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Prehistoric archaeology. The site of Gombore I

Discovery, geological introduction and study of percussion material and tools on pebble

Jean Chavaillon

Up-stream from the Melka Kunture ford, Pleistocene levels are limited to the west, that is to the right bank of the Awash River, as the result of a fault. The bedrock is volcanic: ignimbrites and lava, some of which are a dark red colour. Because of this unusual characteristic, the Oromo peasants called the area "*Gombore*" which means "red earth". The site is situated a few hundreds metres from the ford.

A small seasonal tributary cuts across this part of Gombore. It flows from the fault, enters the river and creates a narrow gully deep enough to reveal the Pleistocene fluvio-lacustrine infill. In addition, erosion has exposed and partially destroyed anthropogenic living floors. In this way, six sites were identified at Gombore and were either extensively excavated or explored with small test trenches. In chronological order they are:

Gombore IB: Oldowan (*sensu lato*)
Gombore Iγ: Final Oldowan/Lower Acheulian
Gombore II - sectors 1, 3, 4, 5: Middle Acheulian
Gombore II - sector 2, "Butchery site": Middle/Upper Acheulian
Gombore III, IV, V, VI: Middle/Upper Acheulian.

In fact, like Garba, but more clearly, Gombore displays a landscape of stepped terraces despite its small area. The terraces are not uniformly flat and Holocene deposits, clays (Black Cotton Soil) or gravels have partly covered the higher more recent ones.

Erosion has thus created:

A lower level, (2 m above the river at low water). This has exposed a stretch of river bank which reveals old formations containing *in situ* Gombore I archaeological deposits. These Units B, C, D, are dated from 1.7 to 1.6 Ma.

A middle level, uneven, covers the Gombore II archaeological level (sectors 1, 3, 4, 5). It is dated to about 0.85 Ma.

An upper level that includes some Middle Pleistocene formations. These are Gombore II Middle/Upper Acheulian sites, sector 2, and like Gombore III, IV, VI, they are dated to 0.70-0.50 Ma.

Archaeological Mission Melka Kunture.

Finally, overlooking these formations, the uppermost level is partly covered by Pleistocene deposits due to the throw of the fault.

The following people were responsible for investigation of the Oldowan site of Gombore I:

Jean Chavaillon:

geological investigation and introduction;

study of the percussion evidence;

study of the tools on pebble and archaic handaxes.

Nicole Chavaillon:

study of débitage (cores and flakes) and tools on flake.

Jean Chavaillon and *Nicole Chavaillon*:

commentaries and conclusions;

formation of the Oldowan deposits and investigation of a possible shelter.

Discovery and geological introduction

Jean Chavaillon discovered Gombore I B in 1965 when he collected rare Stone Age tools coming from an outcrop of the B2 archaeological level, visible at the bottom of the deep narrow channel of this small Awash tributary (Fig. 1).

A small test trench was excavated in 1966, which confirmed the presence of an old archaeological deposit situated about 10 m from the Awash as it is at present (Fig. 2). It is thus subject to annual flooding.

In 1967, extensive excavations (Figs. 3-4) were begun and they continued up to and including 1974. Excavations were resumed in 1976 (a hominid humerus was discovered), but they were interrupted again by an exceptional flood at the site. They started again in November 1980 and ended in February 1982.

The excavated surface is about 230 square metres and really only concerns Level B2-3.

In order to study the lithic artefacts the excavated surface was divided into seven sectors, leading from west to east (Fig. 5). Each sector represents one or two years of excavation. For ease of observation these sectors were classed into four zones:

zone A (sectors 1, 2, 3) in the northwest;

zone B (sector 4) in the southwest;

zone C (sectors 5 and 6) in the centre;

zone D (sector 7) in the east (Fig. 6).

Many researchers took part in the excavations at Gombore I B. Together with Jean Chavaillon we can mention among others: Kebede Bogale, Grazia Maria Bulgarelli, Christian Chauveau, Caroline Chavaillon, Catherine Chavaillon, Nicole Chavaillon, Marie-Dominique Fallet, Jean Gire, Françoise Hivernel, Francis Hours, Sami Karkabi, Michel Locko, Pierre Marchal, Marcello Piperno. The Gombore Iγ site was excavated by Jean Chavaillon and then by Jean-Luc Boisaubert.

The representatives of the Addis-Ababa Institute of Archaeology followed by the Centre for Research and Conservation of Cultural Heritage (Ministry of Culture) who were active at Melka Kunture during excavations at the Gombore IB excavation, are among others Kebede Bogale, Daniel Touaffé, Yohannes Zeleke, Shitaye Mekasha. We can mention, among the Oromo workers who worked on this site, Batchia Avas, Rorissa Delassa, Eurgetchia, Dady Mulata, Weurku Djiru, Baissa and others too numerous to mention by name.

The typological study of broken pebbles, hammerstones and tools on pebble was carried out by Jean Chavaillon (a chart displays each lithic artefact) while Nicole Chavaillon was responsible for the cores, flakes

