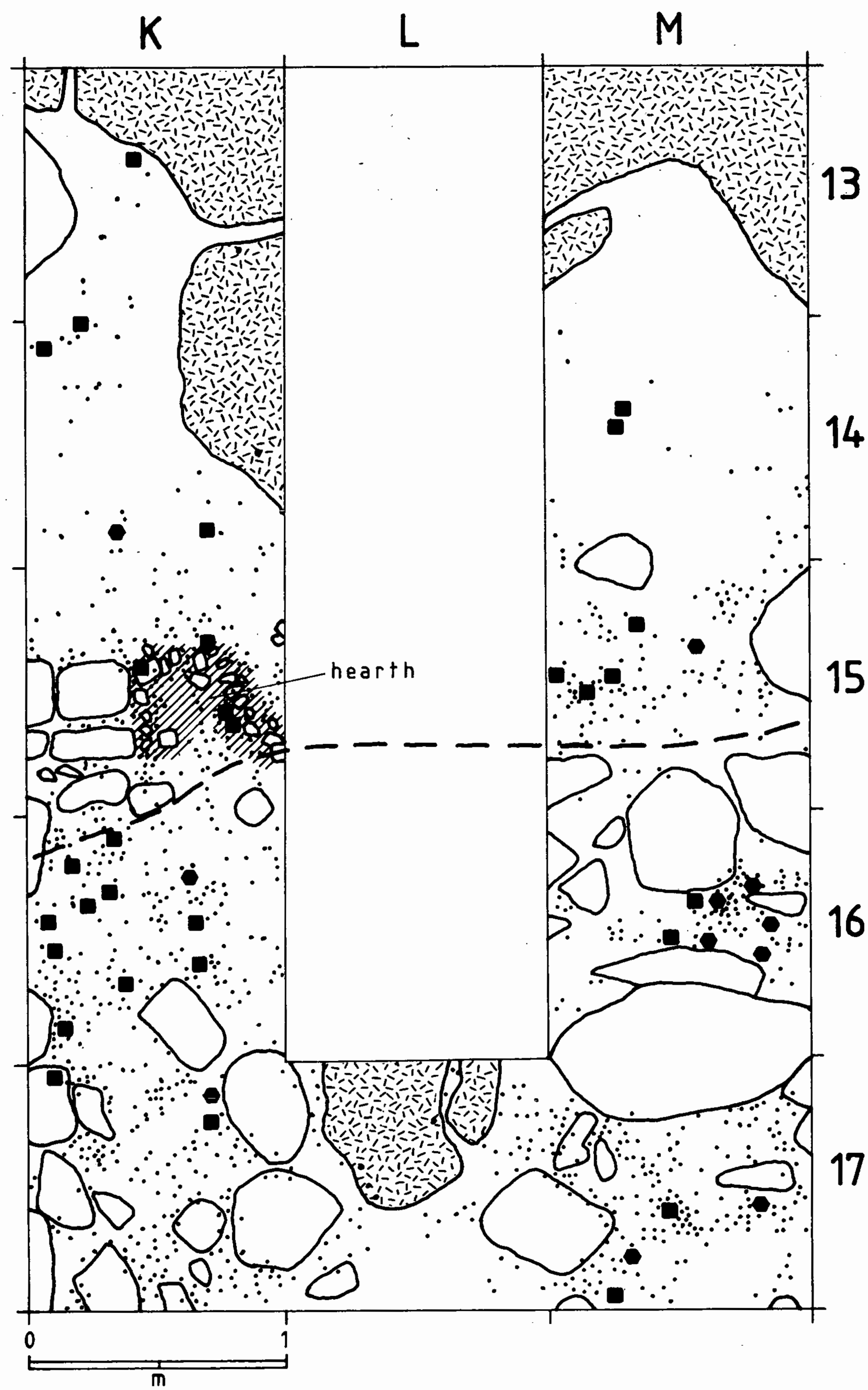

Figure 7. Horizontal distribution of lithic finds in layer 3.

LABORATORY METHODS

Processing Finds

All lithic finds, whether artefact or manuport, were given a preliminary examination before washing in order to detect any trace of ochre or resin which might have been present. Most specimens from the interface of layers 2 and 3 were sorted before washing as the colour and texture of sediments still adhering to them were used to determine to which layer they might have belonged. The lithic finds were then washed, dried and labelled individually for separate data entries for each artefact or manuport. Each specimen larger than 1 cm was examined under a stereomicroscope for traces of edge damage which might have resulted from use. This turned out to be particularly rewarding for the detection of 'used implements' (see also below).

At the inventory stage, date of excavation, position (layer, spit and 3D readings) and a brief typological description were entered in a hand-written catalogue. This method of data recording soon proved to be extremely time consuming and unsuitable for the manipulation and analysis of the large body of data which we were building up. A computer data entry program (QDATA) and a data base management system (1022) were therefore adapted to the specific requirements of our archaeological data (Mardaga-Campbell et al. 1982). These had the advantage of being both quick and easy to use (see also Campbell et al. 1982).

Other inorganic material such as ochre and burnt antbed (i.e. burnt termite nest fragments) was not given any special treatment prior to its entry in the data base. Shell and bone from the main trenches were very limited and extremely fragmentary. They were normally caught in the sieves and were mostly entered as non-individualised organic finds. Identifications have been made where possible on the shell and bone material (*Geloina coaxans* and *Macropus agilis* are represented in the shells and bones respectively), but some further study is still required. Samples of wood charcoal were cleaned with tweezers under a stereomicroscope and repacked in aluminium foil and plastic bags before being shipped to the University of Sydney for radiocarbon dating.

Description and Classification of Lithic Material

The purpose of this paper is not to present an exhaustive glossary of technical terms and typological definitions for lithic material, however useful that might eventually prove to be. We do, however, think it is important to state clearly some of our definitions used for the principal stages of reduction. On the other hand, as the definition of 'formal tool types' is generally more contentious and intuitive, we do not propose any major new 'tool types' for Turtle Rock. Since we do not consider the 'formal tool types' from Turtle Rock to be significant or especially informative on their own, classification of these is based principally on previously published definitions such as those provided by Morwood (1981:2-3) for his work in the Central Queensland Highlands. Overall, like Morwood, we opted to base our description and classification of individualised lithic finds on a simple hierarchical system of alphanumeric codes essentially both for technological and mnemonic reasons. We also decided that it would be more productive and informative to develop a coding system which was based on a general sequence of reduction of lithic material, running from specimens which were left unreduced through various stages of core preparation to the modification of some blanks into formal implements, rather than simply to produce a 'type-list' of formal tool types (see also Allen 1985, Cross 1983, Hiscock 1984, Morwood 1981, Schiffer 1976). In large artefact assemblages such as those which from Turtle Rock where only a very small and statistically insignificant proportion of the artefacts have any sign of retouch or edge-grinding, publication of a tool type-list only would clearly be quite misleading.

The stages of selection, manufacture and rejection or discard of lithic material which we have found to be represented at Turtle Rock are summarised in the flowchart in Figure 8. It is these stages, their subdivisions and the attributes of the specimens within them which our system encodes for data entry, analysis and retrieval. As may be seen, the reduction sequence is fairly complete, despite the small numbers of 'formal tools' found. Although most of the raw material ended up at one or another of the usual stages of knapping from core preparation or abandonment to flake or blade production and use, a sizeable proportion of the manuports which have naturally sharp edges were also heavily damaged by apparently intentional use which has resulted in a sort of 'pseudo-retouch'. Some of these manuports even show signs of edge-grinding without any other signs of preparations. These we have grouped as 'damaged manuports' despite the slight contradiction in terms.

