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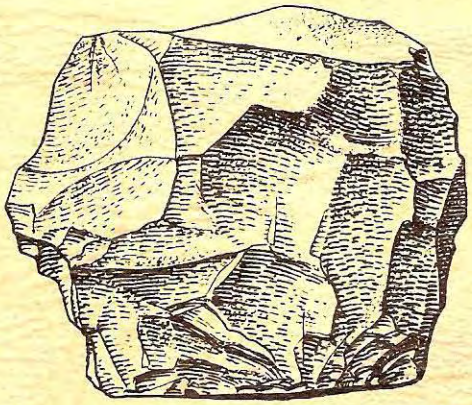

Institut du Quaternaire, Bordeaux University

Western Australian Museum, Perth

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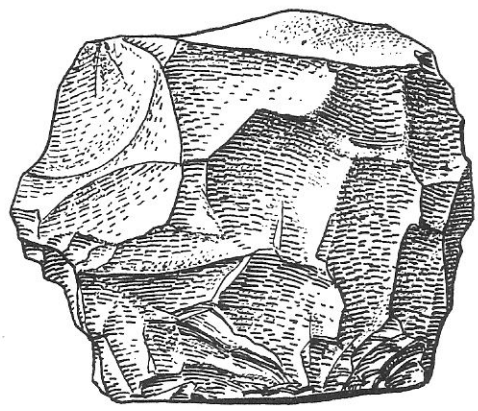

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More than 30,000 years ago the ancestors of the modern Aborigines were well established in Southern Australia as shown by field research carried out during the past decade at the Lake Mungo lunette in New South Wales and the Keilor alluvial site in Victoria (BOWLER, 1976) and at Mammoth Cave and Devil's Lair in Western Australia (ARCHER, CRAWFORD & MERRILEES, *in preparation*; DORTCH, 1979). Southern sites of this age give good reasons to suppose that the first colonists entered Australia from Indonesia at least 40,000 years ago, a probably conservative estimate generally accepted by Australian prehistorians.

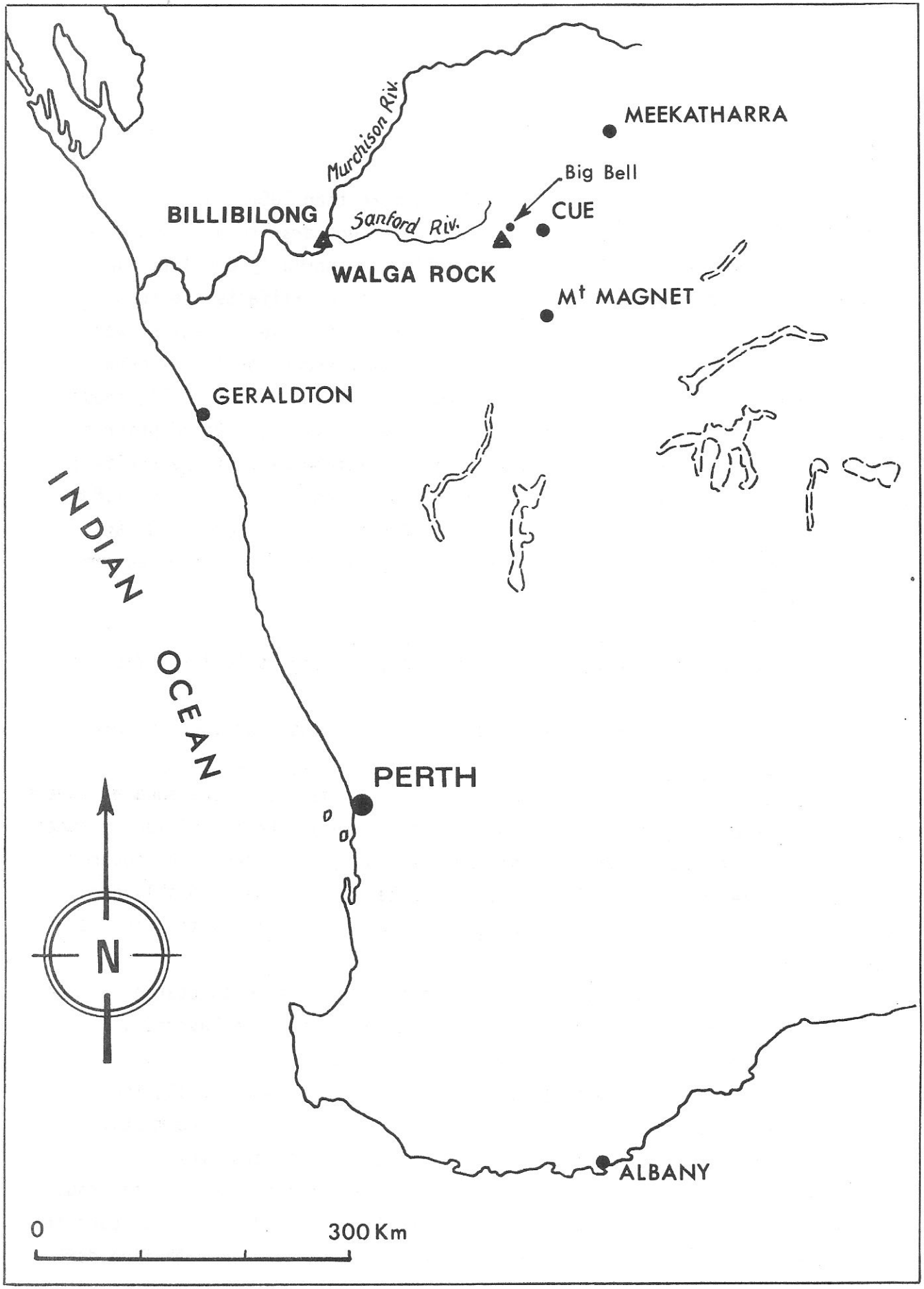
Despite much successful recent field research a great deal more multidisciplinary work is needed in most Australian regions, not only to obtain a better picture of Pleistocene culture and environment, but of the Holocene as well. The following report describes tentatively a regional archaeological sequence extending from Pleistocene times to the terminal prehistoric period, data which when developped may have important consequences for the question of man's antiquity in Australia, and his ability to adapt in this region to changing conditions over many millenia.

In July and August 1978, researchers from the Institut du Quaternaire (Bordeaux University) and the Western Australian Museum (Perth), aided by volunteers from the Anthropology Department, University of Western Australia (Perth) carried out archaeological and geological investigations in the semi-arid Murchison Basin about 600km NNE of Perth. The major aims of the project have been to assess the likely duration and nature of prehistoric human occupation in this region. During this season the group was engaged chiefly on an excavation at WALGA ROCK, a rock shelter near Cue, and on investigations at BILLIBILONG SPRING, an alluvial site on the Murchison River 200km west of Cue. The present project follows initial studies made by Perth-based researchers, mostly from the Western Australian Museum, the foremost of whom is Duncan MERRILEES. During the 1960's MERRILEES perceived the possible age of fossil bones and stone artifacts from ancient alluvial deposits in the Murchison

district and suggested their palaeontological and cultural significance.

Members of the project

Professor F. BORDES, Institut du Quaternaire, Co-Director.
Mr C.E. DORTCH, Archaeology Department, Western Australian Museum, Co-Director.
Dr Cl. THIBAULT, Institut du Quaternaire, Geologist.
M. J.-P. RAYNAL, Institut du Quaternaire, Geologist and Archaeologist.
Miss Jane BALME, Archaeology Department, Western Australian Museum, Palaeontologist.
Mr W.C. FERGUSON, Archaeology Department, Western Australian Museum, Archaeologist.
Miss L. VILLIERS, Mr I. KIRKBY and Miss M. SMITH, all of Anthropology Department, University of Western Australia.



Map of Southwestern Australia showing the position of WALGA ROCK and BILLIBILONG SPRING.

W A L G A R O C K

This very large north-facing shelter, more than 100m long and least 12m wide, is situated at the base of a huge granite batholith emerging from the valley sands of the Sandford River, a normally dry left bank tributary of the Murchison River. Quantities of stone artifacts are found around other batholiths in the locality, showing that these formations were attractive camping places. WALGA ROCK has long been known for its elaborately superimposed paintings covering larges areas of the shelter wall, though its deposits had never been systematically or extensively excavated prior to 1978. This season's test trench, located in the eastern part of the shelter, comprises six $1m^2$ squares, and in the south end extended to a depth of 1.80m without reaching bedrock. The 1978 datum is 50cm above the present surface of the deposit and is fixed by a 4cm hole previously drilled in the eastern shoulder of the shelter.

The stratigraphy of the deposit is, schematically, as follows (fig.1):

1. Superficial layer, disturbed, with some glass flakes and modern rubbish.

2. Very soft, dark grey layer, .55-1m below datum. In one square, layers 1 - 5 were tentatively delineated though these could not be identified in other squares. Sediments are largely undisturbed in squares U 14 and U 15; squares V 14, V 15, W 14 and W 15 are very much disturbed by burrows, probably dug by large lizards ("goannas"). This upper zone contains a microlithic industry, mainly in quartz.

3. In V and W there is a deeply eroded area filled with coarse or fine reddish sands, containing almost no artifacts, and designated layers 6, 7, 8.

4. Layer 9, minor rockfall of granite slabs.

5. A dark brown deposit (layer 10) *in situ* in U 14 and U 15, though with some clearly demarcated burrows in U 14. Stone implements are mostly of quartz, bigger than in the upper zone, and without true microliths.

6. Layer 11 is brown with many small granite slabs and a quartz industry very much like that of layer 10. One microlithic backed point was found in this layer, but microscopic examination shows it to be covered with fine dark

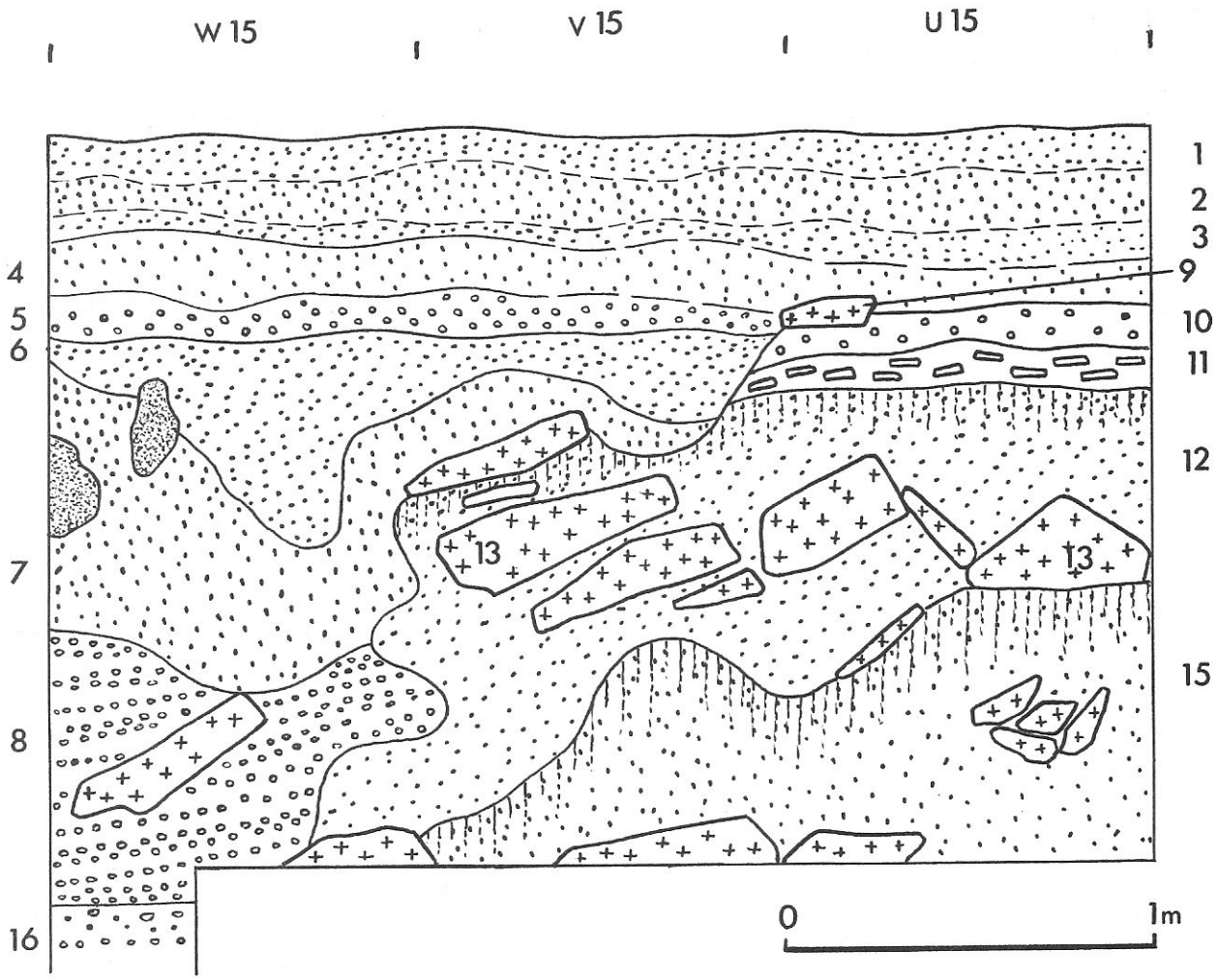


Figure 1: Semi-schematic section at WALGA ROCK.

grey sediments, very different from the more reddish and coarser sediments of layers 10 and 11. As the piece was found close to the edge of a burrow, it is probably intrusive.