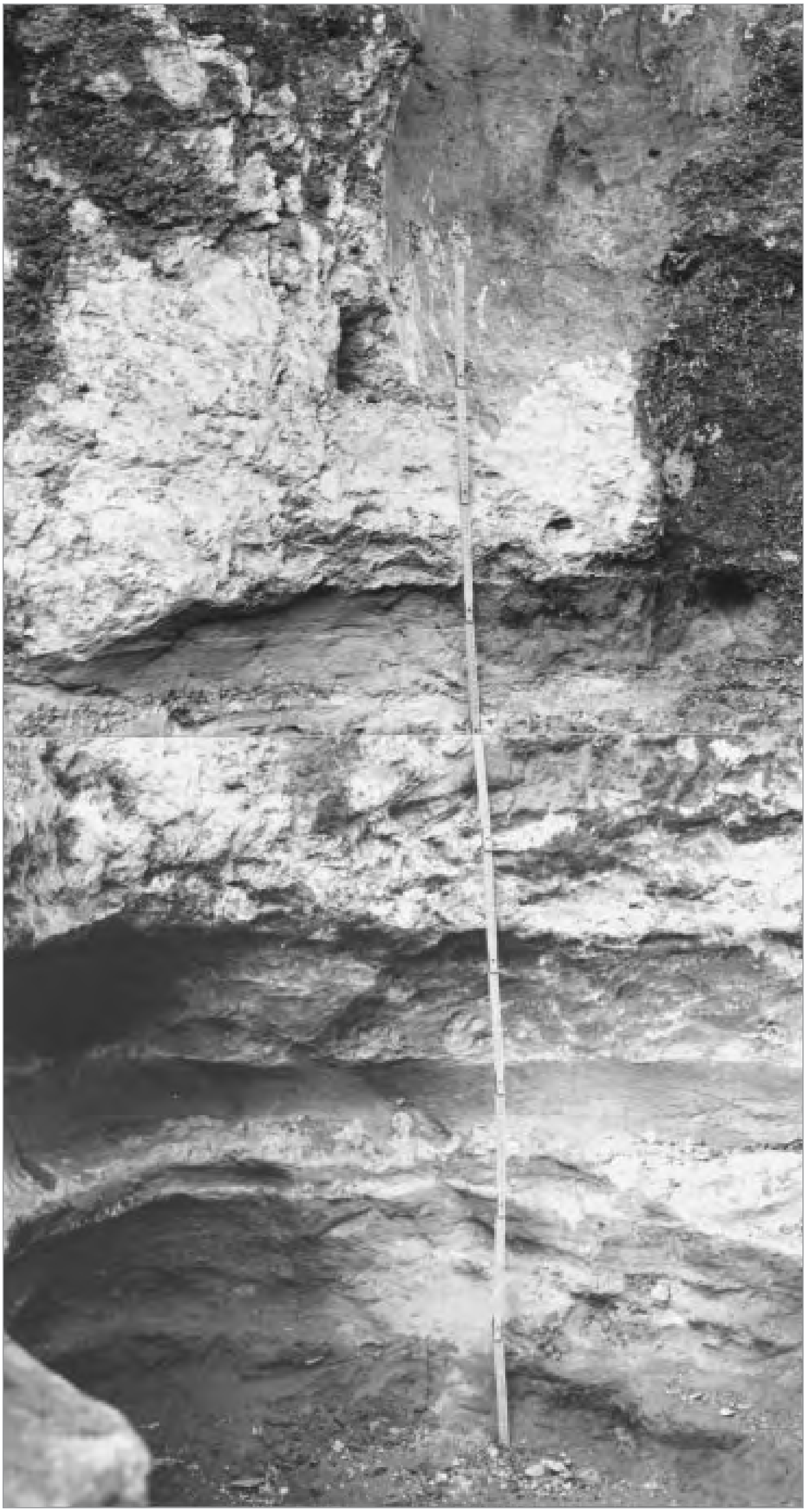

Fig. 1. Gombore I. Section of the gully of the fall at Gombore Iγ. The level of the Oldowan paleosurface B2-3 is situated at about 20 cm above the base of the test trench.

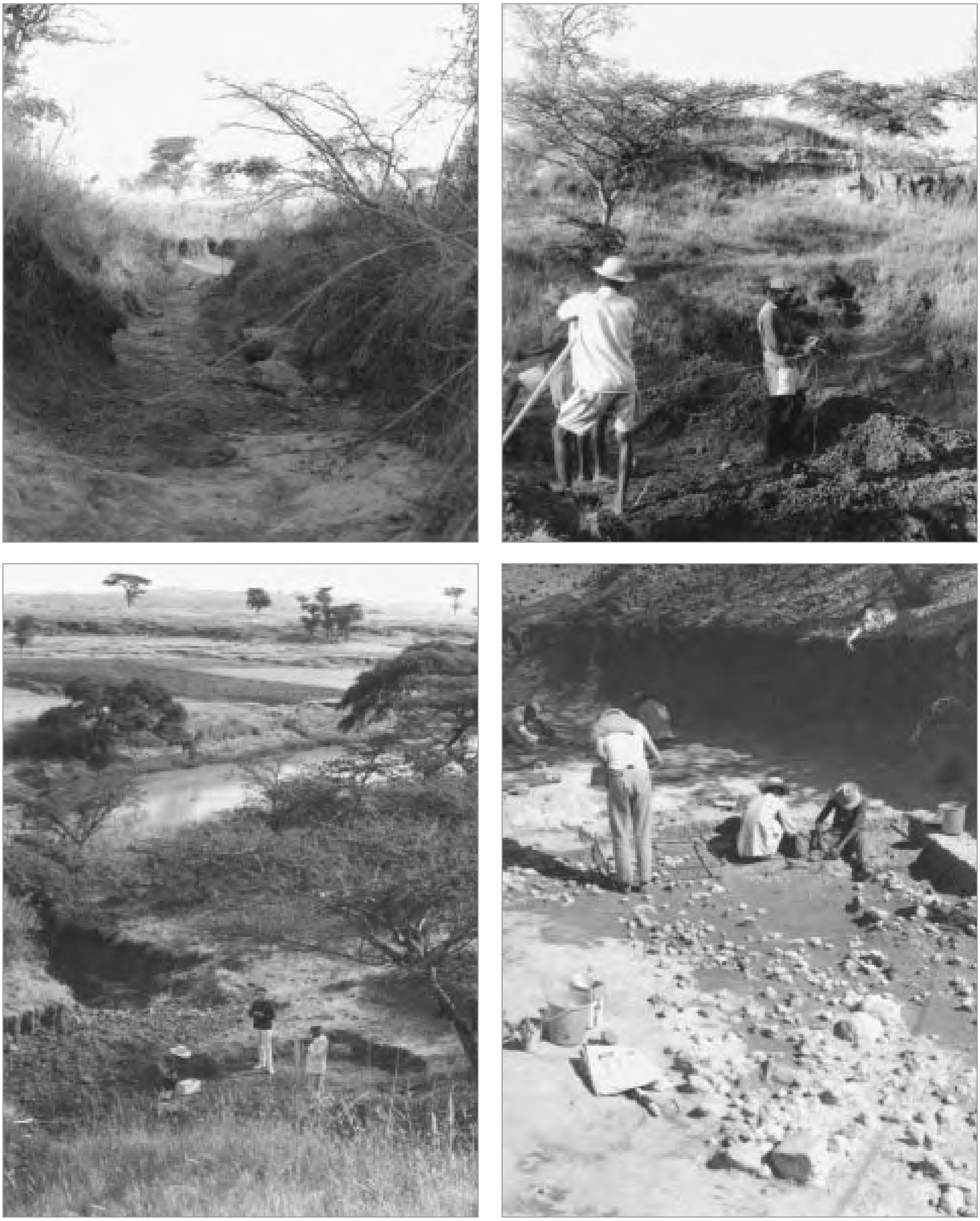

Fig. 2. Gombore I. *Top to the left*: the small gully towards the Awash River as it appeared in 1965, at the time of the discovery of the site. At the base of the soil it is possible to see lithic tools, bones and unmodified pebbles in the Pleistocene sediments. *Top to the right*: beginning of the excavation. In the other part of the Awash it is possible to observe the Pleistocene sediments covering the Oldowan level and containing the site of Gombore Iγ. In the higher deposits the Acheulian levels of Gombore II are embedded. *Bottom to the left*: beginning of the excavation. It is possible to see, to the left, the small gully going to the Awash River. *Bottom to the right*: excavation of the Oldowan level (Sector C).