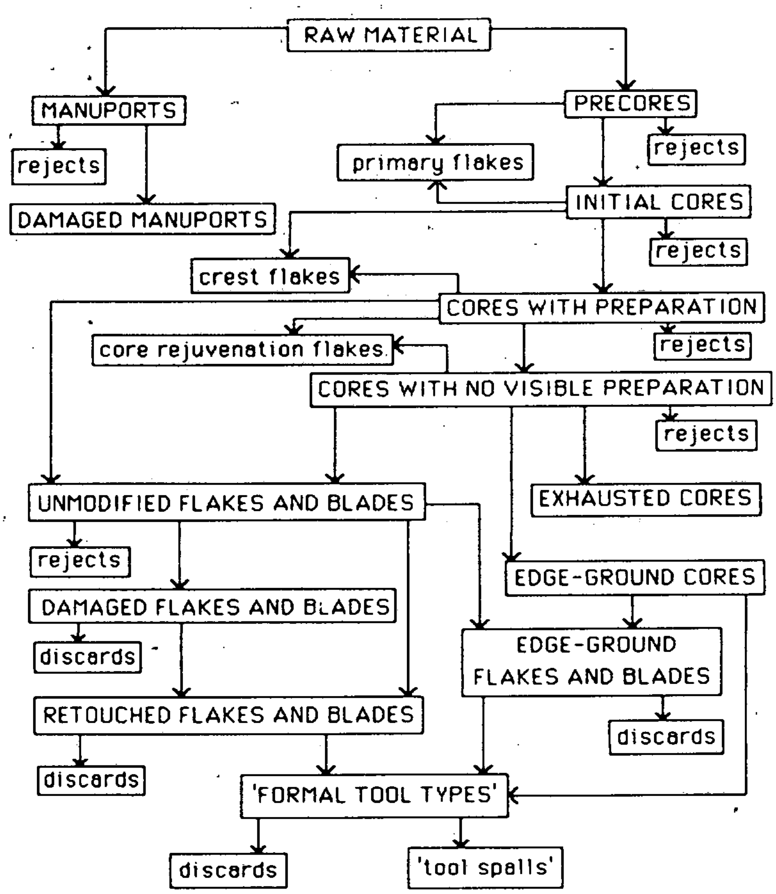

Figure 8. Model of stages of lithic reduction represented at Turtle Rock.

A tripartite sequence was followed in describing the technological status of the lithic material. Each specimen, whether manuport, core, flake or blade (see also below), was first considered as a potential 'blank' for implements (cf. Bradley 1975:5, though our use of the term is clearly broader; see also Minzoni-Deroche 1985) despite the dangers of "beginning in the middle" (Allen 1985:24), of which we are fully aware. Then its technological position in a reduction sequence was deduced from its morphological attributes. Finally, the extent to which the specimen was modified by damage, retouch or grinding was assessed.

The principal reduction categories which we use are defined in the following list. Each may be subdivided as required according to the material which one is trying to describe and analyse. Some of these definitions are now reasonably standard and therefore no reference is given for them; others we feel still require a reference or comment.

A. **Manuport**: a piece of stone which does not belong geologically to the site where it is found and which normally has not been knapped or other reduced of modified (Leakey 1971:3,8);

B. **Damaged manuport**: a piece of stone on which a few minor facets produced by apparent bashing, grinding or other damage are visible but on which the clear characteristics of core, flake, blade etc. are not recognisable. Though to some extent self-contradictory, we feel this term is preferable to 'struck chunk', 'ground chunk', 'hammerstone', 'flaked piece', etc. Damaged manuports may be further subdivided according to type of damage to their surfaces and edges).

C. Precore: a piece of stone which shows preliminary shaping for a core by decortication and/or by unifacial or bifacial preparation of its edges to form a knapping surface which may even be a potential striking platform, but from which no further knapping has taken place (Kozlowski and Sachse-Kozlowska 1974:40-41, Mardaga 1975:97-99, Sachse-Kozlowska 1980:246, Gob 1981:27).

D. Initial core: a precore which has been taken a stage further so that it shows clear evidence of platform edge preparation and/or tentative striking (Mardaga 1975:99, sachse-Kozlowska 1980:243). Initial cores may be further subdivided, though we would see the 'initially stuck cores' of Close et al. (1979:34) as a precore subtype);

E. Core with preparation: a core on which flakes or blades have been struck from one or more platforms, and on which at least one prepared platform and/or case of edge preparation is still visible.

F. Core with no visible preparation: a core from which flakes or blades have been struck, but on which there are no traces of platform edge prepartation.

G. **Exhausted core**: a core which has been reduced to such an extent that further production of flakes and/or blades is not possible, but the piece itself is still recognisable as having been a core (see also Crabtree 1972:62, Speth 1981:19, Clark 1985:6 - though we use this term in a somewhat broader sense than do these authors.

H. Primary flake: a flake or blade (see metrical distinction below under L) which has been detached at the stage of initial decortication, its dorsal face being at least 80% cortical with no signs of other flakes or blades having been detached beforehand (some authors set the cortical limit at only 50%, e.g. Close et al. 1979:34, but we feel 80% is a more objective measure for truly primary flaking).

I. Crest flake: a flake or blade which has been struck off to remove either the edge of a striking platform or a lateral ridge which has been formed during core preparation, its section being relatively thick and triangular with earlier flaking facets preserved on its dorsal face starting from a central ridge or crest.

J. Core rejuvenation flake: a flake or blade which has been struck off a core to obtain a fresh striking platform, its dorsal face preserving a core platform or part of it with flaking facets round the edges starting from the dorsal face (core rejuvenation flakes, or 'tablettes', may also be further subdivided).

K. Core plunging flake: a flake or blade which has been struck off the side of a core, its distal end having removed a core platform which is preserved on the piece more or less at a right angle to the plane in which the piece was struck, forming a thick distal end and a very concave ventral face. Plunging flakes, or 'eclats outrepasses', are frequently produced by knapping accidents and do not necessarily represent an intentional stage of reduction (cf. Brezillon 1968:104-106, Tixier 1974:19).

L. Unmodified flake or blade: a piece of stone which has been removed from a core by knapping after decortication work or primary flaking has been carried out, which shows no signs of edge-damage, retouch or grinding and which has a dorsal face that is less than 80% cortical clearly preserving the negative facets of previously detached flakes or blades (a flake has a length along the axis of percussion which is less than twice the breadth, whilst for a blade it is more than twice).

M. Damaged flake or blade: a flake or blade which shows clear sign of edge-damage or face-damage visible at x10 magnification under a stereomicroscope, which might represent damage caused during knapping, or during use or after abandonment of the piece.

N. Retouched flake or blade: a flake or blade which shows clear signs of retouch along one or more edges which is easily visible to the naked eye. Some retouched flakes and blades may be classified under 'formal tool types' and then according to specific type, depending on the type and extent of retouch present. Those kept under retouched flake or blade may be further subdivided as well.

O. Edge-ground flake or blade: a flake or blade which shows clear signs of grinding or polish along one or more edges which is easily visible to the naked eye. Some edge-ground flakes and blades may be classified under 'formal tool types' and then according to specific type, depending on the type and extent of grinding present, and some may be classified as 'tool spalls' from reworking of edge-ground cores, i.e. 'axes'. Those kept under edge-ground flake or blade may be further subdivided as well.

P. 'Formal tool types': cores, flakes or blades which have clear signs of retouch and/or edge-grinding which allow them to be classified according to one or another of the various 'formal tool types' (e.g. adzes, axes, backed blades, scrapers etc.) normally recognised in Australia, but which may nevertheless represent some of the ultimate products of lithic reduction. 'Formal tool types' are subdivided by us according to apparent 'tool types' as defined in Mulvaney 1975, Morwood 1981, and White and O'Connell 1982 in particular. As there are so few examples at Turtle Rock we do not think there would be any point either in offering new definitions or in repeating old ones here. By 'formal tool type' we do not consider these pieces especially significant; we are simply following convention on this for the moment.

Q. 'Tool spalls': fragments of retouched and/or edge-ground cores and of flakes or blades which retain clear traces of retouch or grinding distinct from traces of core preparation, any of which may have been detached as a result of attempts at resharpening 'formal tool types'. 'Tool spalls' may be further subdivided by type.

R. Debris: minor chips and shatter fragments principally from knapping and retouching, and not recognisable as belonging to any of the other categories defined above.

Examples of the various stages of core reduction are represented at Turtle Rock, and we illustrate these in a following section.