7. Yellowish layer (12) with some small quartz tools but no true microliths.

8. Layer 13 is a big rockfall of large slabs of granite, dipping toward the interior part of the shelter.

9. Layers 14 and 15 are yellowish sandy sediments with very few artifacts.

During excavation all retouched pieces, diagnostic flakes and cores were recorded three dimensionaly and given a number each. Because of the extensive disturbance caused by the burrows the upper part of the deposit was dug in 5cm spits. Screens of 3mm and 5mm mesh were used throughout.

Stone artifact assemblages.

At present artifact analysis has been made only on material from squares U 14 and U 15 in which the upper zone appears undisturbed. The number of tools is insufficient for a layer by layer or spit by spit comparison. However vertical projection diagrams show clearly a high density zone of artifacts at 70 - 90cm and so the upper, "microlithic" zone has been divided into three sub-units: 50 - 70cm; 70 - 90cm; and 90 - 100cm (table 1).

The typology used below is essentially morphological even if there is good ethnographic evidence for the use of some kinds of tools, particularly adze flakes. For these the usual distinction between "tulas" and "non-tulas" (cf. McCARTHY, 1967; MULVANEY, 1975) is maintened despite evidence (cf. GOULD, 1977; GOULD *et al.*, 1971) that these differences in form are not very significant in terms of utilisation, at least not to modern Aborigines and in the light of European experimentation.

The tula adze flake is roughly a short end-scraper or in some larger specimens a transversal scraper, in both cases the working edge being bisected by the axis of percussion of the flake. Successive re-sharpening, typically at the last stage involving the use as a working edge of the acutely angled corner formed by the proximal end of the dorsal face and the butt, soon results in the artifact type termed a tula "slug", often very different from the pieces termed slugs in European typology.

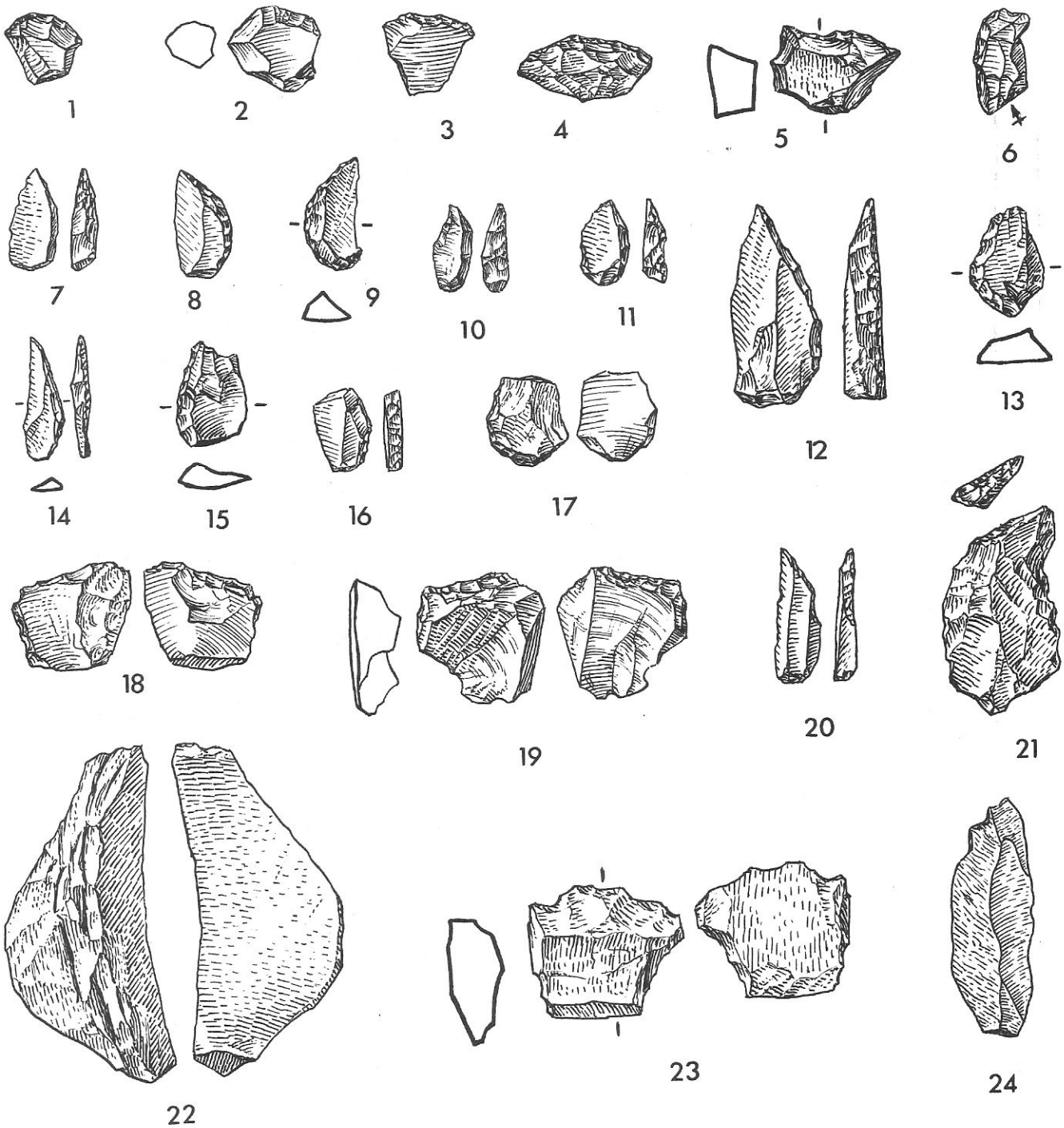


Figure 2: WALGA ROCK, 50 - 70cm zone.

The non-tula adze flake is a rather more heterogenous category of tool though typical forms are flakes, presumably hafted along one lateral side, resharpened, turned, sharpened and resharpened until slugs of variable form are produced which ressemble the tula slugs in size and the flaking and and wear pattern of their working edges but not in the general form.

At WALGA ROCK, there is a difficulty: many adzes are made on broken quartz flakes and it is not easy to tell where the striking platform was. So we termed tulas the adze flakes where the working edge is opposite either to a striking platform or to a flat break perpendicular to the dorsal and ventral faces.

Scrapers on flakes whose length is twice or more their width we have termed end-scrapers since they are unlikely to have been hafted as adze flakes.

For the present the term "microlith" is used for any retouched piece with a maximum dimension of less than 2cm. Most of the tools and even unretouched flakes from WALGA are in this size range. The marked absence of large tools in our excavations is striking and may be explained by the possible use of large pieces of exfoliated granite fallen from the roof as heavy duty tools, but the bad state of preservation of these pieces prevents any affirmation.

Table 1 gives the distribution of tools and flakes in the arbitrary levels: 50 - 70cm: 70 - 90cm; 90 - 100cm. We did a metrical study of the maximum size of the flakes for the 60 - 65cm zone and the 90-100cm zone in square U 15.

In the 60 - 65cm zone, 51 flakes were measured. The mean is $\bar{x}$ = 1.9167cm, with a standard deviation of 0.4913. The confidence interval at 95% is 1.7784 to 2.0550.

For the 90 - 100cm zone, 165 flakes were measured. $\bar{x}$ = 1.8845, with a standard deviation of 0.4750 and a confidence interval at 95% of 1.8112 to 1.9576. There is no significative difference in size between these two zones, since the confidence intervals are overlapping.

Zone 50 - 70cm (fig. 2)

Adzes: 1 tula, half-worn (fig.2, n°4), 1 microtula (n°1), 7 other adzes (n°5), 15 microadzes (n°2, 3). No true slugs. It would be interesting to do a metrical study of the tulas and adzes to see if there are really two subtypes in each, normal ones and micro ones, or if one gets a normal curve of repartition, but we have not enough material for that. It should be done on other sites, or will be done at WALGA when we have more material. We took as an arbitrary limit 2cm. The tool fig. 2 n°2 is a micro-adze indeed!

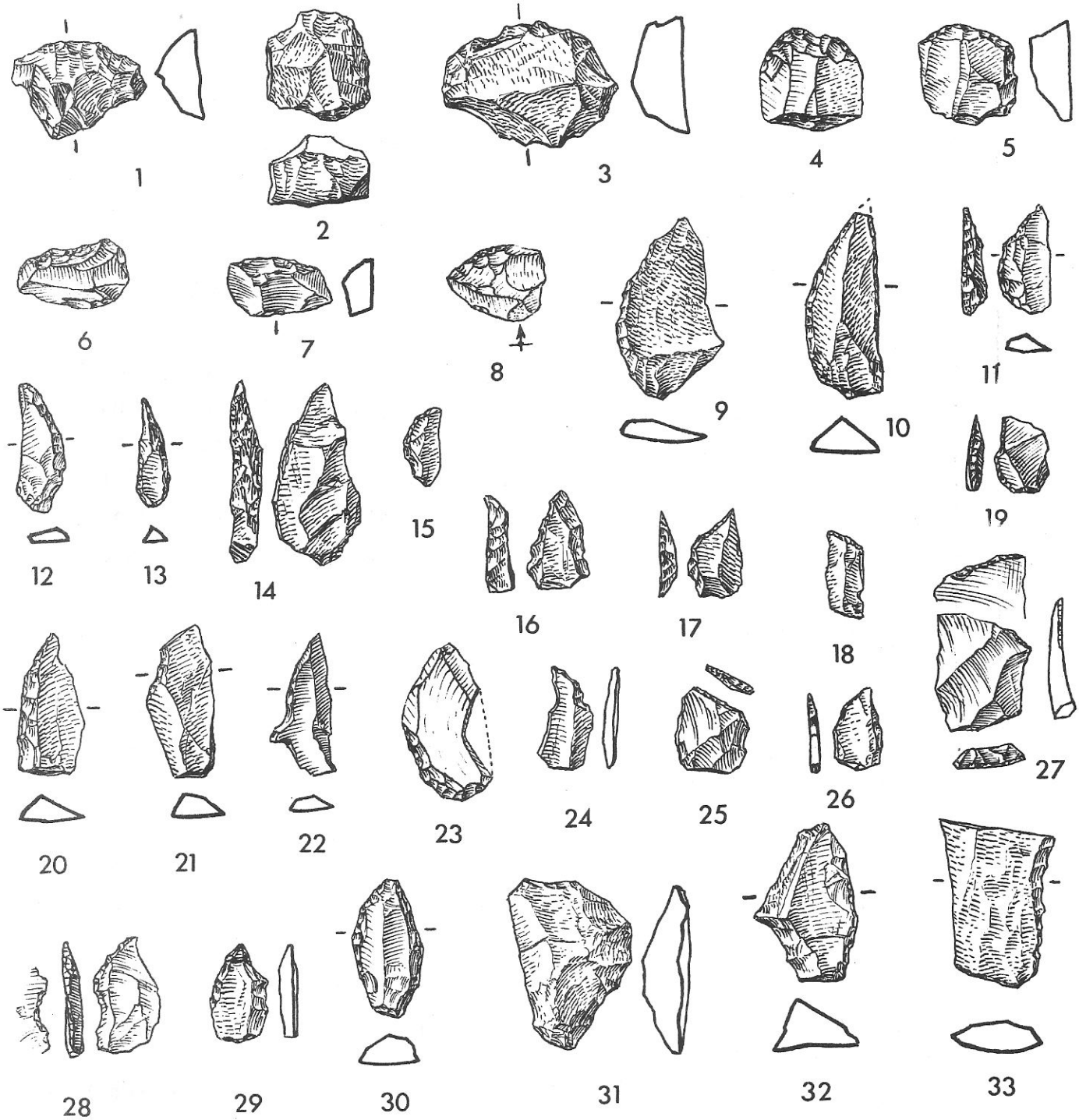


Figure 3: WALGA ROCK, 70 - 90cm zone.

Scrapers: 5 side-scrapers, all of them small. The angle of the retouch is less abrupt than in the adze case (fig. 2, n°6, 13). But they may well be some kind of adzes.

Notches: 10 in all.

Denticulated tools: no large ones, 1 small (fig.2, n°23) and 2 with a microdenticulation.

Backed tools: 1 backed flake, microlithic (n°17), 1 backed bladelet, 6 short backed points, microlithic (n° 7, 8, 10, 11), 2 long backed points (n°12), 1 microlithic long backed point (n°14), 1 partially backed point (n°20).

Truncated tools: 8 truncated flakes with oblique truncation (n°21, denticulated on the side) of which seven are microlithic, 1 truncated blade, small, with oblique truncation, 1 truncated flake with normal truncation, plus one microlithic, 2 truncated and backed flakes, microlithic.

Geometrics: 1 trapeze and 2 segments (lunates) (fig.2, n°9).

Others: 3 fragments of backed or truncated pieces (n°15, 16) and 5 miscellaneous. Among them what seems to be the resharpening flake of a big tool (n°22).

We figure also a small quartz blade (n°24) and 2 splintered pieces ("fabricators")(n°18 and 19).

Index of adzes: 31.17
Index of backed points: 11.69
Index of truncated pieces: 16;89
Index of geometric microliths: 3.90

Zone 70 - 90cm (fig. 3 and 4)

Adzes: 5 tulas (fig.3, n°2), 12 microtulas (n°4, 5, 7), 2 microtulas slugs, 7 other adzes (n°1, 3), 1 adze slug, 15 microadzes (n°8), 5 microadzes slugs (n°6).