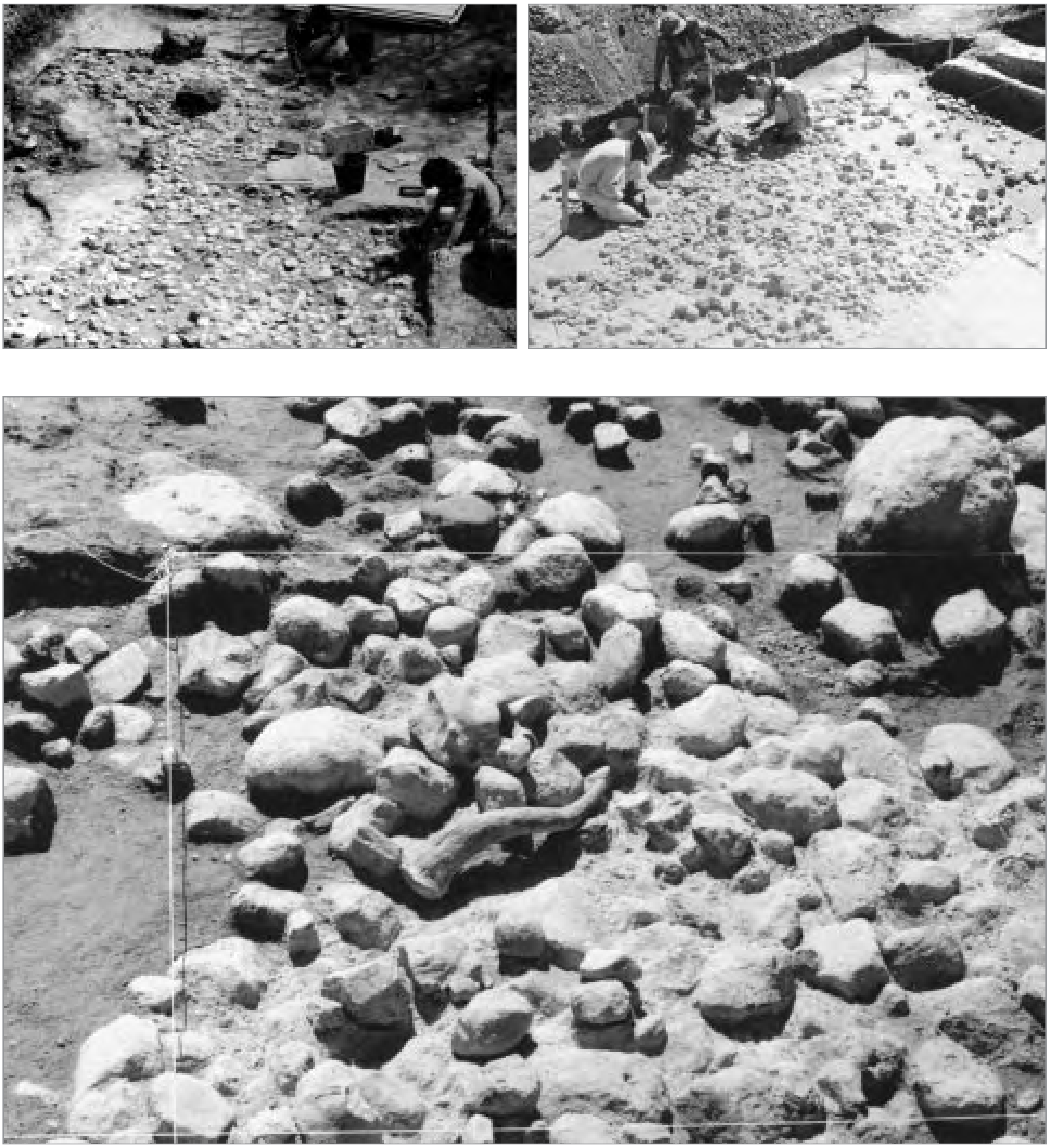

Fig. 3. Gombore I. *Top to the left*: the excavation in 1967, Sector C. To the left it is possible to see the northern limit of the Oldowan level and of the Pleistocene Formation eroded during Holocene. *Top to the right*: the excavation in 1972, Sector A. *Bottom*: the Oldowan level during excavation in Sector A, with huge pebbles, choppers, polyhedrons and antelope horns.

Fig. 4. Gombore I. *Top*: Level B2, Sector A. *Bottom*: Level B3, Sector A.

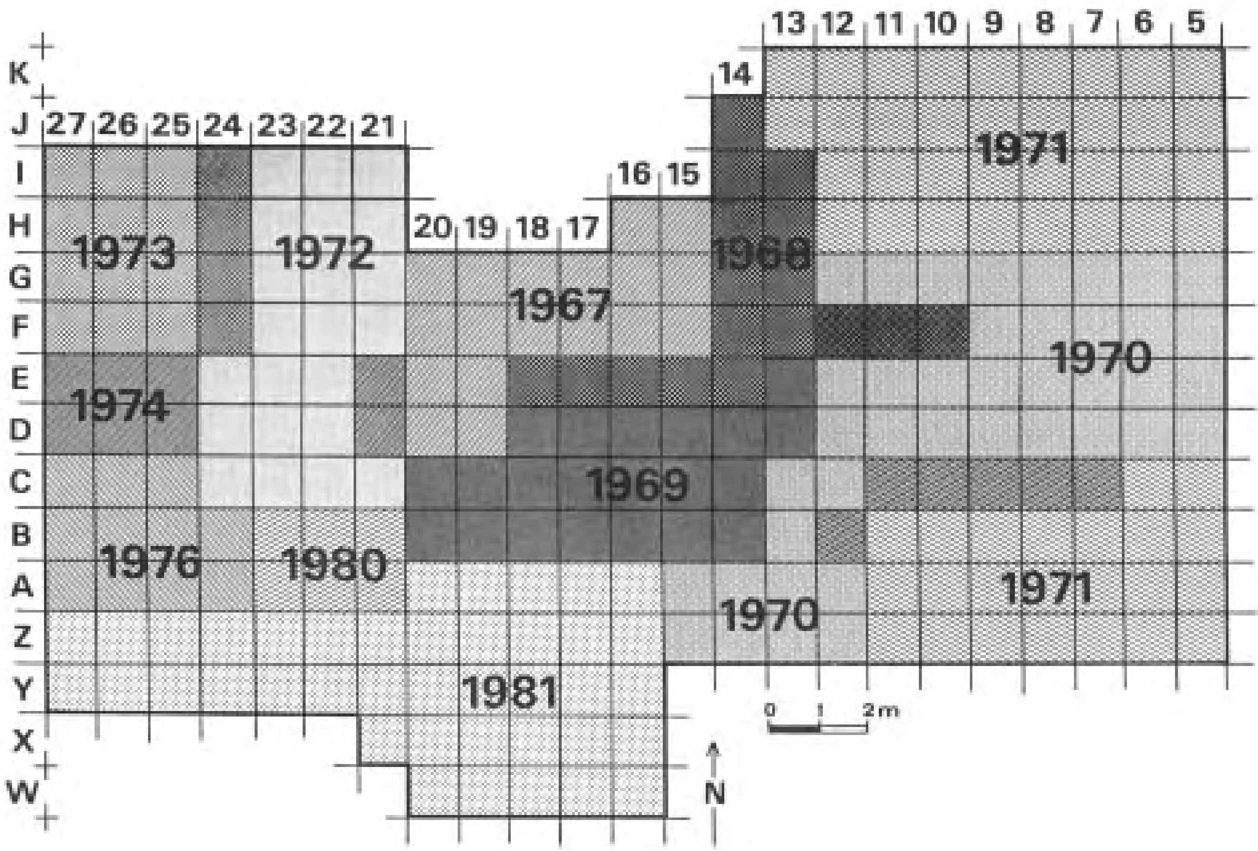

Fig. 5. Gombore I. Different areas excavated since 1967 until 1981. *Drawing by C. Chavaillon*