ANALYSIS

Raw Materials

So far at least 36 different types of stone have been recognised at Turtle Rock. These have been identified with the assistance of Dr. Mike Rubenach of the Department of Geology at James Cook University. Most of these stone materials occur in the Hervey Range region within a few kilometres of the site, and some acid-volcanics such as rhyodacite are particularly abundant in nearby outcrops. None of the stone materials need have been brought from more than about 15km to 20km away.

Transects carried out during our site catchment analysis revealed a possible source for the vein quartz which occurs so frequently in the site's assemblages. A quarry of vein quartz was found just within a two-hours' walk, less than 5km south of the site in fairly rough terrain (see Figure 1; see also Campbell 1978a:11). This material seems to have been preferred to the more readily available quartz pebbles of nearby creeks, as it has slightly better knapping properties. Quartz pebbles are only poorly represented in the site's assemblages as far as we can tell. A possible source for the indurated mudstone which occurs at the site was found during an environmental impact assessment of the Ben Lomond uranium prospect. This extensive quarry, which lies about 3km to the west of Keelbottom Creek and about 15km west of Turtle Rock (see Figure 1; see also Campbell 1978b:6-7, 24-25), covers an area of about 150,000m^2. Whether the porphyry which occurs at Turtle Rock was brought from even further away remains to be determined, but one of a number of possible sources for it is a porphyry quarry at Cape Cleveland, about 60km to the east-north-east (Viv Sinnamon, pers. comm.).

Although we have recorded and encoded in our data base the geological classification of each of our lithic finds, for the purposes of the present study we feel that an analysis based on criteria which represent the structural and mechanical properties of the material would be more informative. We have divided the raw materials into the five principal categories below, which are based on their knapping and use qualities.

A. **Excellent conchoidal fracture:** material which has a very isotropic structure, is brittle and produces very acute but fragile edges (e.g. clear crystal quartz, very fine grained cherts and jasper).

B. Good conchoidal fracture: material which is fine grained and produces sharp but resistant edges (e.g. fine grained quartzite, medium grained chert and silcrete, indurated mudstone, fine sandstone and lustrous opaque crystal quartz).

C. Clear conchoidal fracture infrequent: material which is of medium or irregular grain and produces blunt edges when knapped, sometimes being more suitable for edge-ground artefacts (e.g. coarse grained quartzite and silcrete, medium sandstone and volcanic rocks such as rhyolite, rhyodacite, basalt and andesite).

D. Irregular shattering: material which splits along cleavages rather than forming conchoidal fractures (group limited to opaque and milky vein quartz);

E. **No clear conchoidal fracture:** material which has a very anisotropic structure, a very coarse grain and very poor knapping properties (e.g. granite, granodiorite, arkose, coarse sandstone, porphyry and cordierite hornfels).

There are quite different proportions of these five fracture groups represented at Turtle Rock. The pattern is summarised in Figure 9, where the upper row of histograms gives the proportions both for the collections as a whole and by layer. As may be seen, the lesser quality raw materials (groups C to E) are clearly predominant both overall and in each layer. These groups of materials occur more commonly near the site than do the better quality groups A and B. Going by percentages of actual counts of all lithic finds, the dominant poor quality group is group D (opaque and milky quartz), which varies between about 45% and nearly 60%. However, when one looks at percentages of weights in the total site sample of more than 32kg of artefacts and manuports, groups C and E are higher than D, C being the dominant group at just over 40%. The patterns by weight are again very similar from layer to layer and therefore are not illustrated. Owing to the stratigraphic problems at the site already referred to above in section 3, and owing to the apparent overall uniformity of the material from layer to layer, we feel it is legitimate to analyse and discuss certain aspects by combining the samples.

The exploitation of the raw materials once they were brought to the site is illustrated by the lower row of histograms in Figure 9, which are based on the total site sample. Here, each histogram represents a different fracture group, and the numbers 1 to 4 in each represent the broad categories of (1) manuports, (2) unmodified flakes and blades, (3)

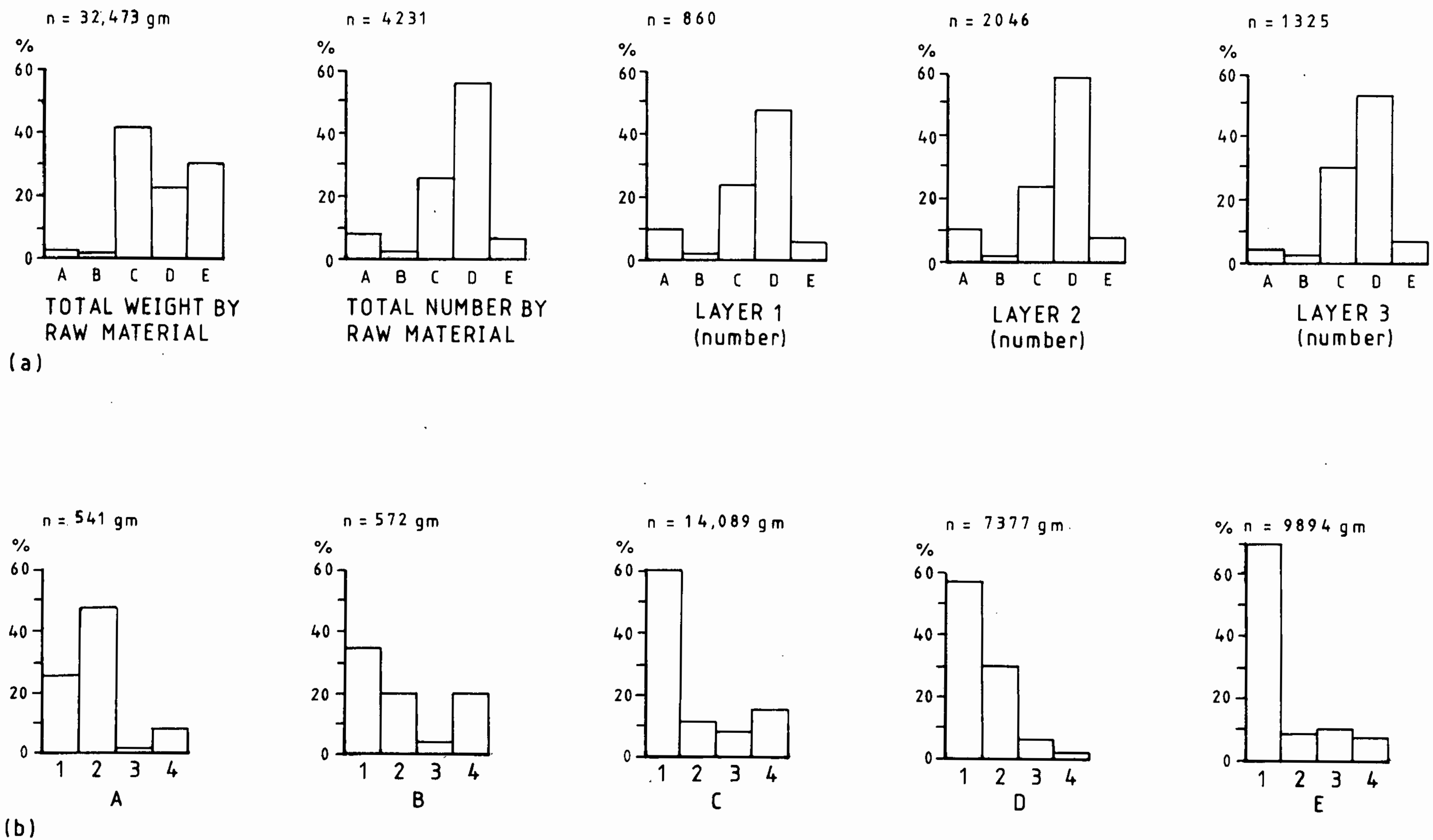

Figure 9. Raw material fracture groups by layer and by use (see text for definitions of groups A to E):
(a) total site sample by weights and numbers of specimens and layer samples by numbers of specimens;
(b) proportions within fracture groups in total site sample devoted to 1. manuports, 2. unmodified flakes and blades, 3. cores and 4. 'implements'.

cores and (4) 'implements' (including all damaged, retouched, edge-ground and 'formal tool' specimens). The percentages are based on weights, not counts, within each fracture group. From this it is clear that a higher proportion of the raw materials in groups A and B has been employed for the manufacture of artefacts, whereas more than half of the materials in groups C to E have been simply brought to the site and then abandoned as manuports. Even so groups C and E were made to yield a fair amount of 'implement' material by weight, when compared with the better quality groups A and B. 'Implements' made in materials belonging to groups A and B are generally smaller than those made in materials from groups C and E, though 'implements' in D (poor quality quartz) also tend to be small.