Scrapers: 11 scrapers in total: 2 end-scrapers, 8 side-scrapers (fig. 3, n°31, 32), 1 concave scraper.

Notches: 9 in total (fig. 4, n°4).

Denticulated tools: 5 small, 1 microdenticulate (fig.3, n°33).

Backed tools: 1 backed flake, microlithic (fig.3, n°19), 3 backed points, short (fig. 3, n°9, 14, 20), 5 microlithic short backed points (n°11, 16), 3 long backed points (n° 10, in silcrete), 2 of them microlithic (n° 12, 13), 8 partially backed points (fig. 3, n°21, 22, 23).

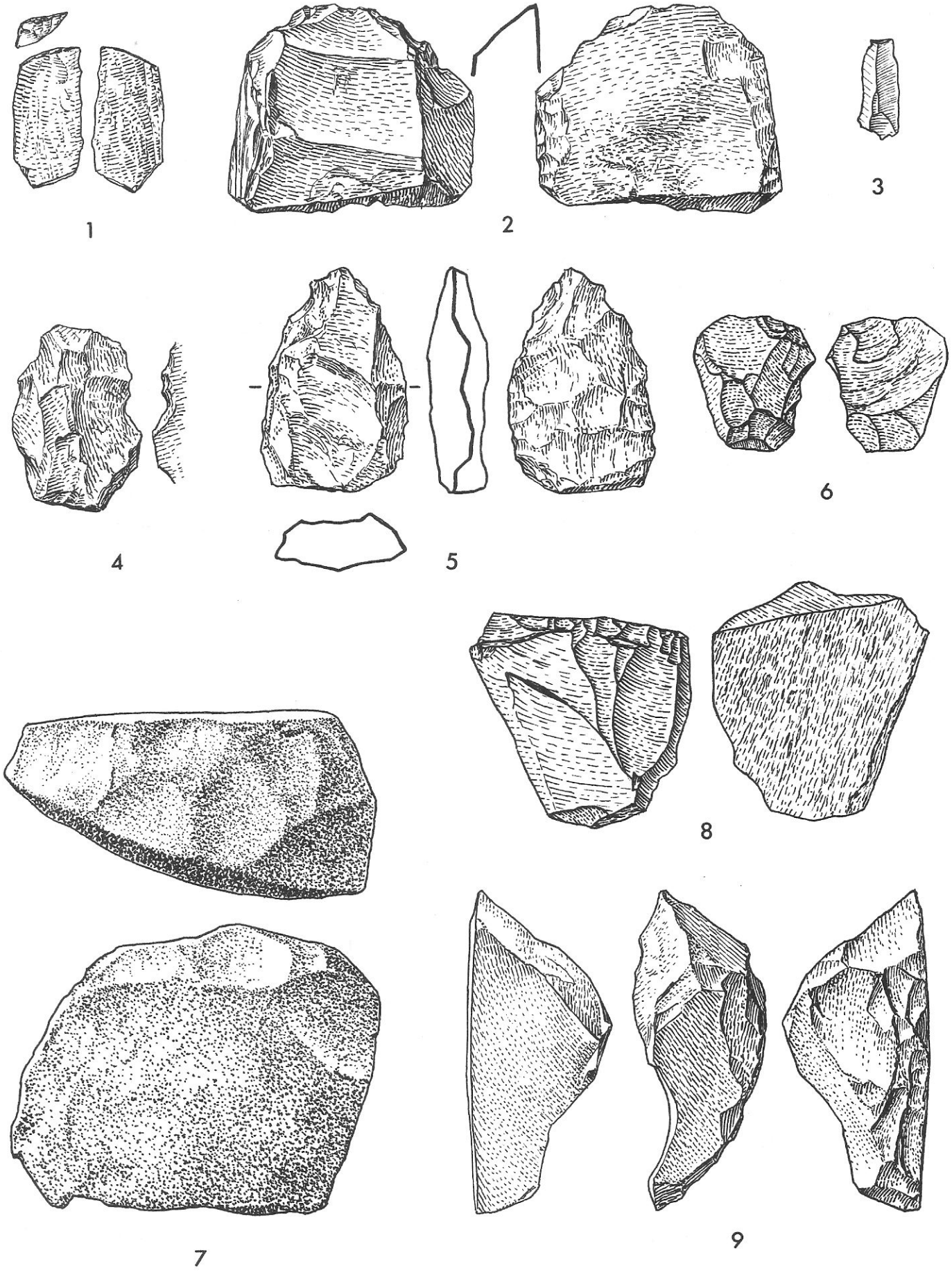


Figure 4: WALGA ROCK, 70 - 90cm zone.

Truncated tools: 10 truncated flakes with oblique truncation, 7 of them microlithic (fig. 3, n°25, 26, 28), 1 blade and 3 bladelets with oblique truncation (fig. 3, n°18; fig. 4, n°1), 1 flake and 2 bladelets with normal truncation, 7 truncated and backed flakes (fig. 3, n°17).

Bilaterally retouched points: 2 of them (fig. 3, n°29, 30).

Geometrics: 3 trapezes (fig. 3, n°27) and 2 lunates (fig. 3, n°15) all of them microlithic.

Others: 1 coarse bifacial point (fig. 4, n°6) worked by percussion, 1 Levallois flake, 1 big retouched flake (fig. 4, n°2), 1 chopper-like big tool (fig. 4, n°7).

We figure also a bladelet (fig. 4, n°3), a bipolar quartz core (n°6), a core (n°8) and a resharpening flake (n°9) very similar to the one found in zone 50 - 70cm.

Index of adzes: 35.7
Index of backed points: 14.18
Index of truncated pieces: 17.91
Index of geometrics: 3.73

These indexes are very close to the ones of the overlying zone.

Zone 90 - 100cm (fig. 5)

Much poorer, it has given only 31 tools.

Adzes: 1 tula, 2 microtulas (fig. 5, n°1), 1 adze, 4 microadzes, 1 microadze slug.

Scrapers: 1 end-scraper in chert (fig. 5, n°8), 2 side-scrapers, small.

Denticulated tools: 2, one large, one small (fig. 5, n°7).

Backed tools: 2 short backed points, one of them microlithic (fig. 5, n°5) and 1 partially backed point (n°2).

Truncated tools: 5 truncated flakes with oblique truncation (fig. 5, n° 3, 4, 9, 10), microlithic, and 2 truncated and backed flakes, one of them microlithic.

Geometric: none.

Others: 2 small Levallois-like flakes (fig. 5, n°6, represented upside down by mistake).

On so few tools, indexes would be meaningless.

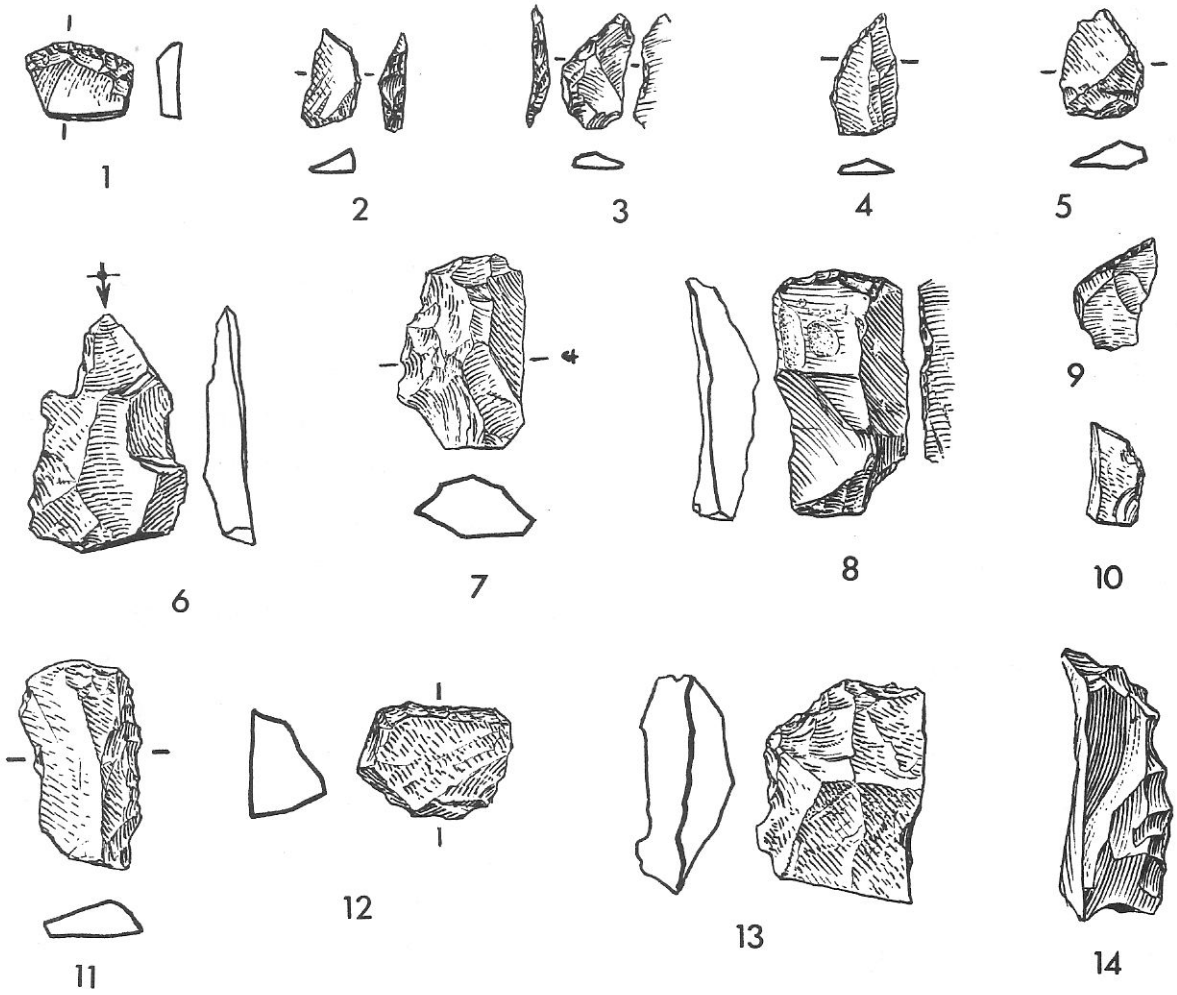


Figure 5: WALGA ROCK, 90 - 100cm zone (n°1 to 10), layer 10 (n°11 to 14).

The following remarks apply to the microlithic assemblages from the upper zone at WALGA.

First, the microadzes, in the general sense, are more numerous than the ordinary ones, which is to be expected, perhaps, in an assemblage where the flakes are close to or under the microlithic size limit: 7 tulas and 15 adzes against 15 microtulas and 34 microadzes. Also the slugs, if one count as slugs the really exhausted tools, are few. Of course, this count is done on 2 square meters only, and so has an indicative sense, and not an absolute one. This is the well known problem of the representativity of the sample, and on so small a surface one can expect that the sample is not truly representative of the industry, except in a wide sense.

Most of the cores are of the amorphous type. There are, here and there, some cores which seem shaped for the production of bladelets, but they are scarce. As for the true bipolar cores, that is the ones which have been clearly squashed between two stones to produce flakes, they are numerous enough. One "horsehoof" only, in the 70 - 90cm zone.

Some of the flakes seem to show a rather careful preparation of the striking platform by facetting, and also a preparation of the side of the core by rubbing off the overhang left by the preceding flake. Which may mean that the techniques of the Aborigines living in WALGA deserved a better material than they had.

Most of the tools are indeed made of medium quality quartz, the origin of which is unknown. There is however a good enough percentage of crystal quartz, also of unknown origin, and sundry material, including chert and a surprising small amount of silcrete since there is a huge outcrop of this stone near Cue, which was extensively quarried.

Layer 10 (dark brown layer) (fig. 5)

It seems separated from the microlithic layer by a big incutting of the sediments (see fig. 1). The flakes are definitely bigger: $\bar{x}$ = 2.1718cm, with a standard deviation of 0.5859 (110 observations). The confidence interval at 99% is 2.0242 to 2.3194, and there is no overlap, even at that level, with the 99% confidence interval of zone 90 - 100cm, which is just over layer 10, and which goes from 1.7876 to 1.9814. This layer 10 is very poor in retouched tools: 17 only.