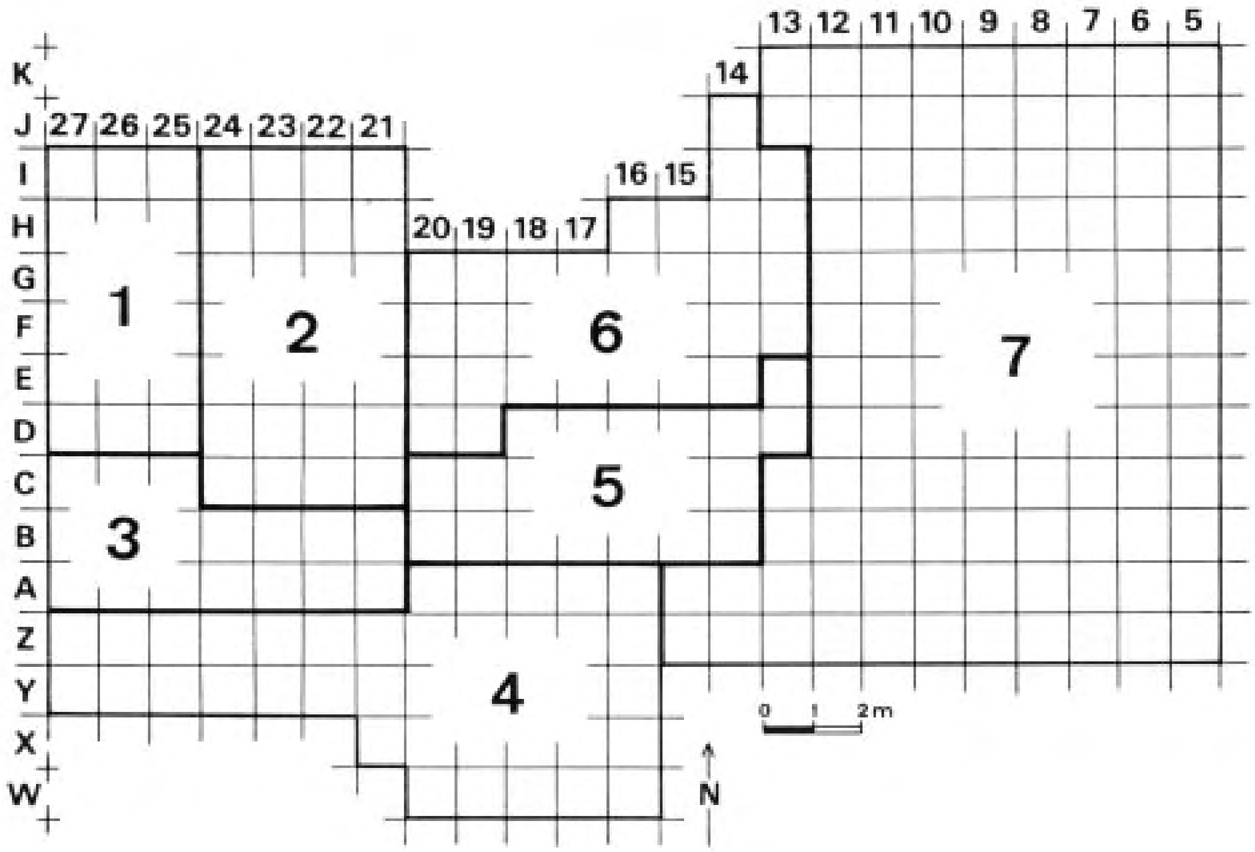

Fig. 6. Gombore I. Different sectors of the excavations. *Drawing by C. Chavaillon*

and tools on flake (Chavaillon and Chavaillon 1969, 1973, 1976a, b, 1980-82). For her Masters Degree in Paris, Marie-Dominique Fallet studied one part of the percussion material. Maurice Taieb and Jean Chavaillon established the stratigraphy (Chavaillon and Taieb 1968) and M. Taieb led the sedimentological study (Taieb 1971, 1974). Raymonde Bonnefille took samples for the palaeobotany (Bonnefille 1976). A fragment of fossil liana, found in Unit B2, was described by J. C. Koeniguer (Chavaillon and Koeniguer 1970). The fauna was systematically studied by Denis Geraads (Geraads 1979) and the microfauna was selected and examined by Jean-Jacques Jaeger and Maurice Sabatier (Sabatier 1979, 1980-82). Finally, the hominid humerus, discovered in the B2 Unit, was studied by Yves Coppens and Brigitte Senut (Chavaillon *et al.* 1977).

Palaeogeographic aspects of Gombore I

It seems that Gombore I was situated on a slightly raised bank or on a beach, scattered with pebbles more or less abraded by the Awash River. We have clear evidence that this bank was subject to flooding. The occupation site of Gombore I B2 (Fig. 7) was buried under clayey mud during its last occupation as a result of the summer floods, hence the well preserved lithic artefacts, bones, pollens and plant fragments. The Oldowan people, *Homo ergaster/erectus*, were settled near the river on a bank composed of a light sediment made of rare small gravels, scattered in sandy clays (Unit B3 - Fig. 8). These people had the benefit of lithic materials they found on the site itself, and they were also able to collect wood and branches.

The landscape was a humid savannah and riverine forest with acacias, junipers and *Podocarpus*. Hippopotamus and crocodiles, now extinct, lived in the Awash River. Large and small bovids, and equids such as horses, came to the river to drink. However, the camps and their occupants were threatened not only by animals (which may account for the shelter they possibly built), but also by the water and alluvium washed down by the seasonal flooding of the Awash.

These camp areas may have covered a wide area. In addition to the 230 square metres excavated, one must take into account the northern area destroyed by the present course of the Awash, probably during the Holocene. Then there are the test holes made in the eastern, western and southern sectors that indicate the permanent presence of flaked lithic artefacts, mixed with rough pebbles. It appears that this site was occupied over a long period, perhaps for several weeks or several months, with periodic breaks of various length, until it was swiftly and definitively buried under floodwaters and mud. So, it was probably originally an area of several thousand square metres occupied at various times, but never as densely and continuously as Garba IV or Gombore II. The occupation density in some sectors must have been very low or non-existent. Nevertheless, however small the groups of people and the fleeting nature of their visits, it proves the interest shown in this area and explains the choice made by these Stone Age people.

Stratigraphy

The archaeological levels of Gombore I are among the oldest formations of Melka Kunture, along with those of Karre and Garba IV. They complete the sequence, unknown but important, which is buried under the present bed of the Awash.

Gombore I C and Garba IV F are at an altitude of 2013.0 m. Gombore I B2 and Garba IV E are located at about 2013.4 m. In fact the altitude of Gombore I B2 varies from east to west and goes from 2013.5 m to 2013.1 m. Unit B3 generally follows the topographical variations of B2 as became very apparent during the excavation (Figs. 7, 8).

From bottom to top the stratigraphy is as follows (Fig. 9):

1 - Compact green clays, moistened by undercurrents of the Awash (from 1.0 to 1.5 m under the B2 soil).