Looked at on the whole, groups A and B were made to yield more artefacts than groups C to E. Several reasons are given below which could account for these differences.

(1) They are due in part to fracturing properties, as raw material groups A and B have generally excellent knapping qualities, and it is therefore not surprising that higher proportions of these materials have been transformed into artefacts, even if the materials themselves are less abundant in the site's catchment area than those of groups C to E.

(2) They are due in part to the fact that clear conchoidal fractures are rare to nonexistent in raw material groups C to E, and some of the specimens which we have classified as manuports, or as damaged manuports, in these groups could in fact be the shattered results of attempts at knapping, even though the fractures do not appear to be the result of percussion (e.g. some fragments could be intentionally split precores which were not exploited further because their knappers judged them unsuitable).

(3) They are due in part to different ends which the manufacturers of the artefacts had in mind, that is, the different raw material groups were collected and worked or employed for different purposes (e.g. flaked versus edge-ground 'tools'or stones for fireplaces).

(4) They are due in part to distinct differences in the basic abilities of the knappers themselves, perhaps not all of whom were particularly skilled at knapping poor quality material, or possibly, some of whom were still learning to knap stone in general (this possibility of differences in ability might be suggested by the fact of the 67 cores found only about 10 show signs of skilful core preparation and reduction, though when in the better materials they were generally well knapped).

We are not yet certain whether only one or perhaps even all of these propositions might account for the variability. Certainly, the most difficult proposition to test is (4), and we consider that one beyond the scope of this present study, although by means of experimental work we hope to test it eventually. Cross (1983) has recently reviewed the problems associated both with the 'motor behaviour' and the 'mental template' perspectives on knapping, and unlike their respective advocates considers them complementary rather than independent. We would agree, and like him we are aware of the danger of substituting reconstruction for general explanation. We consider our study to be a contribution to description at this stage, and not to general laws of behaviour.

Manuports

Manuports at Turtle Rock are relatively small, unreduced blocks with an average weight of only 17.6gm. At first glance this seems surprising as cores, which are reduced manuports, have an average weight of 45.1gm. This could mean a number of things:

(1) That only the largest blocks have been selected for reduction;

(2) That there are differences by weight between the raw materials used which are masked by the above averages;

(3) That raw material group D, which is mostly vein quartz, breaks up naturally and/or accidentally into small pieces along natural cleavages (i.e., some manuports in this group may have shattered during attempts at knapping them without leaving clear traces of core preparation or even knapping; these would be some of our 'damaged manuports').

In fact, a detailed examination of the samples suggests that all three are true, or al least partly true. In the case of (1) and (2) raw material groups C to E have an average core weight of 64.7gm and an average manuport weight of 37.4gm, but groups A and B have an average core weight of 6.9gm and an average manuport weight of 10.4gm. In the case of (3) group D on its own has an average core weight of 18.2gm and an average manuport weight of only 5.6gm. As might be expected, the group with the largest cores (mean 109.6gm) and the largest manuports (mean 60.0gm) is group E, the group least suitable for knapping even though it was clearly tried.

Core preparation and reduction

Most of the 67 cores recovered at Turtle Rock are blocks of poor quality raw material which have been split and knapped in an apparently fortuitous fashion to remove only a limited number of flakes. However, at least 10 of them show evidence for skilful core preparation and reduction. The principal stages of preparation and exploitation of cores are illustrated in Figures 10 and 11. When the raw material was suitable, it would appear that an attempt was made to prepare cores carefully in order to produce reasonably regular flakes and occasionally blades (about 2% of the pieces detached from these better quality cores are blades). In some instances, when working material with excellent conchoidal fracture properties such as clear quartz, a precise reduction and rejuvenation technique was employed to ensure maximum exploitation of the core (e.g. see Figure 11, no. 3, a bipolar bladelet core in clear quartz).

Of the total of 67 cores, 9 precores are present and represent the primary decortication stage of knapping (e.g. Figure 10, nos. 1 and 2). They have been worked from the lateral edges transversely to the long axis of the selected block. Some have unifacial work (Figure 10, no. 2) and some bifacial (Figure 10, no. 1), which produced crested edges in both cases. Amongst the core trimming by-products there are several crest flakes, most of which have unifacial crests.

This work on the edge of the core produces a convex, sometimes polyhedric, flaking face (cf. Cahen et al. 1980:215) which can be seen in the sections of the examples (Figures 10 and 11; the area left

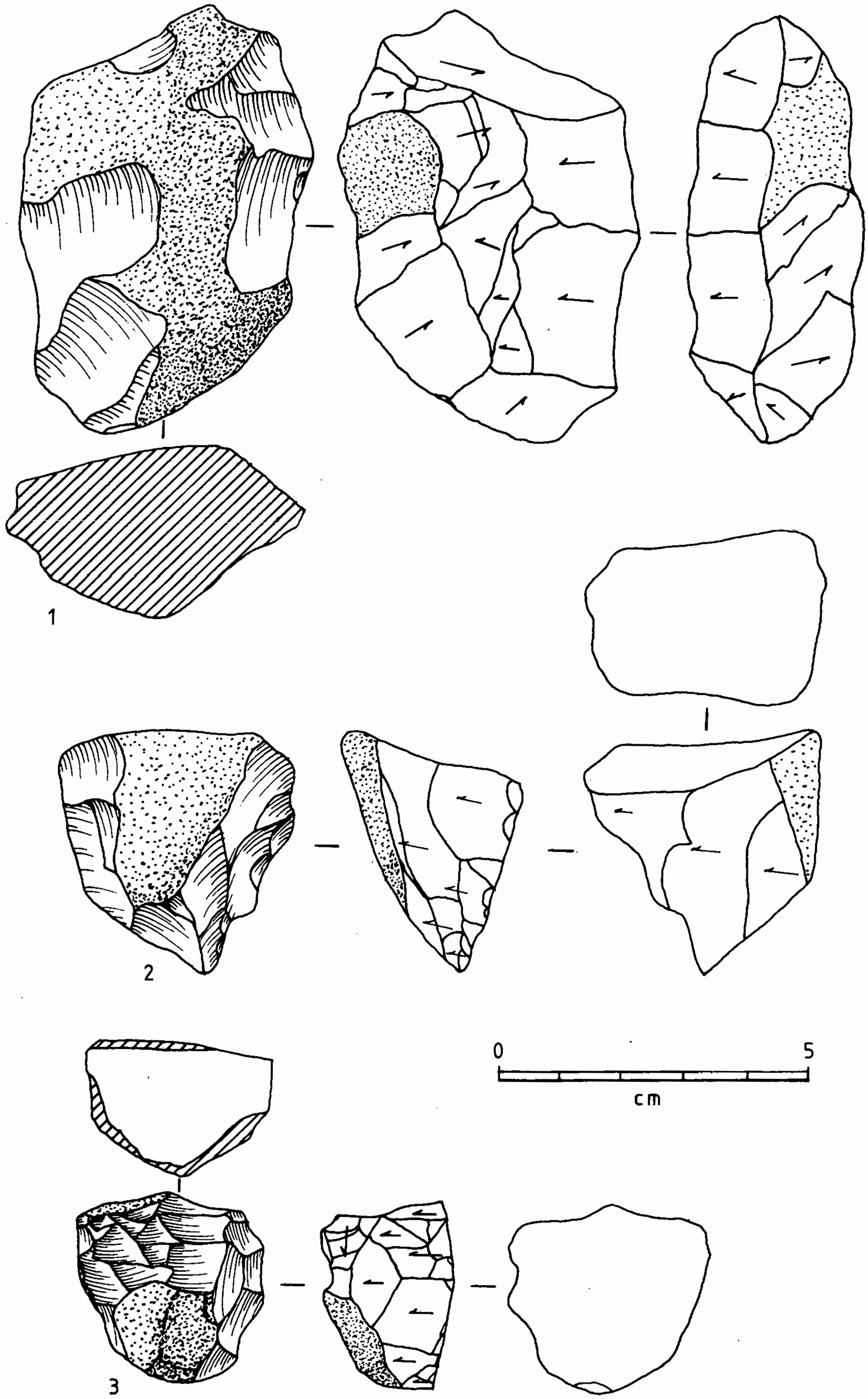

Figure 10. Cores: precores (nos.1-2) and initial core (no.3).