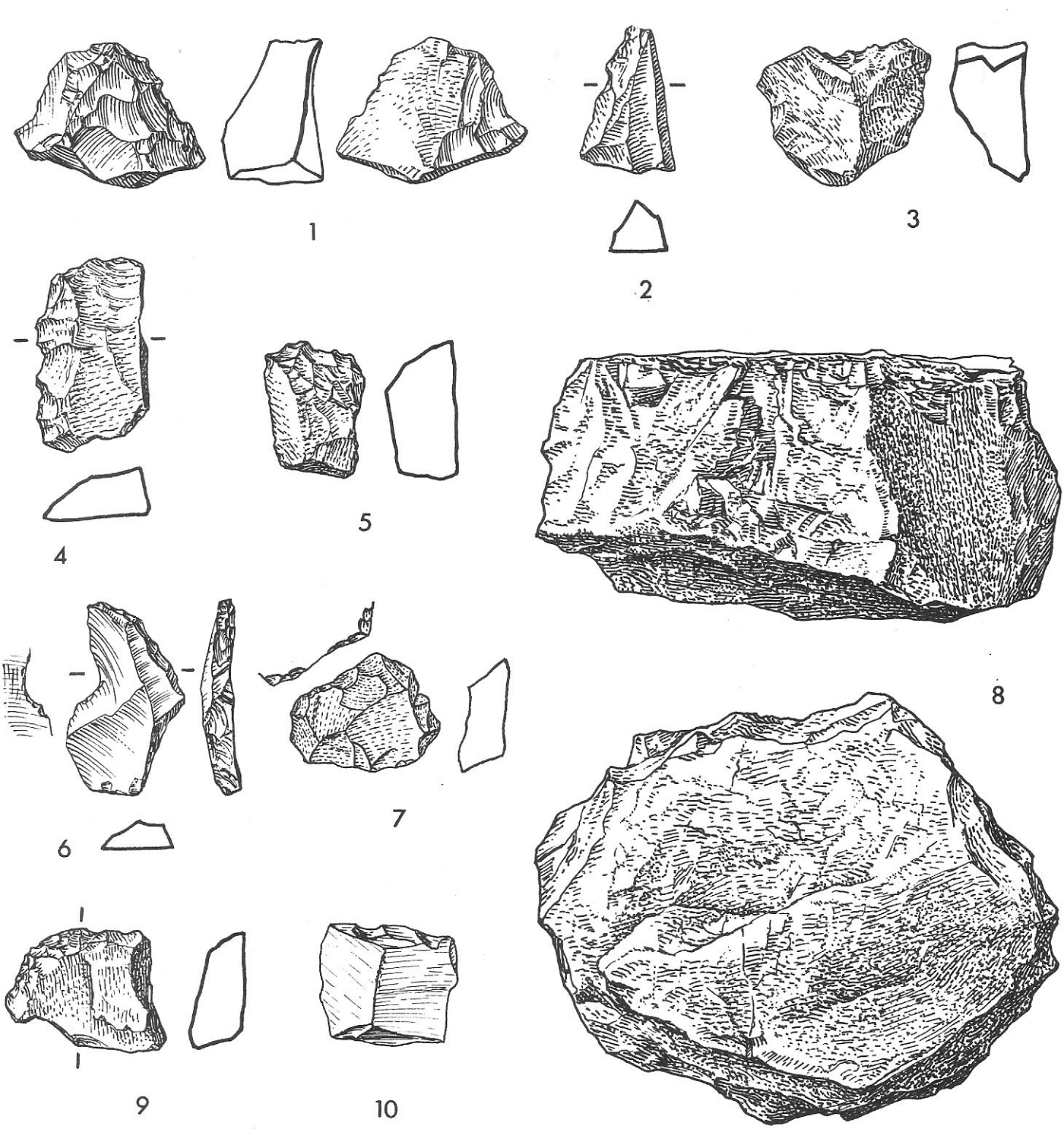


Figure 6: WALGA ROCK, layer 11.

Adzes: 1 dubious tula, 1 dubious microtula, 1 probable adze (fig.5, n° 12). It contains also 3 exemples of what we have tentatively called "proto-adzes", that is flakes which have the general morphology of an adze, with less trimming, but most of the time small undercutting flakes on the working edge (fig. 5, n°13).

Scrapers: 1 side-scraper (n°11) and 1 side-end-end scraper.

Notches and denticulated tools: 2 of each. N°14, fig. 5, is probably a resharpening flake denticulated on the side.

Truncated flakes: 1 with oblique truncation.

Borers: 1

Choppers: 1

This layer contains also one "fabricator", that is what in Europe is called splintered piece (*pièce esquillée*, in French). Most of the few cores are of bipolar type.

Layer 11 (fig. 6)

It is also very poor: 23 retouched tools. The size of the flakes is about the same as in the layer 10. On 165 observations, $\bar{x}$ = 2.3306 with a standard deviation of 0.8437. The confidence interval at 95% is 2.1005 to 2.4607, overlapping the confidence interval of layer 10. However, the general impression is that the tools are bigger than in layer 10, but on so small a sample this impression may be misleading.

Adzes: 2 pieces can be called adzes (fig. 6, n°1, in chert), and there are 12 "proto-adzes" (fig. 6, n° 3, 5, 7, 9).

Scrapers:3 side-scrapers (fig. 6, n°6, in crystal quartz).

Denticulated tools: 4 of them (fig. 6, n°2, 4).

Chopper: 1 big (about 9cm), in coarse quartz (fig. 6, n°8).

The material used in layers 10 and 11 is different as a whole from the material utilised in the microlithic layer: very little crystal quartz, relatively few good quartz flakes. Most of the tools are made of coarse, irregularly flaking local quartz, found in veins in the batholith.

Lowest layers

They have, up to now, given only some flakes each. We figure one from layer 12, with some retouch at one end (fig. 6, n°10).

Summary

The test trench at WALGA has yielded probably two distinct industries, a development seen in other Australian archaeological sequences. Thus the upper "microlithic" zone contains an industry made of small flakes, with a strong component of adze flakes, backed tools and truncated tools. This zone is separated from the lower layers by a deep incutting filled with a practically sterile red sand. The assemblages in the lower layers are characterized by bigger tools, bigger flakes, a scarcity of adze flakes and an absence of backed tools. These apparent typological and size differences between the artifact assemblages from the upper zone and the layers below the erosional feature suggests that a significant time gap occurs between the upper and lower assemblages. No radiocarbon dates are available yet at the time this report is written. However, on the typological and stratigraphical estimates it is suggested that the lower layers date to the late Pleistocene.

Sites near WALGA

Sites at other batholiths near WALGA have been noted above. There is a small painted shelter at one of these batholiths. Here and around WALGA ROCK there are grindstones lying on the ground, showing that hunters-gatherers in this locality utilised grass seed as food, perhaps as a staple. An unusual feature of these very large, well made grindstones is that their outer edges have been shapped by flaking.

About 9km SW of WALGA ROCK, and East of Nobby Well, there are several small rock shelters with surface scatter of stone artifacts, including microliths.

Immediately North of the town of Cue, there is a small quartz and silcrate hill which, as we have said, has been extensively quarried by the Aborigines. The slopes of this hill are covered with numerous silcrete flakes and cores, and also there are some tools present, mainly scrapers and denticulates. It is possible that this site was not only a quarry, but also a camping place.

Four km West of Cue there is a rich scatter of many large stone implements concentrated around a small elevation on the gravel plain. Many other such sites undoubtly exist in the district.

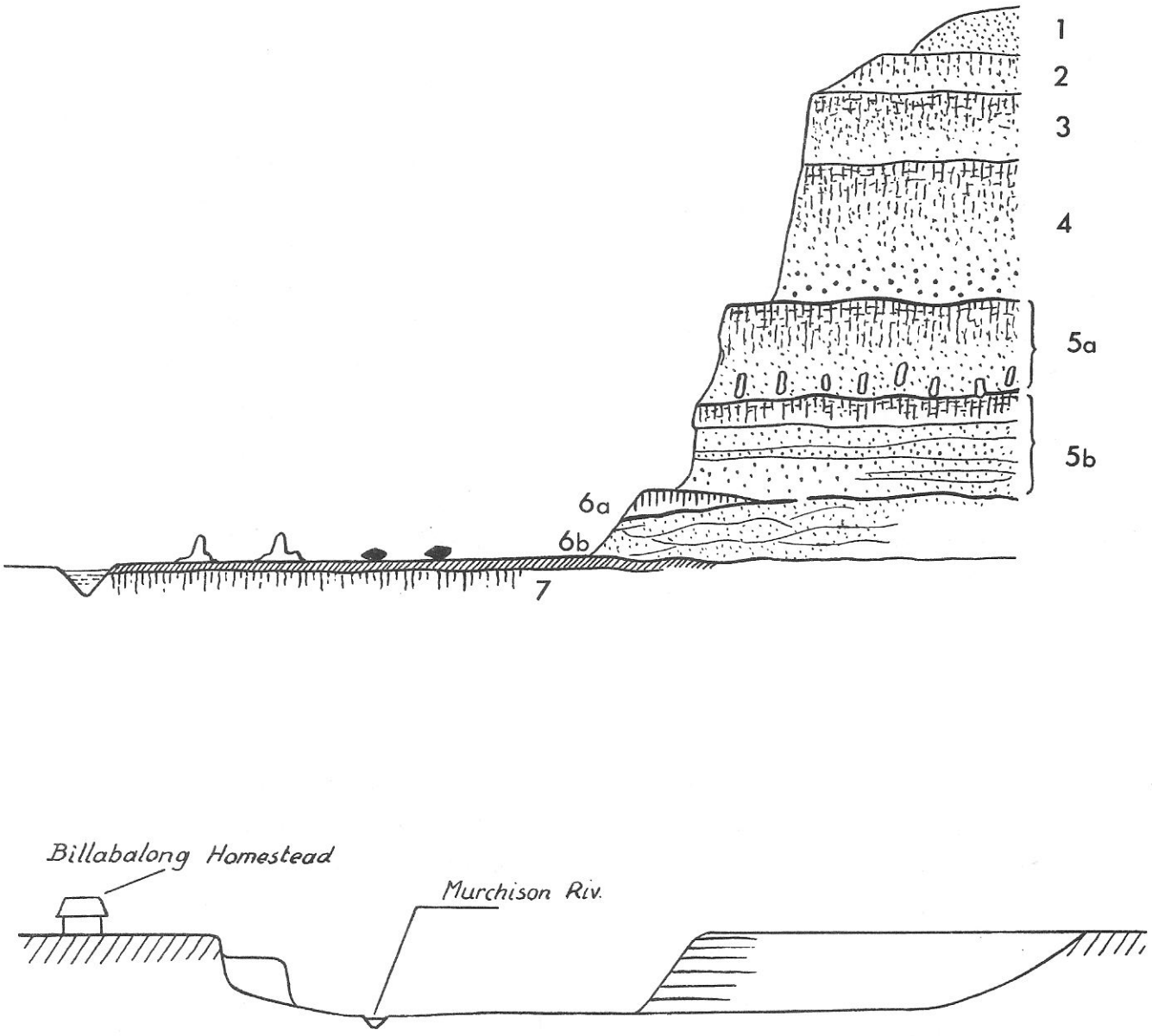


Figure 7: Semi-schematic section at BILLIBILONG SPRING, and position of the sediments in respect to the general morphology of the valley. (Not to scale)

B I L L I B I L O N G S P R I N G

The most important Murchison River site investigated during 1978 is BILLIBILONG SPRING, an alluvial deposit on the left bank of the river, 500m East of the Billibilong Station homestead. Several small test trenches were excavated there, and a burial discovered on the edge of the bank was removed since almost certainly it would have been carried away by the next flood. The burial, which is of Holocene age, was a small rectangular cist made of slabs of siliceous cement taken from the riverbed and contained the skull of a child.

Stratigraphy and sedimentology (fig. 7) .

The deposit at BILLIBILONG SPRING consists of several superimposed soils exposed in the section of the river bank; the whole of this section overlies a very old, indurated fill informally known as the "Murchison cement". This cement is exposed in the river bed, but is buried beneath flood plain deposits for two km East of BILLIBILONG SPRING. On the right bank a small Holocene terrace abuts a broad exposure of the cement extending hundreds of meters West of the station homestead.

About 50m East of the main section at BILLIBILONG SPRING, there is a very irregular deposit (layer 0) consisting of very well sorted, slightly clayey soft sands. This deposit is probably eolian though the grains do not show any evident traces of eolisation, which probably means they were carried only a short distance. The stratigraphical sequence along the river bank where the excavations took place is as follows, reading from top to bottom:

Layer 1. Sands with little clay, well sorted. By comparison with the granulometry of layers 2 and 3 below it seems that this unit has been locally resorted by wind action.

Layer 2. Sands mixed with clay and silt, with a poorly developped sub-angular structure. The granulometry shows poor sorting of the sand fraction, resulting from deposition by sheet wash or colluvation.

Layer 3. Clayey sands (27 - 30% colloids) with a coarse but clear sub-angular structure. The sediment is hard when dry and porous. It is less hard and less structured at the bottom where there are gravels in the range 1 - 2cm.