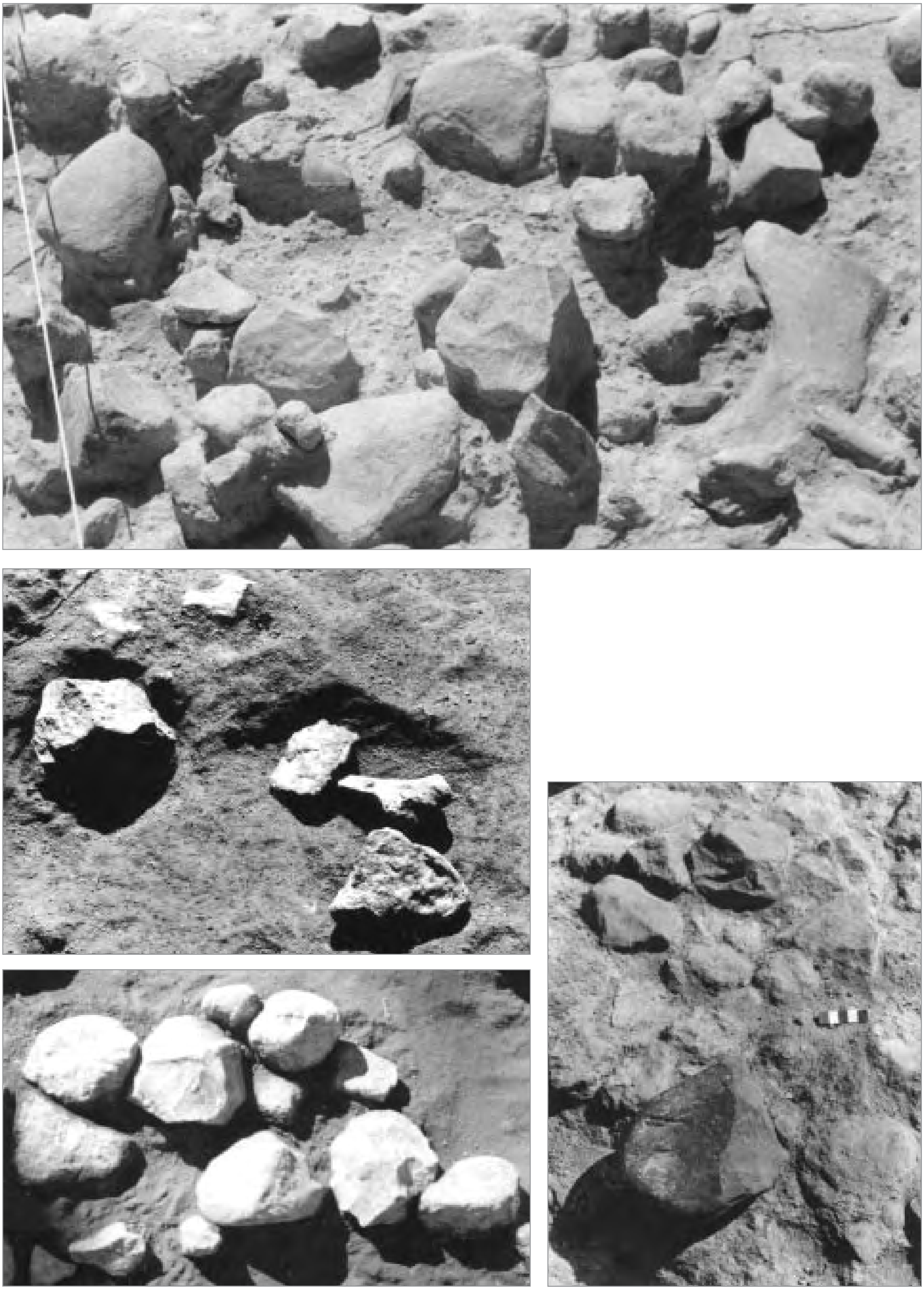

Fig. 7. Gombore I. Detail of the excavation. *Top*: chopper, polyhedron and bone fragments. *Middle*: polyhedrons, cores and humerus of *Homo* cf. *erectus*. *Bottom to the left*: choppers. *Bottom to the right*: polyhedron, flake and chopper.

Fig. 8. Gombore I. Detail of the excavation. *Top*: hippopotamus pelvis. *Bottom to the left*: antelope pelvis. *Bottom to the right*: articulation in anatomical connexion of a hippopotamus leg.

2 - Beige sands and reworked volcanic tuffs.

3 - Thin ferruginous crust embedded with stones and rough pebbles: Unit E contains only broken bones. It was only excavated in deep test trenches.

4 - Compact green clay topped by tuffaceous clays sometimes with a thin tuff bed.

5 - Channelling.

6 - Ferruginous crust coating pebbles and broken bones. Unit D is covered by 10 to 20 cm of sand or mud mixed with gravel.

7 - Mixed clayey sands with sandstone nodules and clay pebbles. The sands show cross bedding. Within this unit which is 0.4 to 0.5 m thick is archaeological Unit C with gravel, obsidian or basalt pebbles, obsidian flakes, sometimes retouched, and some bone fragments.

8 - Compact bed of tuff, very thin (2 to 3 cm). At the base a thin bed of micro-pumice can be seen in places. This tuff separates Units C and B3, is sporadic and is only known on a surface of some 10 square metres: it is a tuff reworked during an eruption, and its deposition was linked to a sudden flood. It is sometimes visible in contact with B2 when the basal Level B3 is missing.

9 - Sand and gravel bed progressively passing to clayey sands, varies in thickness but thin (a few cm). These sands contain Unit B3. It is probably the same occupation as B2, the small artefacts having slipped into the loose sand. The two beds are so similar that Unit B3 can be considered as the base of Unit B2.

10 - Archaeological Unit B2 is a mixture of sandy clays.

11 - Sandy clays, disturbed by the excavation, containing the B2 tools, but preserved and visible some 10 m farther on (Gombore “waterfall”: 2 m, Fig. 9). Some artefacts, attributed during the excavation to Unit “B1”, are in fact probably artefacts displaced by erosion and belong to B2.

12 - Important channelling of this thick bed consisting of rather sandy clay.

13 - Compact grey-green clay bed, thinning at the waterfall but thicker at the excavation (2.5-3.0 m).

14 – Above the clay layer lies a sand and gravel layer, sometimes forming a thin ferruginous crust. This is an archaeological unit that is visible at the waterfall and also a few metres from the Gombore I B excavation. It is the Gombore Iγ site, discovered in 1974, but since the stratigraphy had already been established, we had to use the Greek alphabet!

Gombore Iγ is a living floor with well preserved fauna and artefacts though without handaxes. It is more elaborate than that of Gombore I B. Its age could be Developed Oldowan/Early Acheulian. It could be a bit more recent than Garba IV D-C and more ancient than Garba XII J.

Some aspects of the B2 living floor

The topography is relatively pronounced when compared to other Melka Kunture excavations. Thus, with 230 exposed square metres (Figs. 4, 7-9), a NE-SW slope was identified. In the eastern sector (zone D) a more or less horizontal platform displays a strike-slip fault of some 10 to 30 cm in the centre and towards the west. In addition, a light slope was discovered towards the SW.

Three observations can be made:

1 - the higher platform mentioned above could have been roughly adapted for a shelter made of branches and animal skins;

2 - two micro-faults cross the excavation from the NE to the SW, more precisely from G 5 to Y 24 squares, and from F 8 to C 27. The first fault throw measures 3 cm and the second from 1 to 3 cm (Fig. 10).

3 - there is a shallow depression in G/C-21/25. Water flowing into it would have washed in clay deposits (mud) together with a few lithic tools and broken bones, which accumulated within this depression of 2 to 15 cm deep.