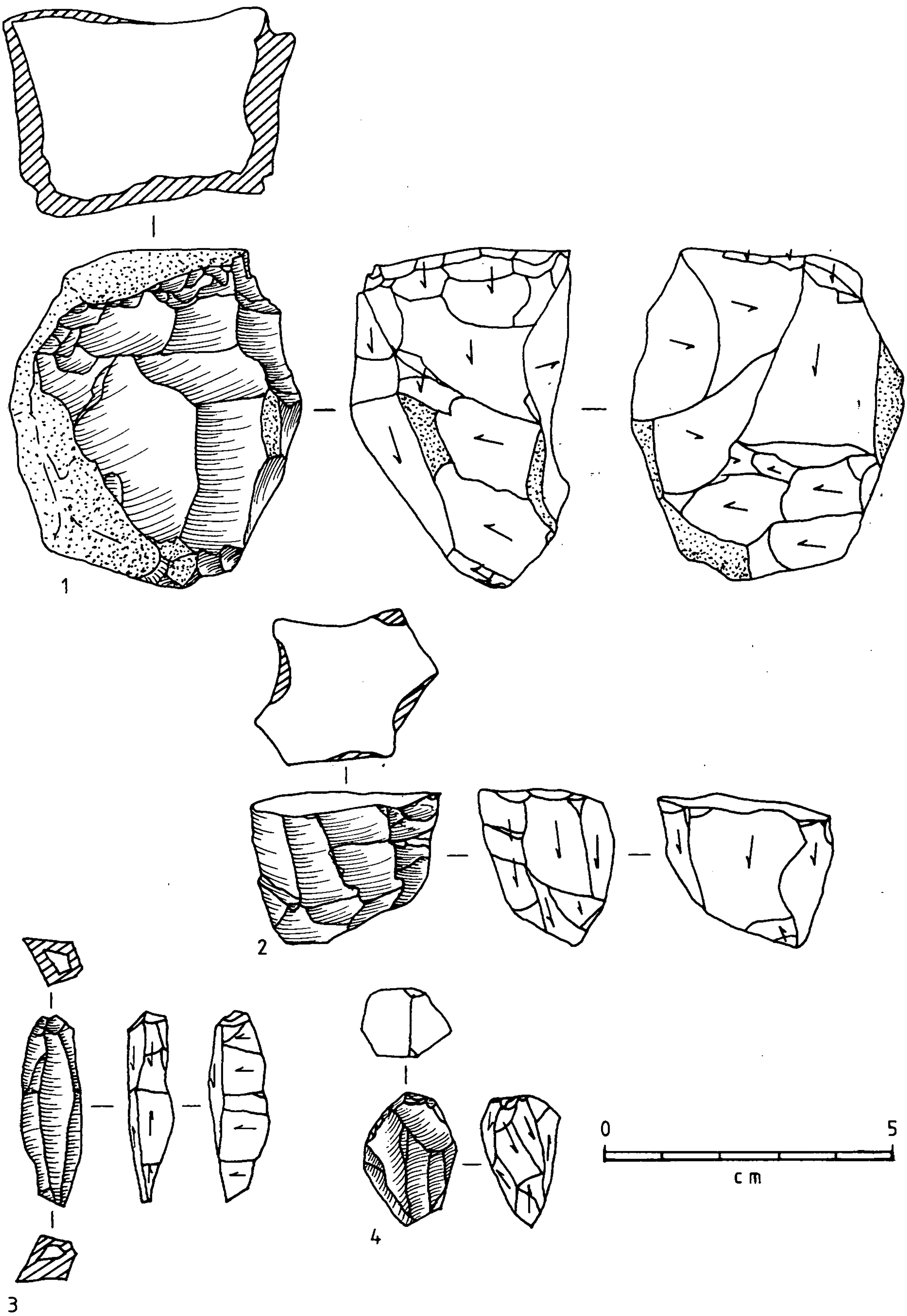

Figure 11. Cores: cores with preparation (nos.1-2) and exhausted cores (nos. 3-4).

unshaded represents the striking platform in the sections shown). Part of the preparation also consists of producing a generally flat surface opposite the flaking face. An example of such a flat face opposed to an angular flaking face is illustrated by the initial core in Figure 10 (no. 3). In general, the characteristics of a flat 'back', lateral preparation and a quadrangular to triangular section seem to be preserved right through to the final stages of core exhaustion (see Figure 10, nos. 2-3 and Figure 11, nos. 1-4).

Flake production in the Turtle Rock industry was usually performed from a single platform, regardless of whether or not proper core preparation had been carried out. This single striking platform was obtained alternatively by fracturing the original block at right angles to its long axis (e.g. Figure 10, no. 2), or by removing one or several flakes, or in some cases by taking advantage of a flat natural surface which was already there (e.g. Figure 11, no. 1). The possible use of an anvil technique is suggested by the frequent occurrence of bruising on the surface of the core opposed to the platform, though this could also mean that some cores were re-used as 'hammerstones'. Some cores were abandoned well before their platform was exhausted (e.g. Figure 10, no. 3 and Figure 11, no.1), whilst others were abandoned when the striking angle lost its suitable acuteness. The angle formed by the platform and the flaking face of these cores ranges between 85^{o} and 108^{0}. Other cores in the sample have been knapped so thoroughly that their platform has been reduced virtually to a spot (e.g., the exhausted core in Figure 11, no. 3) or to nothing leaving only a chamfered edge where the platform had been (Figure 11, no. 4).

From the above description one might conclude that the initial stages of core reduction were not aimed exclusively at the manufacture of blades or flakes of a predetermined shape as say in the so-called 'Levallois' technique. Furthermore, amongst the flakes and blades discussed below there is no special morphological distinction between those selected for possible use, retouch or reduction to 'formal tool types' and those left as unmodified flakes and blades. The 'toolkit' at Turtle Rock is generally very heterogeneous and easily discernible 'formal tool types' are rare. The nature of core preparation and reduction here seems more likely to have been determined frequently by the morphology and structure of the raw materials which were employed (e.g. presence of cortex or flaws, absence on some stones of naturally occurring angular faces, conchoidal fracturing properties etc.). On the whole, the preparation and rejuvenation of cores here seems to have been aimed at their maximal exploitation, even if that aim was not always accurate.

Unmodified flakes and blades

The by-products of core reduction constitute 90.9% of the total number of artefacts in our total site sample. So far we have not attempted a thorough systematic refitting of cores, flakes and blades. Trial studies revealed this to be a very time consuming exercise with only a very poor success rate. The generally poor conchoidal fracturing properties of the material make most of this sort of effort much more difficult than it would be if all of the materials belonged to groups A and B. Further, although a relatively wide area of the site has been sampled, the number of unrecovered artefacts outside our excavation which would be required for any proper refitting experiment seems to preclude for the moment refitting even some of the 'easier' pieces in the best materials.

Together with Alan Pomeroy we are currently analysing selected aspects of the unmodified flakes and blades as well as those which were modified. Attributes which appear to covary include elongation (technological breadth to length ratio, or B/L) and raw material group. Obviously elongation would depend on the quality of the raw material, as well as the knapping technique employed. We are also testing to see whether elongation relates to the selection of blanks for possible use, retouch or 'formal tool types'. Ethnoarchaeological studies in New Guinea have shown that some living stone knappers name artefacts and select blanks for tools on the basis of criteria such as quality of raw material and elongation, though they are not always fully aware of the finer differences in what they are producing (White and Thomas 1972; White et al. 1977). Amongst Western Desert Aborigines metamorphic rocks are preferred for chopping tools to crystalline rock because of the larger size of blanks, the naturally occurring angular edges requiring little or no modification for use and a suitable grain for cutting through wood fibres (Hayden 1979:11). Flake elongation is not significant for these chopping tools, but for adzes produced in finer grained material Hayden (1979:26) observed a systematic use of elongated flakes which offered long lateral edges. Cutting implements like knives and saws were seen to require long cutting edges as well (1979:13).