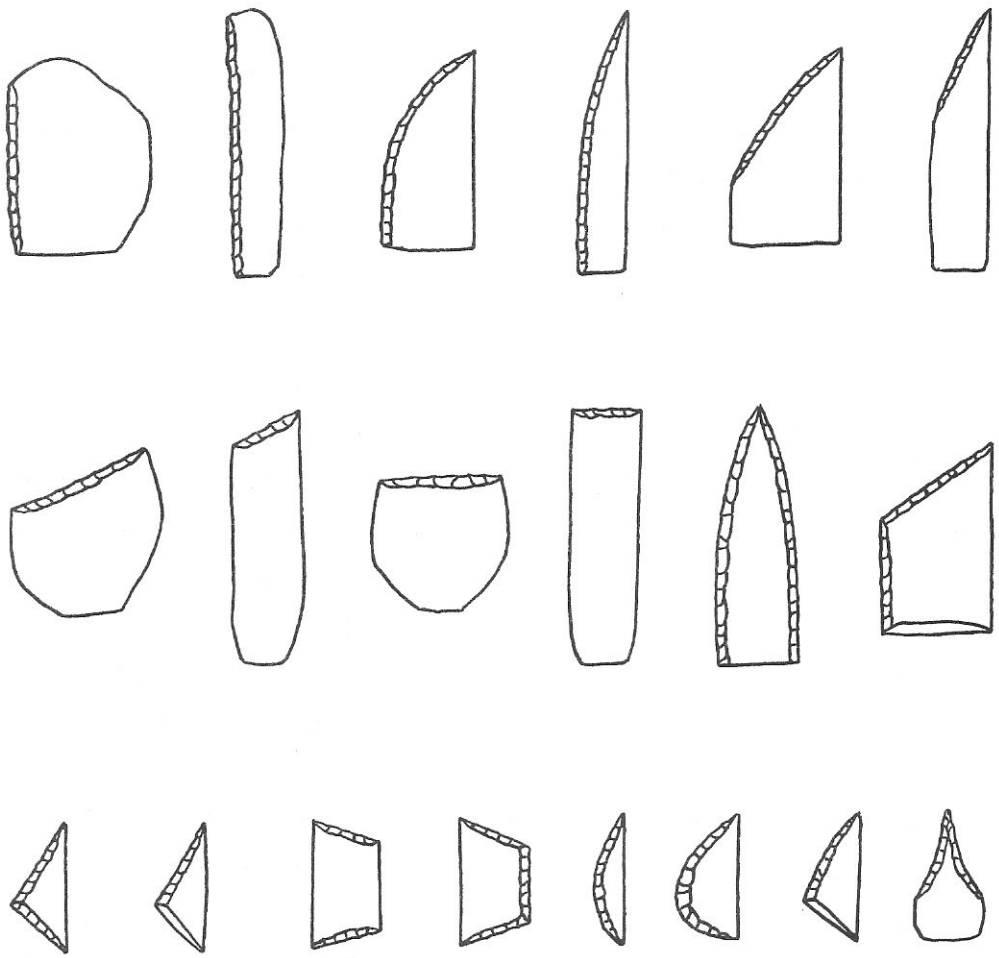


Figure 8: Schematic representation of the types of microliths in layer 1 at BILLIBILONG SPRING.

Even though layer 3 has a poorly sorted sandy fraction over almost its whole thickness, this layer's granulometric characteristics are very similar to those of layer 4, suggesting a derivation of layer 3 sediments from layer 4 by means of faint sheet wash or colluviation.Sands at the top of layer 3 are much more well sorted, either by stronger sheet wash or by eolian action. Other evidence of eolisation in layer 3, mainly toward its top, is shown by the 5 or 6% of mat-surfaced sand grains. Also the sub-angular grains are bruised on the corners, evidence of impact which is virtually absent in quartz grains from layer 4.

Layer 4. Slightly clayey sands, reddish brown toward the base and brown at the top, where the structure is polyhedric, medium developped, within an over-structure of irregular clods. This sediment, with little porosity, is hard at the top and soft at the base.

Field observations suggested that this layer is alluvial. Granulometric analysis shows clearly that the sandy fractions are well sorted. Although this layer's hardness and structure diminish quickly beyond a 15cm depth, the sedimentological analysis indicated that the colloid gradient goes lower (to a depth of 30cm), attesting to a marked degree of weathering in layer 4. From bottom to top the enrichment in colloids is 17%.

Layer 5. Clayey and silty sands, brown to reddish brown in the accumulative horizons of the two soils contained in this layer. The residual soil of layer 5 A has a well developped sub-angular structure, within a columnar over-structure. The sediments are very hard and porous. The soil on 5 B has a medium developped sub-angular structure and is less thick. The sediment is porous, but less hard. The C horizons of the 5 A and 5 B soils are fine grained sands, soft, well sorted and evidently of alluvial deposition. On the whole the sediments of this layer are well sorted despite the differences in texture and structure and the enrichment in colloids toward the base of the two soils.

Elongated, vertical carbonated concretions are present in and at the base of the B textural horizon of soil 5 A; in places these penetrate the C horizon and extend to the top and occasionaly slightly penetrate the textural B horizon of soil 5 B.

Layer 6. Slightly clayey-silty sands of a light colour, sometimes whitish. The sandy fraction is well sorted, of characteristic fluviatile

deposition. This layer is very much eroded at BILLIBILONG, and the soil lying on it consists of a truncated B horizon with a clear polyhedric structure, indurated, with well developped macroporosity. Below the soil, the alluvial material consists of sands and small gravel beds, hardened by siliceous horizons which follow the stratification planes. These horizons, some of which are gravels and sands cemented by silica, and others bands of almost pure silica, are visible in the present bed of the river. In places they support vertical siliceous "pipes" which seems to indicate that the silicification came from the top during the weathering of the soil.

Layer 7. This unit is apparently the weathered surface of the Murchison cement, and extends under eroding remnants of layer 6 exposed in the river bed. This unit is composed of indurated sands, dark red when heavily pedogenized, light brown elsewhere, and contains many ferruginized, hardened slabs.

Summary.

The Quaternary deposits at BILLIBILONG SPRING are of alluvial origin from layer 7 to 10cm below the top of layer 4. The top 10cm of layer 4 and layers 3 and 2 have been deposited by colluvation, diffuse sheet wash or a combination of these. Layer 3 in particular consists of redeposited material from the weathered top of layer 4. Layers 1 and 0 are probably eolian in origin.

Weathering of the lower layers has been intensive. The probably very well developped paleosoil on layer 6 has been largely truncated. Marked and complex pedogenetic action has occured on layer 5, including the intermediary weathering episode defining the top of 5 B. Layer 4 is consistently heavily weathered. Downcutting of the river may have occured after the deposition of layer 4, or even before the end of this deposition, since the upper 10cm consist of poorly sorted sediments which probably colluviated down a slope.

Archaeological material (table 2).-

Layer 0

A 1902 coin near the base of this unit shows it to be modern.
Stone artifacts in layer 0 represent Aboriginal occupation of the site

during this century, or pieces blown or fortuitely dropped on surfaces buried within the layer.

Layer 1

Little excavation has been carried out in layer 1; many tools and flakes were systematicaly collected on a wide surface in a deflation zone exposing this layer. This collection has not been studied so far, but fig. 8 shows the range of microlithic tools present. They comprise obliquely or normally backed flakes and bladelets, backed points, short or elongated, partially backed points, short or elongated, bilaterally retouched points, triangles, half-triangles (one side being an unretouched break), trapezes, backed trapezes, backed and truncated flakes and bladelets, segments (lunates) and small "borers" (fig. 8).

Layer 2

This assemblage lies at the bottom of geological layer 2. It is also a microlithic industry. On 145 observations, the mean size of the flakes is $\bar{x} = 1.8362$ with a standard deviation of 0.4319. At the 99% level, the confidence interval is from 1.7421 to 1.9303.

Adzes: 1 tula slug (fig. 9, n°3), 2 microtulas (n° 1, 2), 1 ordinary adze.

Scrapers: 1 end-scraper, microlithic.

Notches: 1, of clactonian type.

Backed tools: 1 backed point, microlithic, in chert; 1 partially backed point, microlithic, also in chert (fig. 9, n°4, 5).

Truncated tools: 6 obliquely truncated bladelets (n° 6, 8); 1 bitruncated bladelet (not trapeze)(n° 7); 1 truncated and backed bladelet.

Others: 4 Lavallois flakes, with very well prepared facetted platforms (fig. 9, n° 9, 10, 11).

With the exception of the backed tools, all are in a rather good quality quartz. The cores are mostly amorphous, but there is 2 bladelet cores, 1 discoidal core and 2 true bipolar cores (fig. 9, n°12).

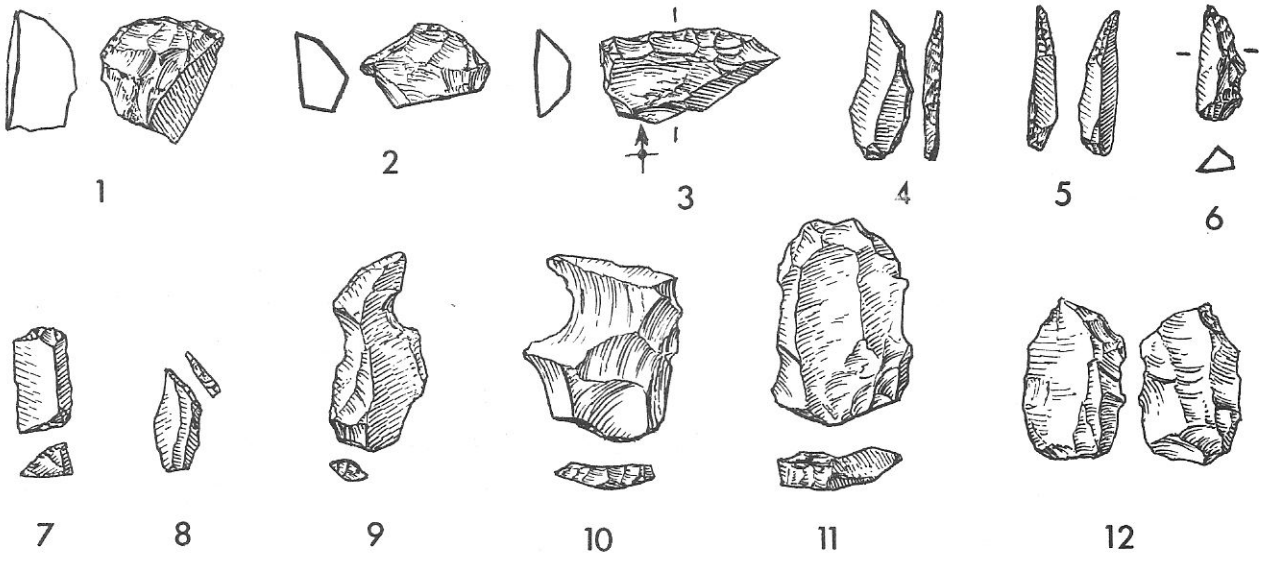


Figure 9: BILLIBILONG SPRING, layer 2.

Layer 3 (fig. 10)

The artifacts lay at the bottom of geological layer 3, on the surface of the soil of layer 4. 46 retouched tools. On 298 observations, the mean size of the flakes is greater than in layer 2: $\bar{x}$ = 2.0953 with a standard deviation of 0.6199. The confidence interval at 99% level is from 2.0020 to 2.1886. There is no overlap with the confidence interval of layer 2, and we can safely conclude that the flakes are larger in layer 3 than in layer 2.

Adzes: 3 tulas (fig. 10, n°1, 2, 3), two of them a little atypical; 2 adzes (n° 4, 11); 2 adzes slugs, 1 microadze.

Scrapers: 1 side-scraper (which may well be an adze too) (fig. 10, n°5) and a microlithic canted side-scraper; 1 big convergent scraper (n°30) with facetted butt.

Denticulated tool: 1

Borer: 1 (n° 25)

Backed pieces: 2 short microlithic backed points (n° 6, 7).

Truncated pieces: 1 truncated bladelet with oblique truncation and 14 truncated flakes with oblique truncation (n° 12, 13, 14, 16, 22); 1 flake with normal truncation (n° 15); 10 of them are microlithic.

Geometrics: 8 trapezes, 4 of them microlithic (fig. 10, n°18 to 21, 23, 24), and one lunate.

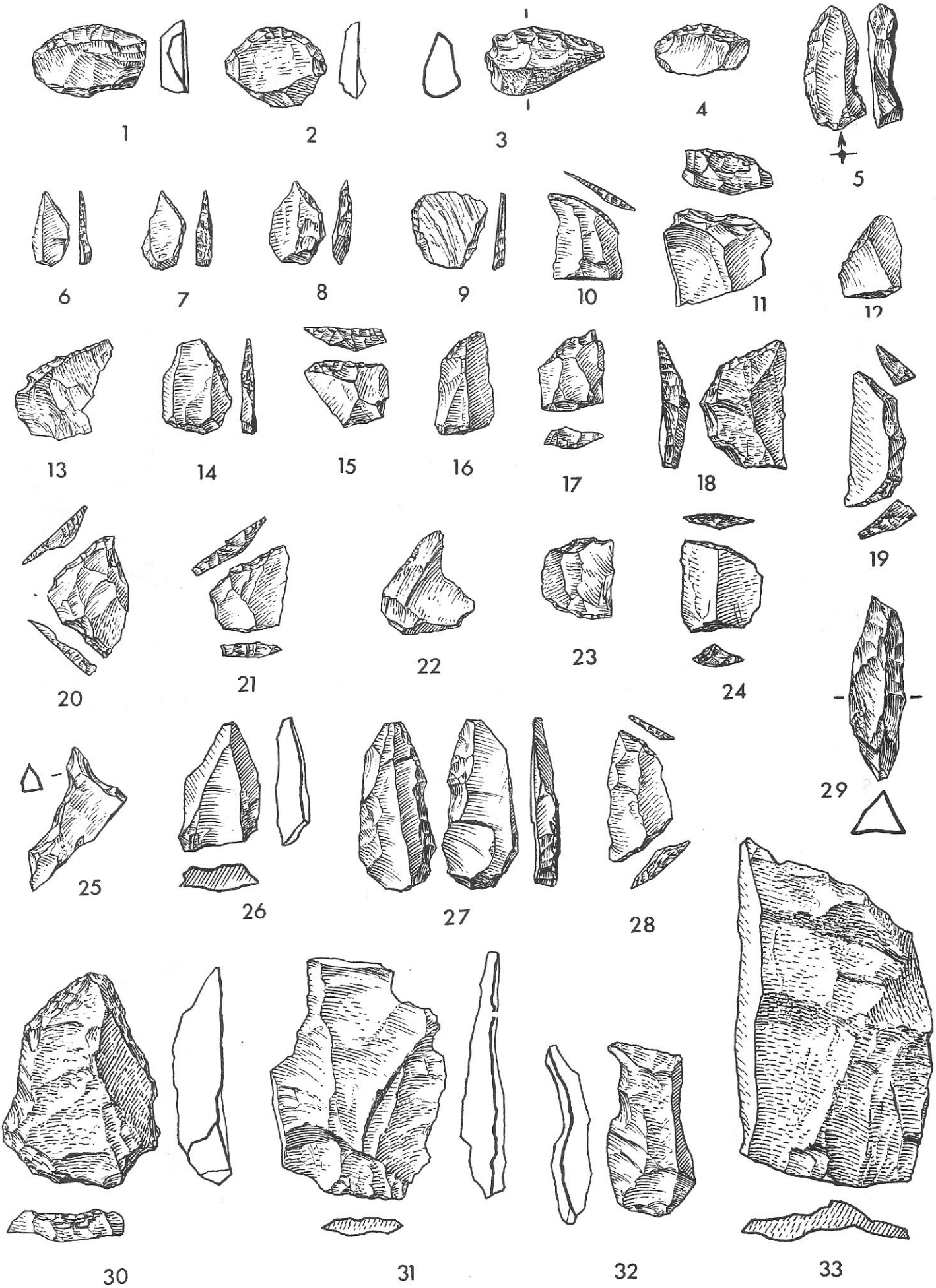


Figure 10: BILLIBILONG SPRING, layer 3.