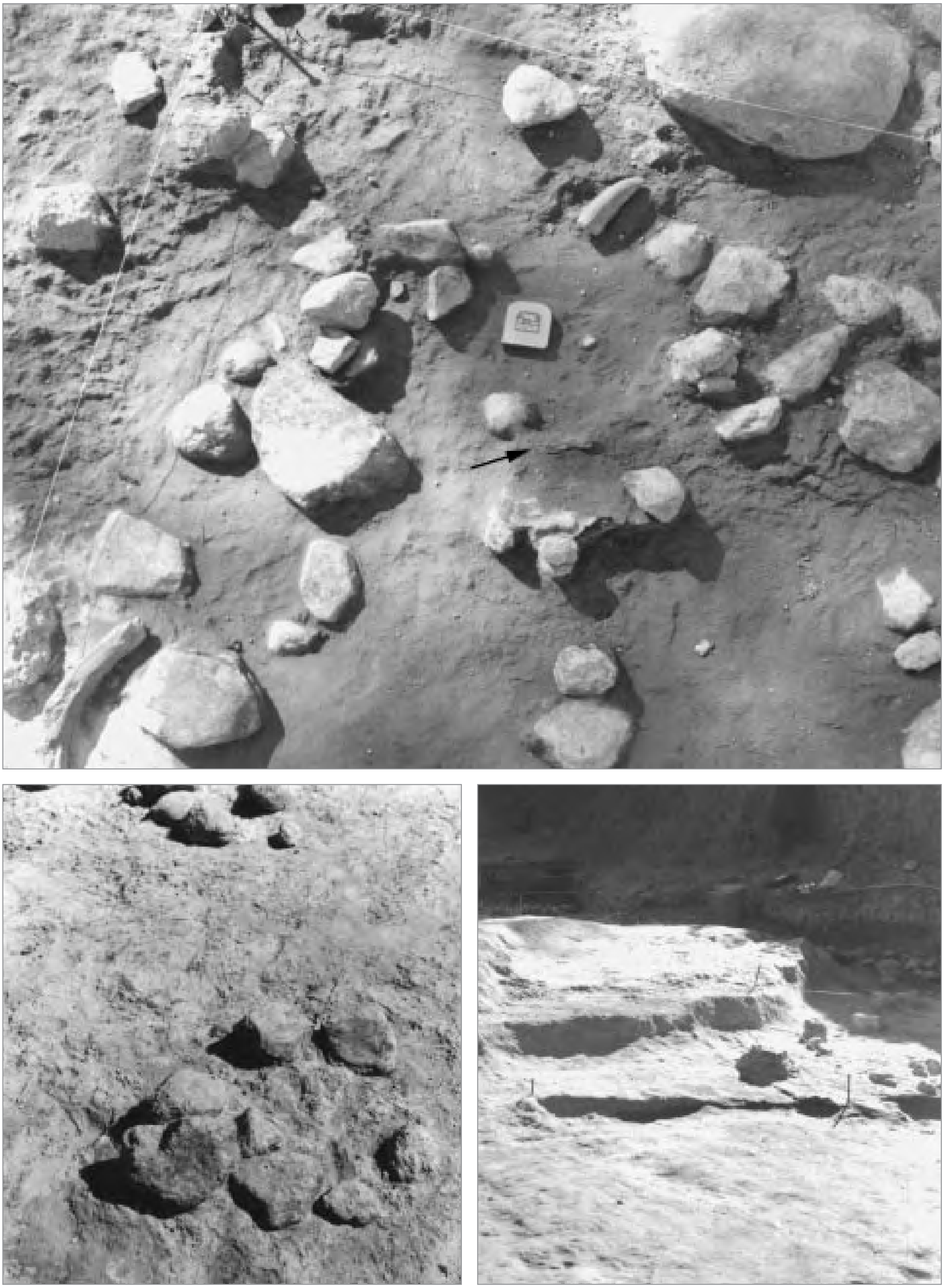

Fig. 9. Gombore I. Detail of the excavation. *Top*: bones and tools. In the middle of the photo it is possible to see a fragment of fossil liana. *Bottom to the left*: two of the small circles of stones to the east of the platform. *Bottom to the right*: detail of the platform.

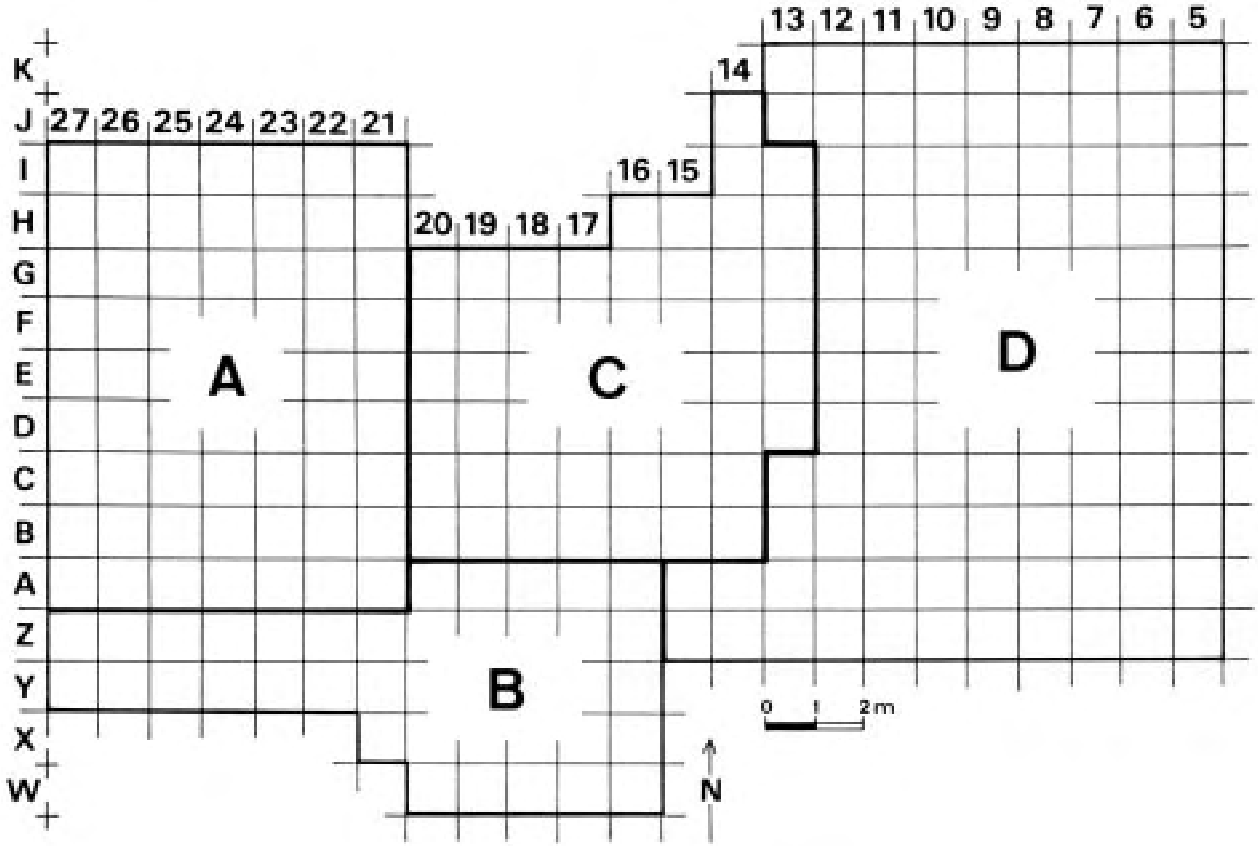

Fig. 10. Gombore I. Different zones of the excavations. *Drawing by C. Chavaillon*

Vegetation

The palynological study by R. Bonnefille (1972a, b; 1976) was based on several samples taken from Units IB and IC. According to Bonnefille (1976, p. 62), this is a complete catalogue of the pollen microflora from the Oldowan level at Gombore I B:

Trees, shrubs, lianas		
Podocarpus cf. *gracilior*	Podocarpaceae	11
Juniperus cf. *procera*	Cupressaceae	64
Juniperus?	Cupressaceae	36
Olea sp.	Oleaceae	1
cf. *Oleaceae*	Oleaceae	1
cf. *Hypericaceae*	Hypericaceae	2
Anthospermum	Rubiaceae	3
cf. *Polyscias*	Araliaceae	1
Myrica cf. *kettiana*	Myricaceae	1
Clematis sp.	Ranunculaceae	1
Dodonanea viscosa	Sapindaceae	1
cf. *Carissa*	Apocynaceae	1
Heteromorpha	Umbelliferae	2
	Total A P	**125**

Herbaceae		
Gramineae	Gramineae	290
Plantago	Plantaginaceae	6
Chenopodiaceae	Chenopodiaceae	4
Compositae tubuliflorae	Compositae	2
cf. *Carduus*	Compositae	1
Rumex	Polygonaceae	1
cf. *Arabis*	Cruciferae	1
Umbelliferae	Umbelliferae	2
cf. *Rhynchosia*	Papilionaceae	1
cf. *Plectranthus*	Labiatae	1
Typha sp.	Typhaceae	1
Cyperaceae	Cyperaceae	11
	Total N A P	**321**
Pteridophytes spores		9
Undetermined		1
General total		**456**

There is a relative abundance of *Podocarpus* pollens. The pollen spectrum in sample A.1966 shows a higher count of forest pollens like *Juniperus*. The mountain thicket is equally well represented by *Myrica*, *Clematis*, *Dodonaea viscosa*, *Carissa* and *Heteromorpha*. The percentage of Graminiae in relation to the total pollen count is 57.4%. The herbaceous flora does not display any particular characteristics. Note the genus *Arabis*, a Crucifera which does not often occur in our analysis.