For the present for Turtle Rock we wish only to illustrate the length of unbroken unmodified flakes and blades by different sizes and by raw material group. This is shown in Figure 12. The histogram on the left repeats for comparison the proportions of all artefacts and manuports by raw material group in the total site sample. The vast majority of flakes and blades are smaller than 50mm, only 31 out of 1901 specimens being longer than 50mm. This might suggest that only light to medium duty tasks were intended to be carried out at Turtle Rock, at least with flakes and blades (cf. comments in Hayden 1979, Kamminga 1982), although it is also likely that many pieces were not suitable for any task and equally possible that some of the better pieces were removed from the site for use elsewhere once they had been produced.

Implements

We have classified 130 specimens as 'implements' on the basis of clear traces of 'use', retouch or edge-grinding. This represents 4.1% of the total artefacts and 3% of the total lithic sample. If we exclude 17 fragments of edge-ground artefacts and/or possible axe roughouts or preforms, there are only 24 so-called 'formal tools'. This coupled with the stratigraphic problems already described above and the difficulties in observing microwear on most of the material, owing to its coarseness and sometimes severe patination, would make most sorts of detailed analyses rather pointless.

We have, however, considered individual edges rather than implements in our computer-aided study. Individual edges can tell one something about the extent to which material was used, and perhaps at times re-used or resharpened for re-use (but cf. Allen 1985 for critique of edge analysis). For the modified edges, seven principal attributes have been taken into account by us: (1) raw material group; (2) size of specimen; (3) weight of specimen; (4) angle of modified edge; (5) type of modification; (6) type of reworking; (7) extent of modification (ratio of modification/perimeter).

There is a total of 140 modified edges for 113 implements (edge-ground artefacts not included), or an average of 1.2 modified edges per implement. Considering 'used' versus retouched edges, most retouched edges are semi-abrupt to abrupt (i.e. angle of 70° or more), whereas most 'used' edges fall between 30° and 69°. This could reflect reworking of some specimens (i.e. those with a steeper edge-angle), but it might also reflect a desire to produce steep edges for scraping and adzing versus more acute edges for cutting purposes (cf. comments in Hayden 1979; Kamminga 1982). This will need to be tested by proper microwear analyses of all suitable specimens in the total collection (i.e. those in suitable raw materials and without too much weathering and patination).

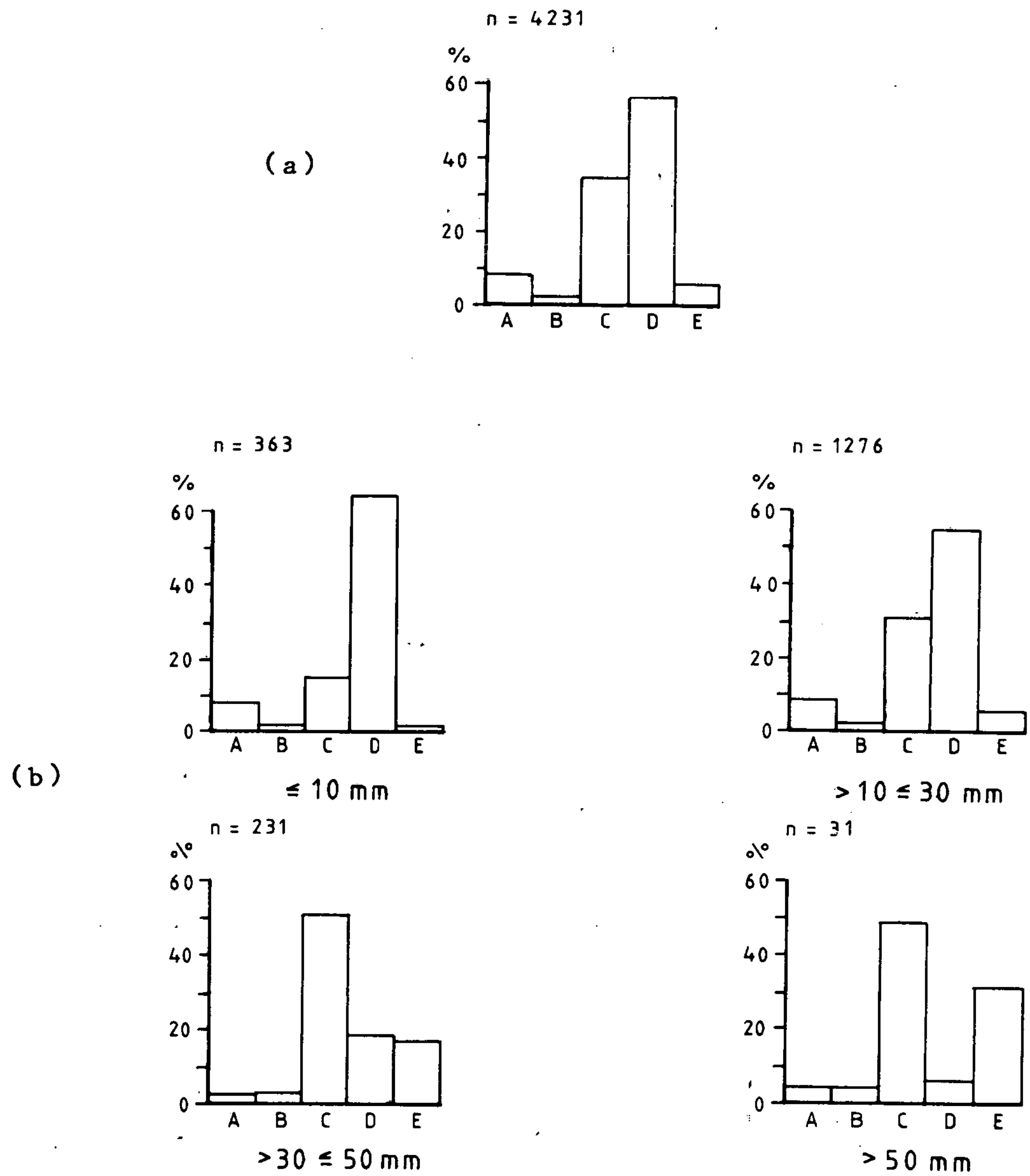

Figure 12. Lengths of unbroken unmodified flakes and blades by raw materialfracturegroup(see textfordefinitions of groups A to E): a) total site sample of artefacts and manuports (for comparison); (b) length classes.

Regarding the possible influence of raw material on extent and angle of the modified edge, extent and angle vary with raw material group, showing an increase in modified edges and in angle for raw materials C and D. These groups are more abundantly represented in the total site sample and more frequently have naturally occurring steep edges. However, as with many other things at Turtle Rock, no significant variation in the extent of modification appears to occur between layers. When comparing extent of modification between 'used' and retouched implements, 81% of 'used' edges and 73% of retouched edges account for less than 50% of the perimeter. In other words, judging from our observations and analysis, it would appear that only a fairly small proportion of the available edges has actually been used.

Examples of 'used' and retouched implements are shown in Figures 13 to 15. These have been grouped in a fairly standard manner by morphology, and we provide these drawings here for the sake of our readers who may wish to make the more traditional comparisons with their own material. The left side of each figure shows implements from layer 2 and the right side from layer 3, though as we have already pointed out there is no major difference between most of the material from these layers. The upper part of Figure 13 shows a small series of 'formal scrapers' (nos. 1-3, 5-6, 8) and nos. 4 and 7 are examples of what have sometimes been called 'amorphous implements' (Morwood 1981). They have similar edge-angles and general morphology to some of the 'formal scrapers'. Nos. 9 and 10 are reused cores, no. 9 being a precore which was heavily abraded on part of its faceted surface and at one end (?possibly used as a plane) and no.10 an exhausted core both platforms of which were worked out before one end was developed into a chisel-like edge.