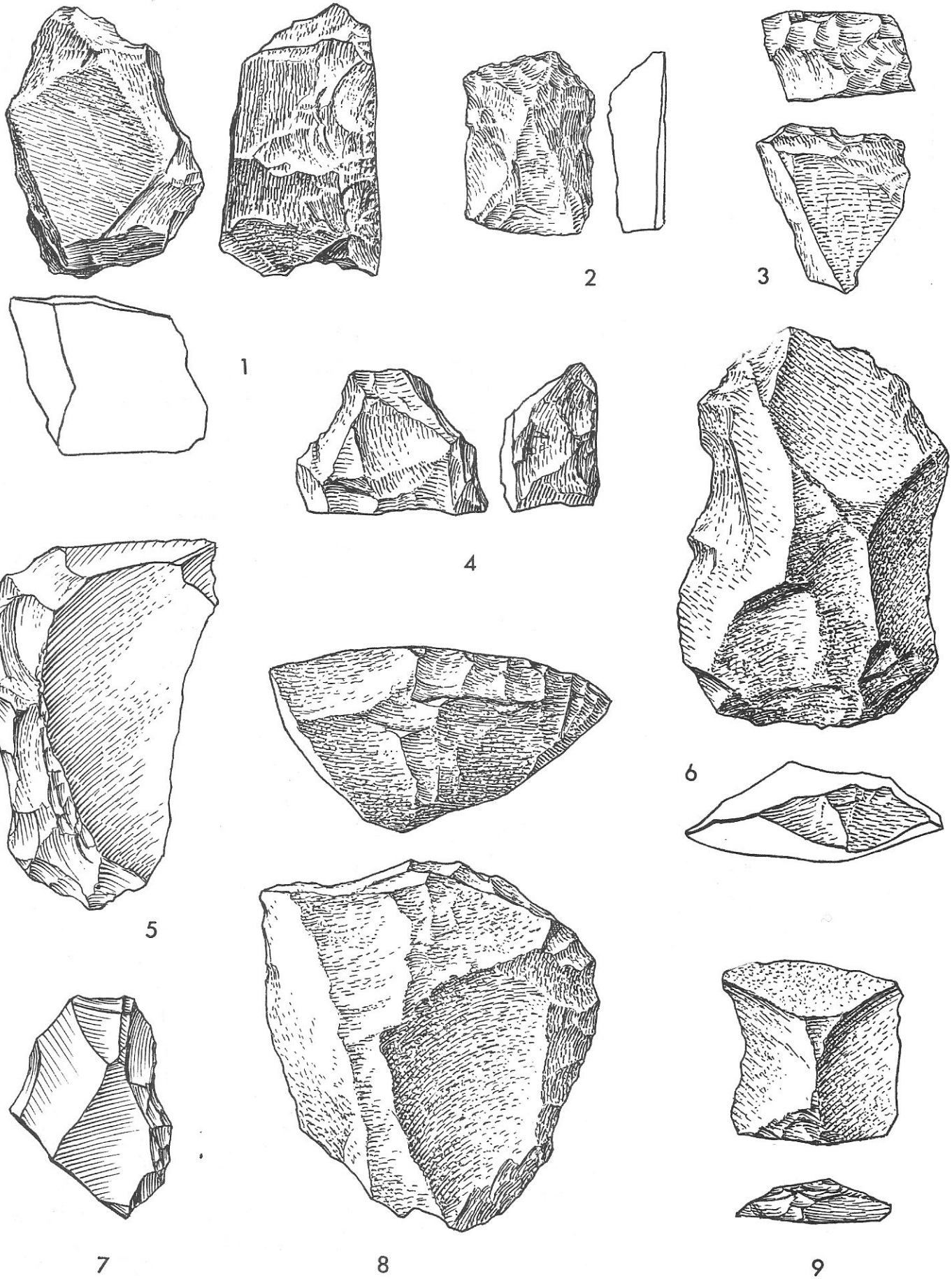


Figure 11: BILLIBILONG SPRING, layer 4 (n°1 to 3) and layer 5 (n°4 to 9).

Others: 4 Levallois flakes (n° 31, 32); 1 Levallois-like chert point (n° 26), 1 semi-backed tool with a retouch on the ventral surface (n° 27), and some other miscellaneous tools.

We figure also a crested blade (n° 29) and a big quartz flake (n° 33).

The core are mainly amorphous, but there is one bladelet core and 2 true bipolar cores. As in the case of layer 2, most of the artifacts are in rather good quality quartz.

Layer 4 (fig. 11)

We have a very scanty collection, mainly small quartz flakes scattered on the top of the soil of geological layer 5 A. Among them 2 thick quartz flakes, retouched, which may be scrapers, but also proto-adzes (not of tula type) (fig. 11, n° 2, 3). South of the BILLIBILONG bridge, we have found, isolated, a quartz core-tool (fig. 11, n° 1) which is a kind of nosed scraper, very much undercut by small retouch, comparable to a tool of layer 6 (fig. 13, n° 1).

Layer 5 (fig. 11)

A small collection of tools and flakes, often stuck in the zone of carbonated concretions. Before the expedition, one of us (Ch. DORTCH) has found in this layer 5 a big Levallois flake in igneous rock (fig. 11, n° 6). We have found a big end-and-side scraper (n° 8) in the same material. 3 or 4 others tools of that type have been found on the river bed, out of stratigraphical context, and may come either from this layer or from layer 6. A chert side-scraper (n° 7), a bad quartz scraper (n° 4), a big quartz flake (n° 5), and some small flakes, either of igneous material (n° 9) or more often of quartz complete the series.

Layer 6 (fig. 12, 13, 14)

The tools have two different origins: some have been found under the bulk of the deposits in a small test trench in the bank of the river, but most have been found stuck in the siliceous slabs, now exposed by erosion, on the dry river bed. In both positions, they were usually associated with small reddish and blackish gravels. As the siliceous slabs pass under the bulk of the layers, we feel confident that the tools imbedded in them belong to layer 6. The horsehoof core represented on the title page was loose, but is partly covered by siliceous concretions, and probably belongs to layer 6.

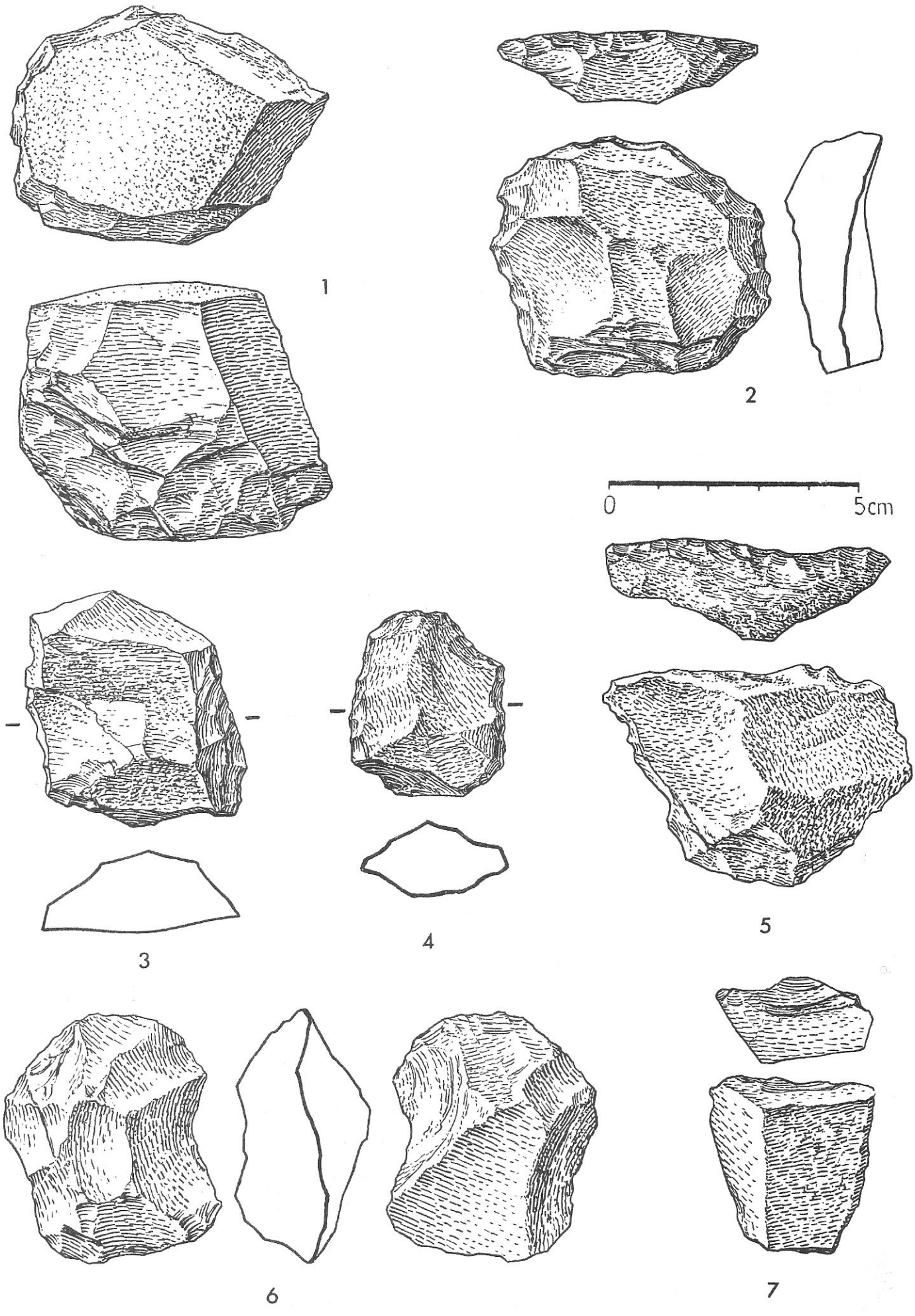


Figure 12: BILLIBILONG SPRING, layer 6.

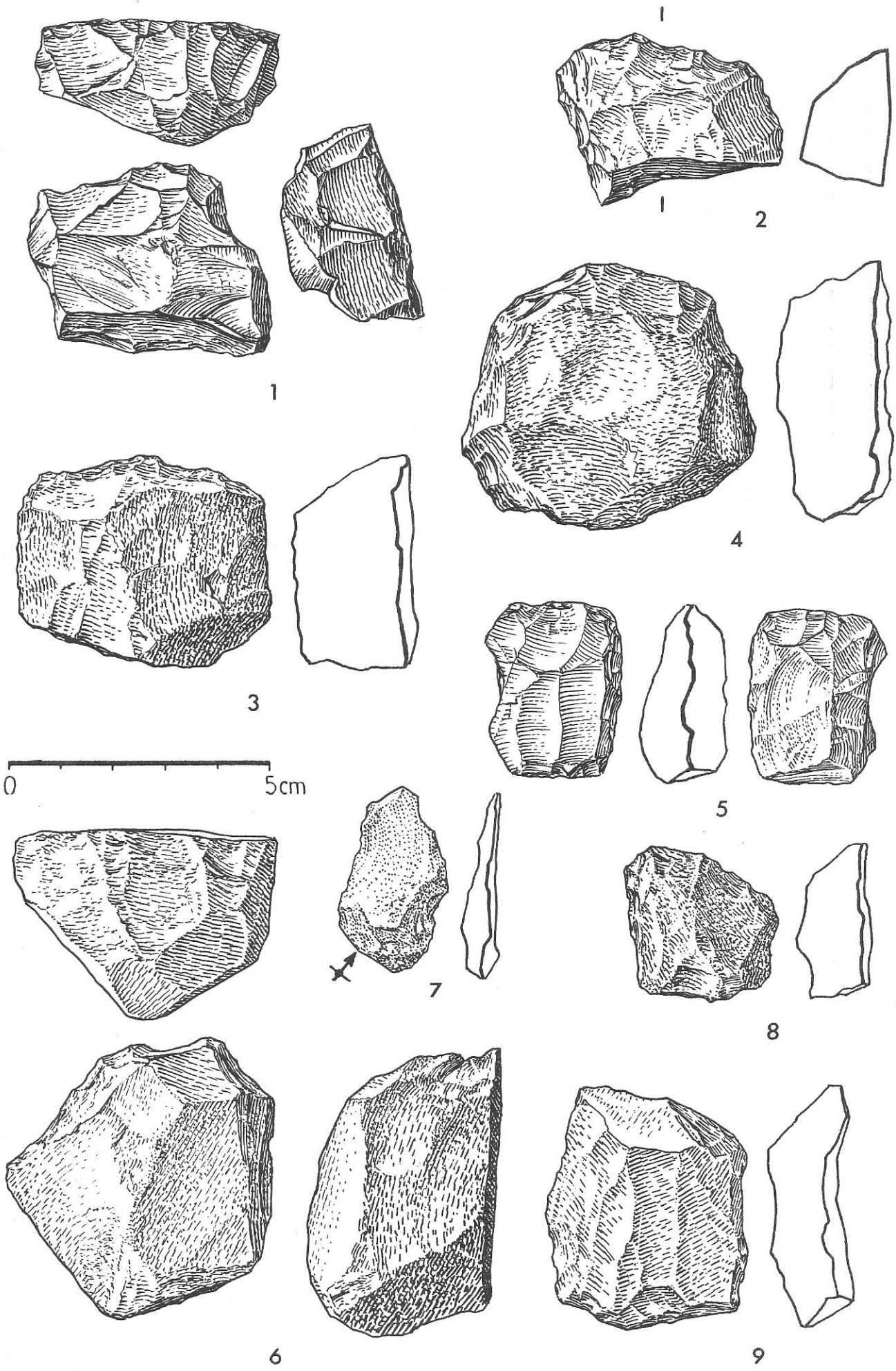


Figure 13: BILLIBILONG SPRING, layer 6.