The *Diplolophium*, *Carduus* and *Tephrosia* pollens could attest to a microflora belonging to an altitude vegetation at least as high if not higher than the juniper forest (Bonnefille 1976, p.58).

The palynological analysis clearly indicates a thicket/scrub vegetation (bush) and a nearby forest for the percentage of *Juniperus* and *Podocarpus* pollens is high and these pollens go with those of the altitude thicket. Thus:

Gramineae 61 with 63%

Trees 27 with 29%

Among the trees, juniper represents 80%. It represents 21% of the total pollens while at present it accounts for only 1.5%.

In conclusion, this indicates a humid climate, which cooled during the time of Gombore I B.

A fragment of fossilised wood was found at the base of soil B2 (Fig. 9). Fossilised wood is extremely rare in Lower Pleistocene deposits. This exceptional find in the 1.6 Ma Oldowan unit was examined and described by R. Koeniguer (Chavaillon and Koeniguer 1970). The sample is 6 cm long and 2 cm in diameter. Some vessels are poorly preserved; some are small, others very large and they are often isolated. The vertical circum-vascular parenchyma are abundant and the uniseriate stepped ligneous rays are extremely short. Finally, R. Koeniguer observed the presence of vertical secretory channels in the vertical parenchyma. This is a structure typical of a liana from the Cesalpiniacae family (*Caesalpinioxilon* sp.) or perhaps from the Papilionacae.

In fact identical characteristics are found in silicified wood collected by Y. Coppens at Bochianga near Koro-Toro, in Tchad, in Lower or Middle Pleistocene levels. This liana indicates a light forest or gallery forest-edge environment.

The presence of this fragment of liana on the Gombore I B2 living floor perhaps indicates utilization by humans. This kind of liana could have been used as binding to strengthen a bush fence, for example a fence that enclosed the nearby shelter, and could also have served other domestic purposes (Chavaillon and Koeniguer 1970).

Fauna

The macrofauna study carried out by D. Geraads (1979) confirms the presence of hippopotamus at Gombore I because of the proportional abundance of bones and teeth. This hippopotamus might be tetraprotodont. The P3 is trapezoidal and the P4 is formed of a single main tubercle in a 5-point star shape. The molars are very large. The limbs are similar to those of the present-day hippopotamus. This *Hippopotamus amphibius* also shows some characteristics similar to *H. gorgops* from Olduvai. Another species, with its fourth upper premolar, is reminiscent of that of East African Plio-Pleistocene fossils such as *H. hipponensis*, *H. imagunculus* and *H. aethiopicus*. Thus, at Gombore I B there is a species similar to that of the present-day, and another which could be described as a dwarf hippopotamus.

Badly preserved suid remains can be related to the *Metridiochoerus-Phacochoerus* group. One tooth could be attributed to a *Kolpochoerus* left upper canine.

Antelopes are represented by *Connochaetes taurinus*, and in particular by the horns of a *Damaliscus* species. Other Alcelaphini are important because they are reminiscent of the *Damaliscus niro* species from Olduvai or the *D. cuicule* from Aïn Boucherit in Algeria or *Parmularius braini* from Makapan in South Africa.

Equids are rare and elephant even more so.

Study of percussion material and tools on pebble

This study is divided into the following sections: percussion material, tools on pebble including archaic handaxes, *débitage* (cores and flakes), flake artefacts and, finally, some concluding remarks.

A general inventory introduces the study and each section contains a detailed typological inventory

General typological inventory of Gombore I B

Percussion material	
Battered pebbles	1858
Hammerstones	532
Broken pebbles (1043 hammerstones and battered pebbles)	3692
Tools on pebble	
Choppers	846
Polyhedrons	345
Heavy end-scrapers	332
Various tools on pebble	329
Archaic handaxes	13
Artefacts with abrupt fractures	44
Fragments or debris	70
Débitage and tools on flake	
Cores	250
Unmodified flakes (397 broken)	1045
Utilized flakes (103 broken)	516

Retouched flakes (51 broken)	184	
Tools on flake	355	
Total of typological count	**10411**	

Class distribution

Percussion material	6082	(58.42%)
Tools on pebble	1979	(10.01%)
Débitage and tools on flake	2350	(22.57%)

Percussion material (hammerstones and battered pebbles)

In studying an archaeological level such as Gombore I, one can leave no trail unexplored. All the anthropogenic material must therefore be listed and studied. Furthermore, as this level is largely intact or has been only slightly disturbed by natural phenomena, the location of artefacts and structures must be noted. This is why it is not possible to ignore a category of lithics such as the percussion material that is abundant in places, although rough and badly trimmed. Two main classes are recognised, one with battered pebbles and various hammerstones and the other with broken or split pebbles.

Broken pebbles can, of course, have percussion marks as battered pebbles and hammerstones may have been broken. This is the reason why some artefacts will be studied twice: first with the battered artefacts and second with the broken or split pebbles.

Battered pebbles and true hammerstones, then broken pebbles, are described in this order.

Tables of percussion material in actual numbers and in typological numbers are distributed according to the four zones A, B, C, D.

The typological inventory numbers will be used in studying the different categories.

The difference between the typological number (6082 studied artefacts) and the actual number of collected artefacts (5049) comes from the fact that 1033 broken battered pebbles and broken hammerstones have been studied in both classes.

Artefacts	A	B	C	D	Total N	Total %
Battered pebbles	481	51	199	148	**879**	17.41
Battered and broken pebbles	451	77	287	164	**979**	19.37
Active hammerstones	182	23	82	37	**324**	6.42
Active hammerstones with fracture	14	6	6	3	**29**	0.58
Passive hammerstones	47	5	32	12	**96**	1.9
Passive hammerstones with fracture	9	3	8	3	**23**	0.46
Pitted hammerstones	43		9	6	**58**	1.15
Pitted hammerstones with fracture	1			1	**2**	0.04
Broken pebbles with one fracture	483	113	1154	127	**877**	17.37
Broken pebbles with two fractures	377	106	149	126	**758**	15.01
Broken pebbles with three fractures	174	50	61	50	**335**	6.64
Broken pebbles with several fractures	393	59	138	99	**689**	13.65
Total					**5049**	

Table of percussion material (actual numbers).

Artefacts	A	B	C	D	Total N	Total %
Battered pebbles	932	128	486	312	**1858**	30.55
Active hammerstones	196	29	88	40	**353**	5.8
Passive hammerstones	56	8	40	15	**119**	1.96
Pitted hammerstones	44		9	7	**60**	0.99
Broken pebbles with one fracture	730	157	268	210	**1365**	22.44
Broken pebbles with two fractures	530	132	256	184	**1102**	18.12
Broken pebbles with three fractures	197	58	94	64	**413**	6.79
Broken pebbles with several fractures	445	67	185	115	**812**	13.35
Total					**6082**	

Artefacts	N	%
Battered pebbles	1858	30.55
Hammerstones	535	8.75
Broken pebbles	3692	60.07

Table of percussion material (typological numbers).

Hammerstones

Hammerstones are abundant at Gombore I.

Battered pebbles	1858
Active hammerstones	353
Passive hammerstones	119
Pitted hammerstones	60

Amongst the 2390 battered pebbles and hammerstones, 1033 artefacts bear one or several sharp fractures. All these artefacts, broken and battered, are studied for their fractures together with the broken pebbles, which comprise another class of percussion material.