Figure 14 shows a range of pointed implements, including a small but definite series of backed points (nos. 1-3). No. 7 is backed as well despite the fact that its dorsal face gives the impression that it has been made on a 'side-struck' flake. Nos. 4-6 and 8-12 have various degrees of trimming of their edges and/or faces.

Figure 15 shows examples of some of the larger and less 'diagnostic' implements, all of which have some signs of damage and/or retouch on their edges. Nos. 5-6 are technically burins on primary flakes, though we have seen no clear evidence on them that would suggest they were in fact used as burins.

The 'formal tool types' illustrated here seem to show reasonably clear affinities with the so-called Australian Small Tool Tradition (STT). However, given the small number of retouched pieces in the entire series of artefacts from Turtle Rock, the limited number of modified edges and the fact that the STT is such a broad concept, it could be debated whether or not it might not be more appropriate to consider the material attributable to the 'Australian Lesser Retouched Tradition' (LRT) which one of us has proposed (Campbell 1982b:355). Of course, the broad concepts of the STT and the LRT are largely intuitive models of possible cultural variability and change in Australian prehistory, as is the Australian Core Tool and Scraper Tradition (CTST), all of which are based on presence or absence of certain 'formal tool types' and in general on comparatively simple statistical assessments of parts of assemblages (see comments in Allen 1985, Hiscock 1983, 1984).

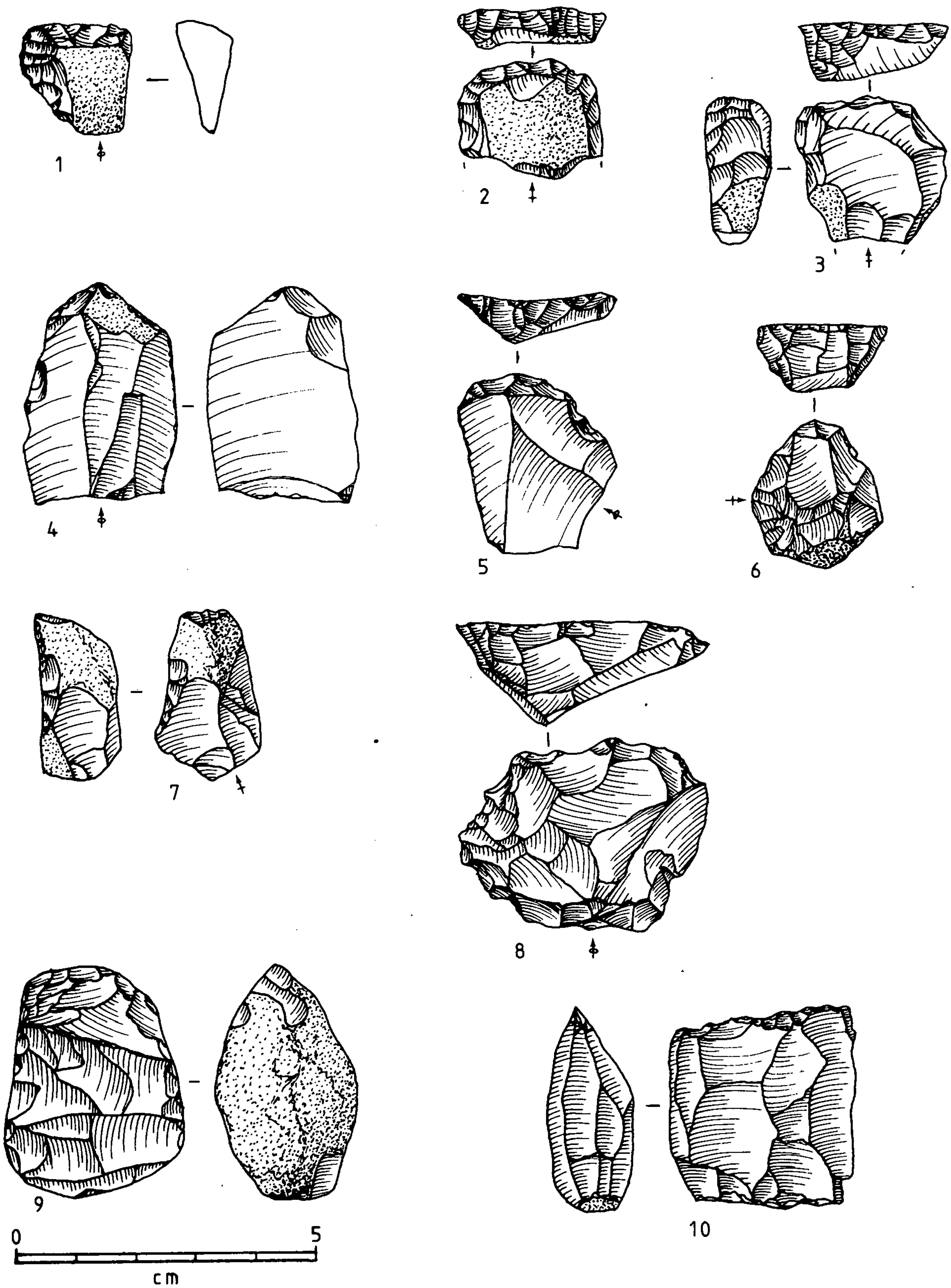

Figure 13. 'Scrapers' and allied forms: 'formal scrapers' (nos. 1-3, 5-6 8), 'amorphous implements' (nos. 4,7) and 're-used' cores (nos. 9-10) (arrows under or beside some specimens indicate direction of detachment of blank).