We have found:

2 horse-hoofs (fig. 12, n° 1, quartz; fig. 14, n° 4, quartz),

3 round scrapers (fig. 12, n° 2, igneous rock; fig. 12, n° 4 and fig. 13, n° 4, both in quartz),

2 canted scrapers (fig. 13, n° 2; fig. 13, n°8, both in quartz) (1),

1 nosed scraper (fig. 13, n°1, in chert),

3 side-scrapers (fig. 12, n° 3; fig. 14, n° 3, both in quartz; fig. 14, n° 6, in chert),

4 transversal scrapers (fig. 12, n° 5; fig. 13, n° 3, both in quartz; fig. 14, n° 1 and 2, both in igneous material),

1 bifacial chopper (fig. 12, n° 6, in quartz),

1 splintered piece or bipolar core (fig. 13, n° 5, in igneous material),

1 Levallois-like flake (fig. 13, n° 9, in quartz),

1 tool which looks like a big adze (hand held?) (fig. 13, n° 6, in quartz).

In spite of infamous eolithic connotations, the tool fig. 14, n° 5, is best described as a rostro-carinate. Several flakes (fig. 12, n° 7, in quartz, fig. 13, n° 7, in igneous material) complete the series. Only one small silcrete flake was found.

Summary and datations.-

At BILLIBILONG there appear to be two very different industries. One is microlithic, almost entirely made of quartz (layers 1, 2 and 3) and is found in almost undisturbed position in colluvial deposits. It is also fairly recent. We have two radiocarbon dates for layers 2 and 3:

Layer 2 : Ly 1810. 2030 BP ± 330. Interval at 95% probability: 2690 BP to 1370 BP.

Layer 3 : Ly 1809. 3590 BP ± 130. Interval at 95% probability: 3850 BP to 3330 BP.

The second industry is "macrolithic" (layers 4, 5 and 6) and is found scattered in fluviatile deposits. No stone artefact is known from layer 7. No microlithic tool has been recovered below layer 3. The relative importance of the soils developped on layer 4 and 5, and probably 6 (taking into account extensive erosion)suggests a considerable time depth for the sequence. Wether

(1) .- It may be of interest to note that one of us (F. BORDES) has recently seen in the Tasmanian collections of the British Museum in London a quantity of canted scrapers.

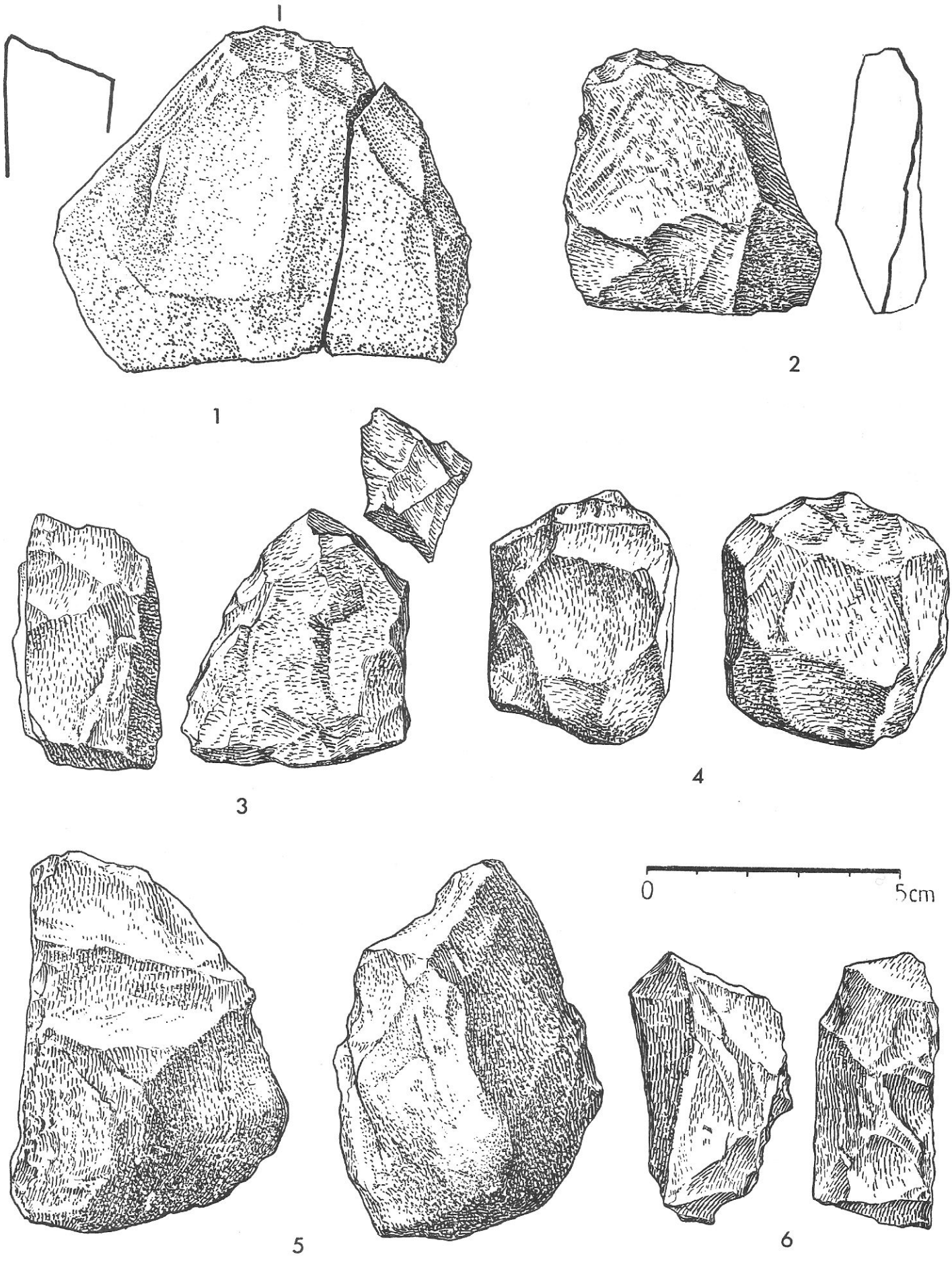


Figure 14: BILLIBILONG SPRING, layer 6.

this time depth extends beyond the age of any other archaeological material known in Australia is another question which in the absence of datable material in layer 5 and 6 requires further detailed geological studies. A small charcoal sample, however, from layer 4 is being processed now, and this may provide a reliable absolute date for the middle part of the BILLIBILONG sequence.

Other sites

BALLINU SPRING, located on the river 13km downstream from BILLIBILONG SPRING, is an alluvial site where in the 1950's Mr H. WHITE recovered the very well preserved mandible of a *Zygomaturus*, an extinct marsupial the size of a small cow. This find led to MERRILEES' pioneer study of the cemented alluvium in this region. This site contains a sequence of Holocene and Pleistocene stone industries within very much the same sequence of soils identified at BILLIBILONG SPRING. Soon after the 1978 season Mr J. WHITE, the brother of the finder of the first *Zygomaturus* mandible, found another mandible of the same species at BALLINU SPRING, and this and other bones were excavated by J. BALME, W.C. FERGUSON and G.W. KENDRICK in October 1978 (BALME, *in press*). Until now these finds have not been associated with archaeological material from the site though one of the aims of the 1979 Season will be a stratigraphical study of the deposits at BALLINU SPRING.

The only other regional site where bones of extinct marsupials and artifacts are present is on the Greenough River 75km due South of BALLINU SPRING where several stone artifacts are from the same silicified horizon as another *Zygomaturus* mandible (WYRWOLL & DORTCH, 1978).

Other sites which are of potential importance in the Murchison valley are at BILLILLY CLAYPAN and WAIL OUTCAMP, 50km NW of BILLIBILONG SPRING. The lakeshore dunes at BILLILLY CLAYPAN contain rich Holocene stone artifact assemblages and it is possible that an important industrial sequence exist there. A deflated lake shore dune near WAIL OUTCAMP contains a stone arrangement which may be thousands of years old.

A significant aspect of the Murchison River sites is that the richest artifact assemblages and the only fossil mammalian remains so far recovered are located in the vicinity of springs (*i.e.* BILLIBILONG and BALLINU), suggesting that these features were favoured camping places and also attractive to animals. At present Pleistocene artifacts appear to be very rare and Holocene assemblages very scarce along stretches of the river away from springs or pools, evidence which will be tested further during 1979.

In the Greenough River the exposed granite basement rocks contain pools of fresh water after floods or rain, and nearby concentrations of artifacts and the recently discovered *Zygomaturus* mandible (WYRWOLL & DORTCH, 1978) seem to represent human and animal response to a scarce commodity.

A closer study of the hydrogeology of the Murchison and Greenough Basins might enable more such sites to be discovered. Certainly the availability of reliable water resources was a key determinant affecting occupation patterns here just as in many other semi-arid or arid regions of Australia.

May 1979

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Table 1

WALGA ROCK

		50 - 70	70 - 90	90 - 100	L 10	L 11
1	Proto-adzes				3	12
2	Tulas	1	5	1	1 (?)	
3	Tulas slugs					
4	Microtulas	1	12	2	1 (?)	
5	Microtulas slugs		2			
6	Adzes	7	7	1	1 (?)	2
7	Adzes slugs		1			
8	Microadzes	15	15	4		
9	Microadzes slugs		5	1		
10	End scrapers		2	1		
11	Side scrapers	4	8	2	1	3
12	Concave s.scrap.	1	1			
13	Side-and-end scrapers				1	
14	Notches	10	9		2	1
15	Large denticul.			1	2	1
16	Small denticul.	1	5	1		1
17	Microdenticulates	2	1			2
18	Backed flakes		1			
19	B. flakes microl.	1				
20	B. bladelets	1				
21	B. points, short		3	1		
22	B. points, short, microl.	6	5	1		
23	B. points, long	1	1			
24	B. points, long, microl.	1	2			
25	Partially back points	1	8	1		
26	Truncated flakes, oblique	1	3		1	
27	Trunc. flake.obl. microl.	7	7	5		
28	Trunc. blade oblique	1	1			
29	Trunc. bladelets oblique		3			
30	Trunc. flake normal	1	1			
31	Trunc. fl. norm. microl.	1				
32	Trunc. blade, normal			1		
33	Trunc. bladelet, normal		2			
34	Trunc. & back. flakes		6	1		
35	Trunc. & back. fl. microl.	2	1	1		
36	Trunc. & back. bladelets					
37	Retouched points, both sides		2			
38	Triangles					
39	Trapezes	1	3			
40	Backed trapezes					

W A L G A R O C K (suite)

	50 - 70	70 - 90	90 - 100	L 10	L 11
41 Bitrunc. bdlets. obl.+ norm.					
42 Segments	2	2			
43 Fragm. of back.or trunc.pieces	3	3	4		
44 Borers				1	
45 Bifacial points (percus.)		1			
46 Levallois flakes		1	2		
47 Choppers		1		1	1
48 Ch. tools				1	
49 Miscellaneous	5	4		1	
Total	77	134	31	17	22
Utilized flakes	68	87	29	18	28
Utilized blades	3	1	1		
Fabricators	7			1	
Flakes	401	640	212	155	196
Blades	7	7	3	1	3
Bladelets	25	30	6	1	9
Chips	1201	1279	439	299	213
Crested blades	1				
Debris	397	202	78	84	156
Cores	12	26	1	1	10
Bipolar cores	9	19	4	6	1
Chunks	54	54	20	19	51

Table 2

B I L L I B I L O N G S P R I N G

	Layer 2	Layer 3
Tulas		3
Tulas slugs	1	
Microtulas	2	
Adzes (non tula)	1	2
Adze slugs		2
Microadzes		1
End-scrapers, microlithic	1	
Side scrapers, microlithic		1
Canted scrapers, microlithic		1
Convergent scrapers		1
Notches (clactonian)	1	
Denticulates		1
Backed points, short, microlithic	1	2
Partially back. points, microlithic	1	
Bladelets with oblique truncation	6	1
Bladelets with normal truncation	1	
Flakes with oblique truncation		14 (8 microlithic)
Flakes with normal truncation		1 (microlithic)
Trunc. and backed bladelets	1	
Trapezes		8 (4 microlithic)
Lunates		1
Borers		1
Fragments of back. or trunc. pieces		1
Levallois flakes	4	4
Levallois points		1 (microlithic)
Miscellaneous		4
	20	49
Utilized flakes	1	14
Utilized bladelets	3	1
Flakes	132	249
Blades		1
Bladelets	30	28
Chips (less than 1.3cm)	295	229

.../...