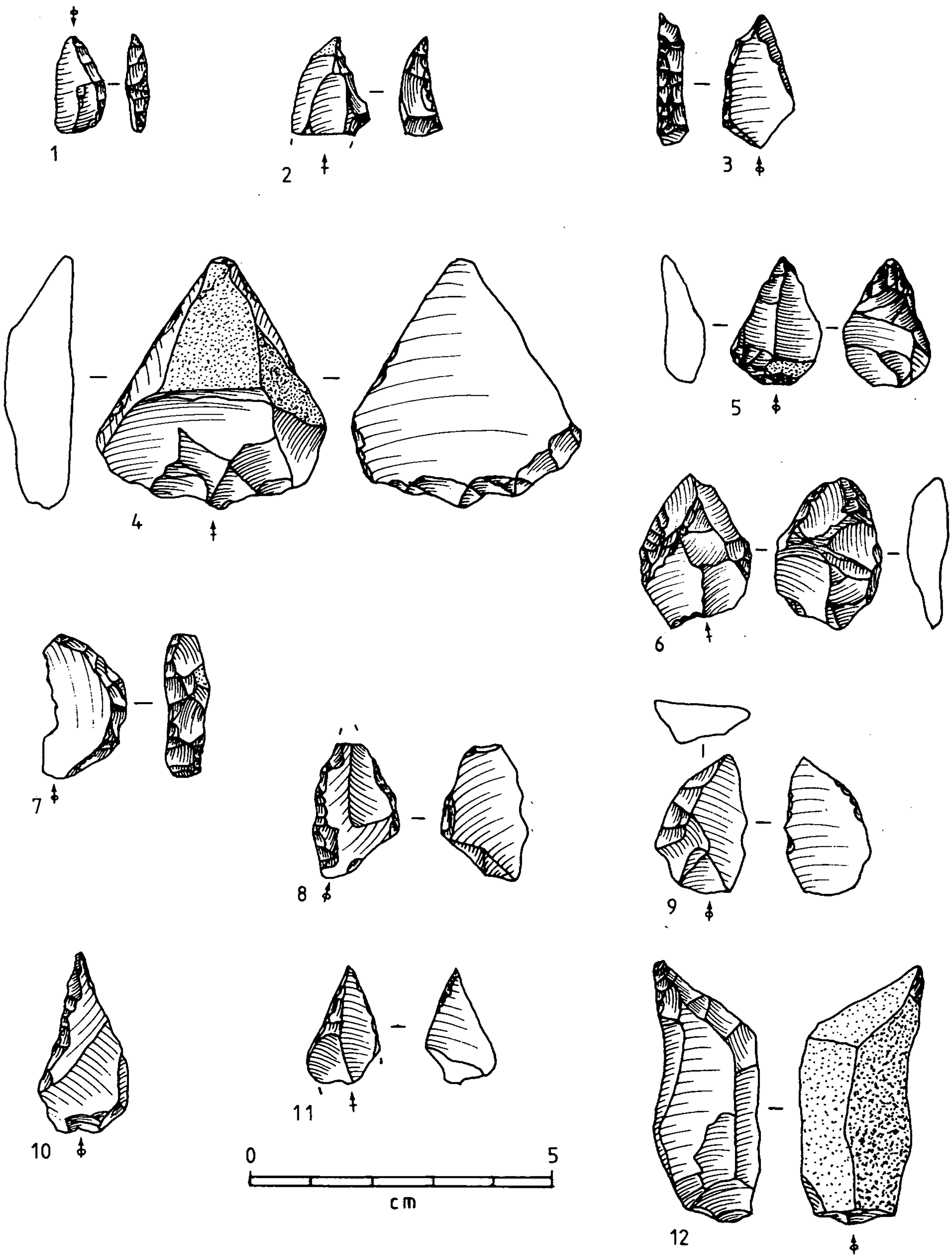

Figure 14. 'Points': backed points (nos.1-3), backed flake (no.7) and various 'trimmed points'(nos.4-6,8-12) (arrows under specimens indicate direction of detachment of blank).

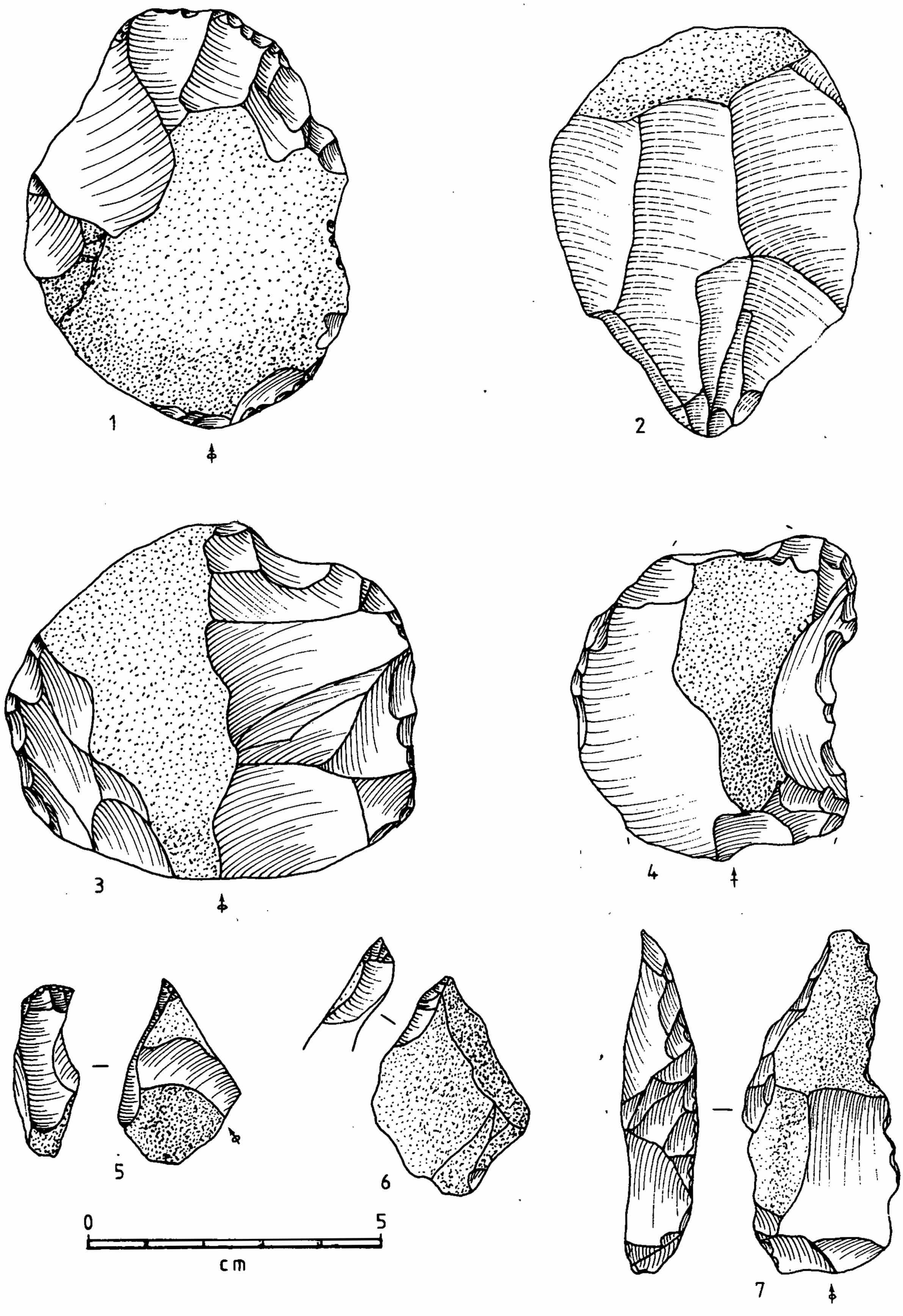

Figure 15. Less 'diagnostic' implements showing some signs of use and/ or retouch (see text).

CONCLUSIONS AND FUTURE RESEARCH

The lithic material from Turtle Rock includes a wide range of raw materials which we have grouped into five different categories based on their knapping and potential use qualities. All of the raw materials are available within about 15km to 20km of the site. Most of the material is of poor quality, but attempts were made to knap materials and even to produce 'implements' in each of the five categories. We have recognised and described in detail the patterns of core preparation and reduction, running from what we term precores and initial cores right through to exhausted cores. It is clear that a large number of manuports were brought to the site, and that a fair amount of basic knapping was carried out at the site. The final stages of reduction and use are represented as well, though we are not yet certain which tasks the artefacts were meant to serve.

Owing to erosional problems which have compressed and contorted the stratigraphy, as well as to the lack of clearly separate and well preserved assemblages and the comparatively short timespan of what we do have (i.e. the major portion of the lithic material dates, or seems to date, from about 4,200 to 3,000 years ago), we have combined all of the lithic material from our main excavations for most of the analyses presented here. This gave a total of 4,231 lithic specimens, including both manuports and artefacts, and about 130 'implements', of which only about 24 might be classified as 'formal tool types'. Initial analyses carried out by us, together with our colleague Alan Pomeroy, show that there were no major differences in the materials or work on them between either spits or layers. Nevertheless, as we have shown above in our description of the material and its distribution within the site, parts of what were originally separate assemblages were preserved <u>in situ</u>, as were perhaps at least small areas of original 'living-floors', especially near the hearths. As mentioned above, we have conducted initial trials at refitting material, and despite the problems which we face with it, now intend to pursue this task further, being certain that it will tell us much more about what was happening in the central area of the shelter. As we have a three-dimensional record of the positions of all lithic finds within the site, once more thorough refitting of the reduction sequences has been carried out, it might prove possible to produce multi-dimensional models of changes in human behaviour, as well as changes in patterns of erosion, in different parts of the site through time.

For the moment we have considered it premature to make comparisons with lithic analyses of other sites in North Queensland such as Hiscock's (1984) fairly thorough work on Colless Creek Cave. We also leave open the question of whether the lithic material from Turtle Rock should be assigned to the Small Tool Tradition or the Lesser Retouched Tradition and question whether these sorts of broad archaeological labels are even appropriate for the study of lithic occurrences in North Queensland (see also Hiscock 1984; Rosenfeld et al. 1981).

Although we have not previously considered it worthwhile to attempt microwear analysis of quartz artefacts, of which there are many at Turtle Rock, Sussman's (1985) experiments have now shown that with the aid of appropriate SEM microscopy and associated techniques, microwear not only on crystal quartz, but on milky vein quartz, can be discerned and analysed. As we now have the right facilities at James Cook University, this is something that we will be attempting with the sizeable number of quartz artefacts and manuports from both Turtle Rock and other sites which we have been excavating in North Queensland. We will also be looking at the less frequent chert and other fine grained materials which we have in our collections.

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