Crested blades		1
Crested bladelets	1	1
Amorphous cores	8	14
Bladelet cores	2	1
Discoidal cores	1	
True bipolar cores	2	2
Chunks		4
Fragments of flakes, small	1	34

PLATES

Plate I : WALGA ROCK shelter seen from the East.

WALGA ROCK shelter seen from the West.

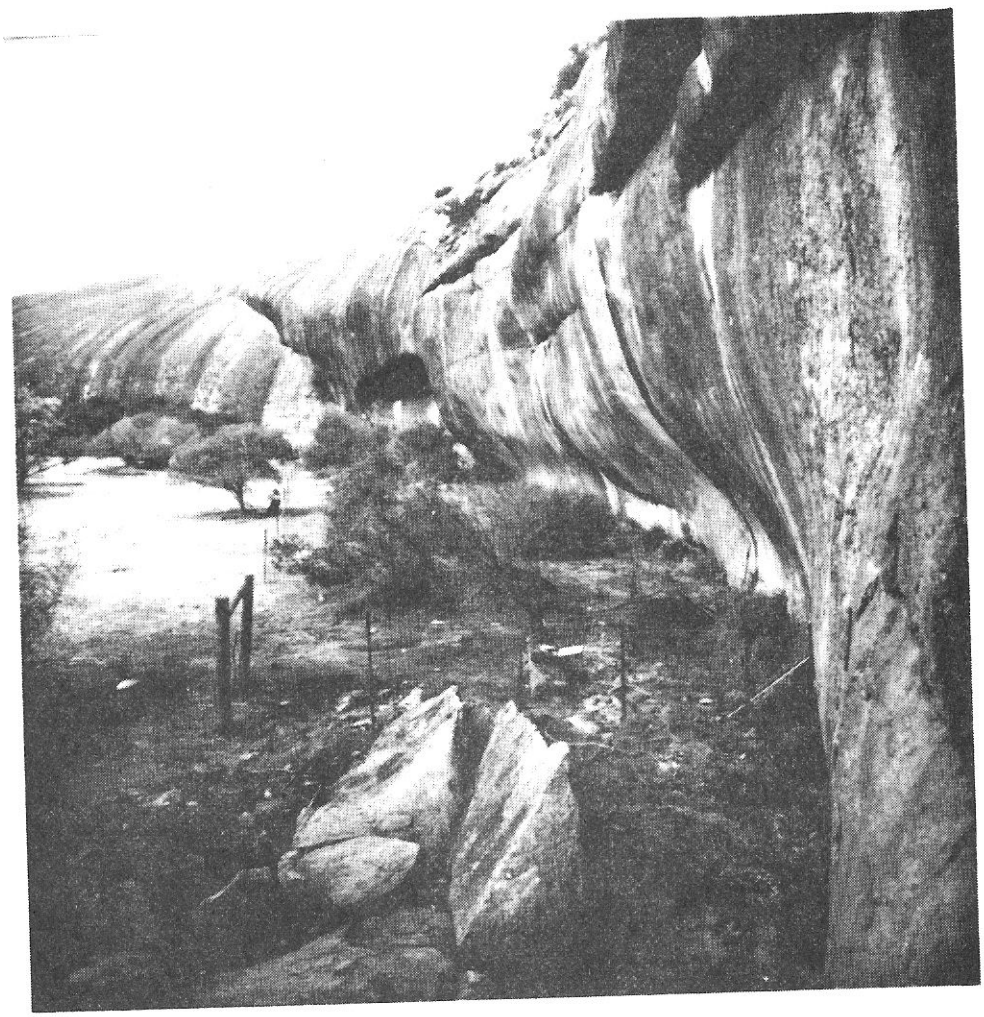


Plate II : Temporary water holes on top of WALGA ROCK after the rain.

Layer 13 (big rock fall) at WALGA ROCK.

Plate III : Air view of the Murchison Valley at BILLIBILONG SPRING.

Structure at WAIL OUTCAMP.

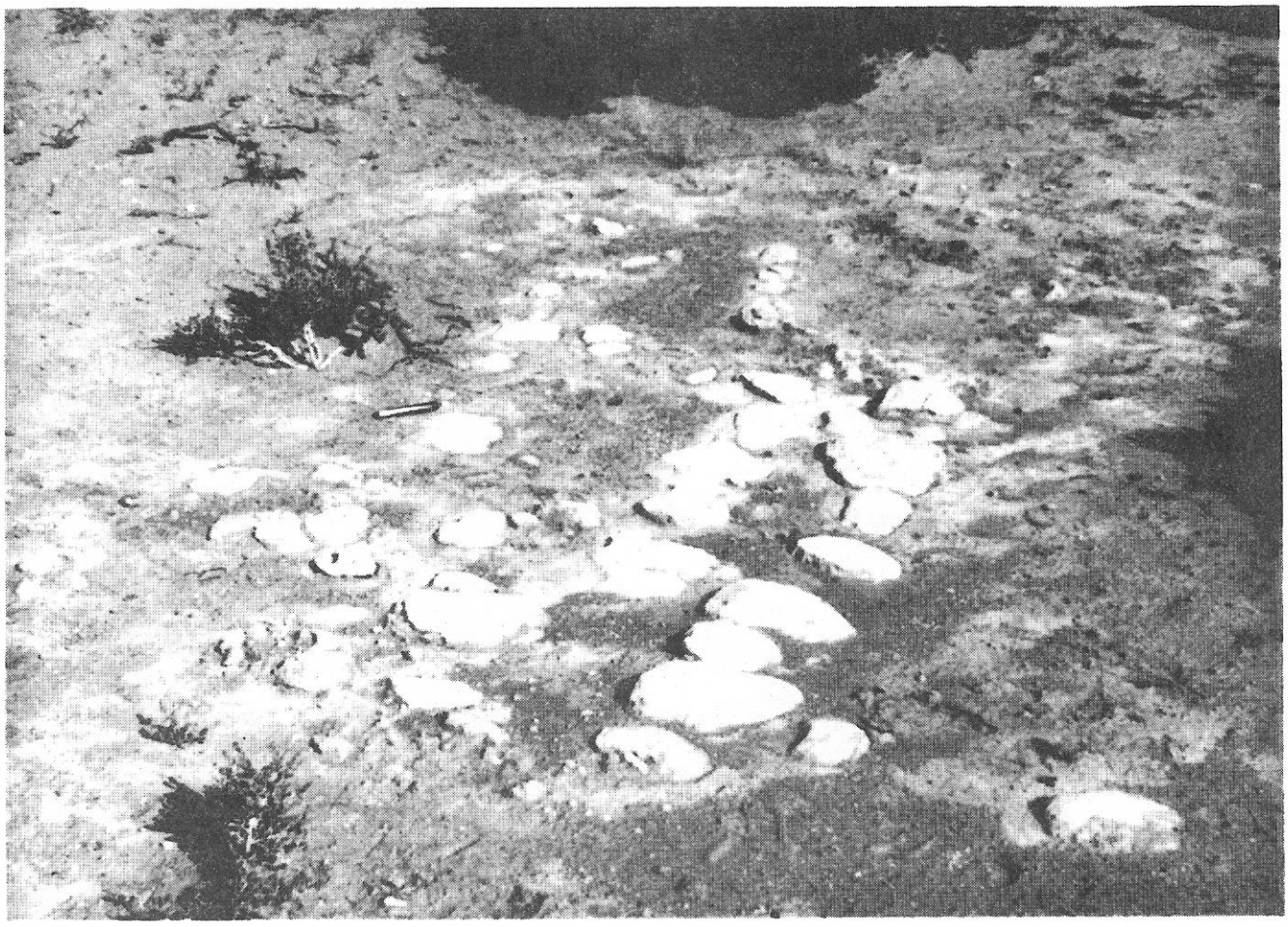
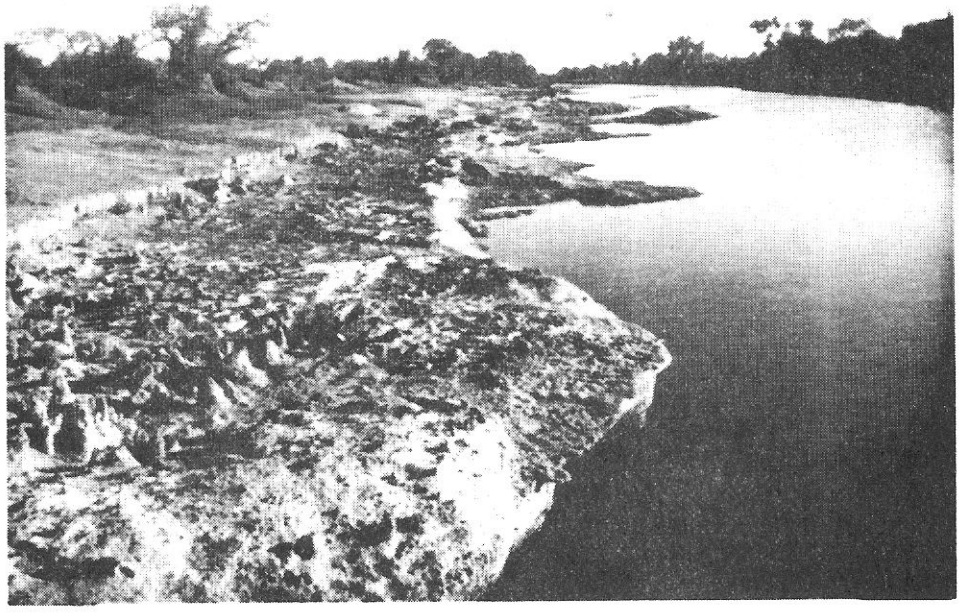
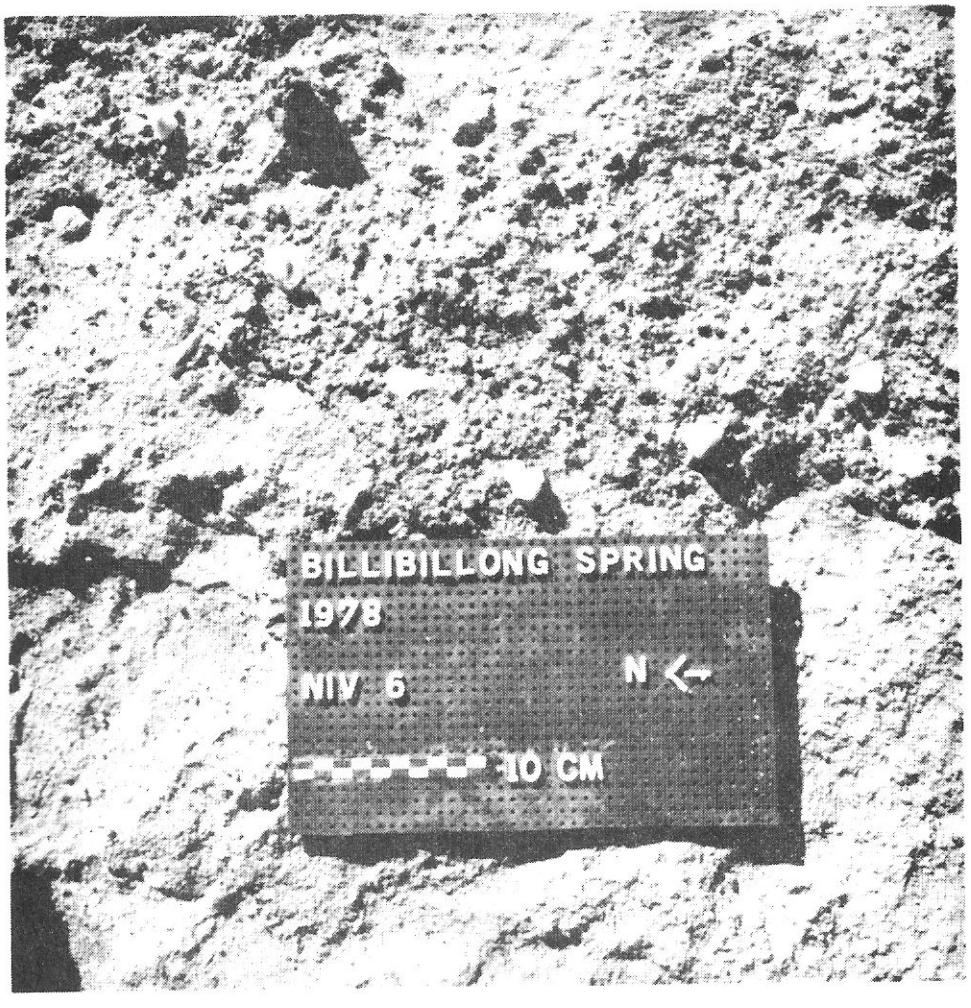


Plate IV : Layer 6 near BILLIBILONG SPRING, with the "pipes".

Quartz flakes stuck in silicified layer 6.




BILLIBILLONG SPRING
1978
NIV 6
N
10 CM