Raw material, morphology, weight and percussion marks of the hammerstones will be analysed. Their distribution on the ground plan was noted and will be discussed. Comparative tables will be found at the end of this chapter.

Percussion marks

These are the traces left by blows given or received. The characteristics described include their aspect, their location and their distribution on the pebble. Four series of characteristics were used in this study (see “Methodology” in this volume and Chavaillon 1979b):

1 - percussion type;

2 - aspect of percussion marks;

3 - location of marks on hammerstone;

4 - distribution and importance of these marks.

Battered pebbles

Battered pebbles amount to 1858, 36.8% of the percussion material. One class is represented by 879 artefacts with only impact marks, and another class by 979 pebbles also showing one or several fractures. These artefacts were also studied for their fractures in the broken pebbles class. Nearly half (47.3%) show only one fracture (Fig. 11, *2*) and only 20% show several fractures (Fig. 12, *6*).

A battered pebble is a pebble with sharp impact (shock) marks, probably because it has been used. Typologically they are not called hammerstones because the impact marks, while sometimes clear, are few in number, or because the marks, although abundant, are uncharacteristic. These pebbles have not been shaped, but were probably chosen for their form or for the quality of raw material. Their shape dictated whether they were used actively (thrown) or passively (as an anvil). The battered pebble is in fact a temporary active or passive hammerstone that was abandoned, either because its shape was unsuitable, or because it was broken during use, or because it was only meant to be used for a short time (Fig. 11, *10*).

Raw material

The most commonly used raw material is of volcanic origin. Trachyte or relatively soft rocks dominate with 39%, but obsidian is rare (0.75%). Welded ignimbrites (18%) are particularly well represented in zone A with 22.4%, as well as in zones C and D, but few are found in zone B (2.3%).

Morphology

Dimensions: Nearly half of the artefacts have a maximum length of between 50 and 80 mm. Whole battered pebbles are more numerous than battered and broken pebbles in the categories over 100 mm. A large proportion (70%) have a maximum width of between 40 and 80 mm. 75.5% of battered pebbles have a maximum thickness of between 20 and 60 mm.

Elongation: 62% of battered pebbles fall into the general categories of "rather short" and "rather long". The elongation index can depend on the presence of fractures and on their number.

Flattening: "Thick" and "rather thick" artefacts dominate with 73.5%. They are generally stubby artefacts. "Flat" and "rather flat" battered pebbles are often found among the battered and broken pebbles and are especially noticeable in the artefacts from zone D.

Shape: Elliptic and circular shapes are fairly common (18%), but pentagonal pebbles are more numerous with 28.5%.

Weight: Half of these artefacts weigh between 100 and 400 g, while 22% are under 100 g. Broken and battered artefacts are the most numerous in this last class.

Conclusions

Pebbles which are only battered are more stubby, while battered and broken pebbles are sometimes longer and flatter but also, obviously, lighter.

Percussion marks

The characteristics of these marks are as follows:

1 - Type of percussion

Battered pebbles, that is to say temporary hammerstones, often only display a single characteristic: for example, 40% have only punctiform percussion marks and 21% only diffuse percussion marks. Combinations of these two characteristics have been observed on 613 artefacts, or a third of the artefacts.

Less than 1% of the artefacts combine all three characteristics on the same artefact (punctiform, linear and diffuse percussion).

Together, nearly 77% of the artefacts have punctiform percussion marks, but in addition 56% of the battered pebbles have traces of more diffuse percussion.

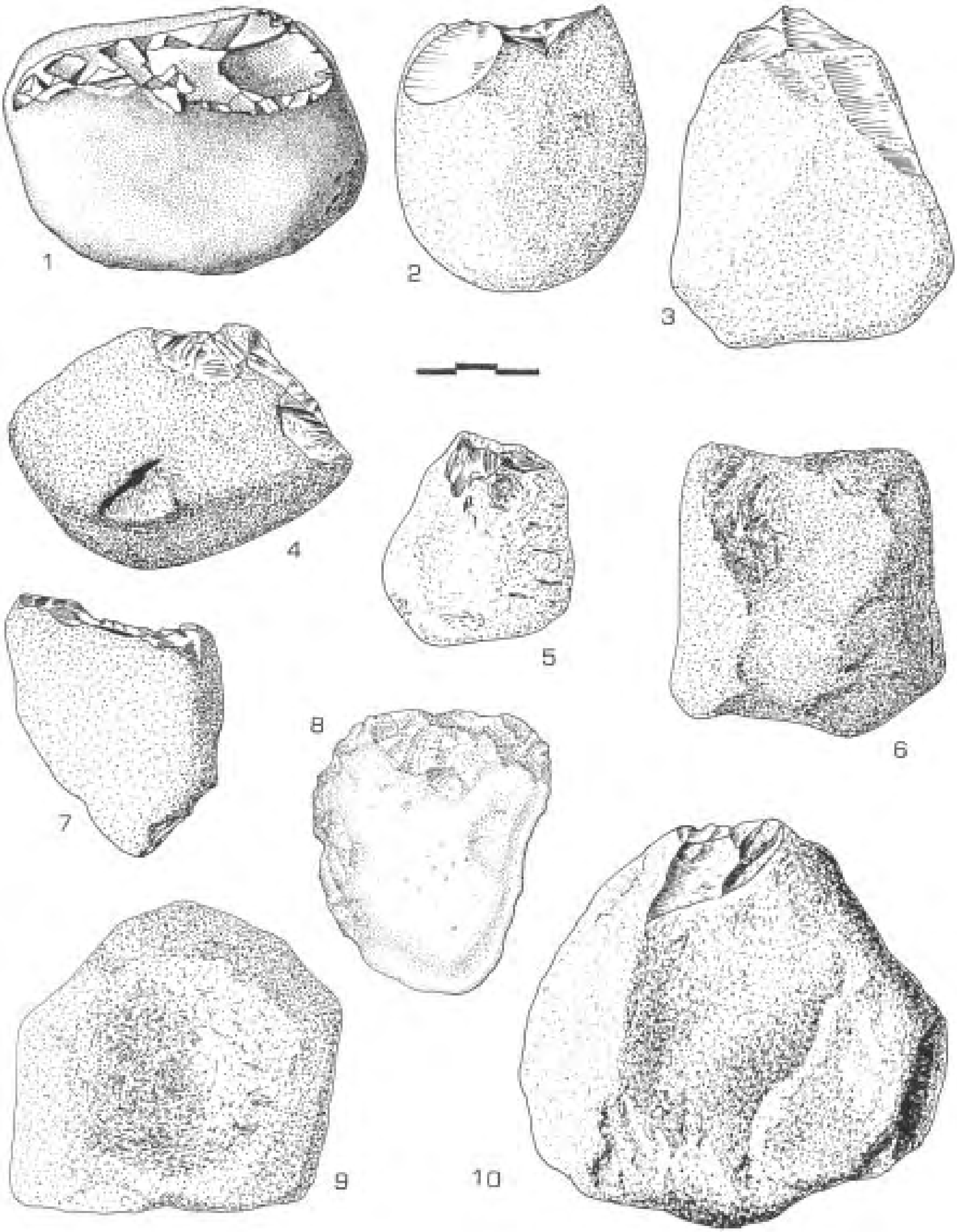

Fig. 11. Gombore I. Lithic industry from Level B. 1, 3-5, 8: active hammers; 2: broken (one split) and battered pebble; 6, 9: pitted hammers; 7: active hammer broken (two splits); 10: battered pebble. 1, 2, 4, 9: basalt; 3, 5, 7, 8, 10: trachyte. *Drawings by C. Chavaillon (1), J. Chavaillon (2-7, 9), J. Jaubert (8) and J. Gire (10)*

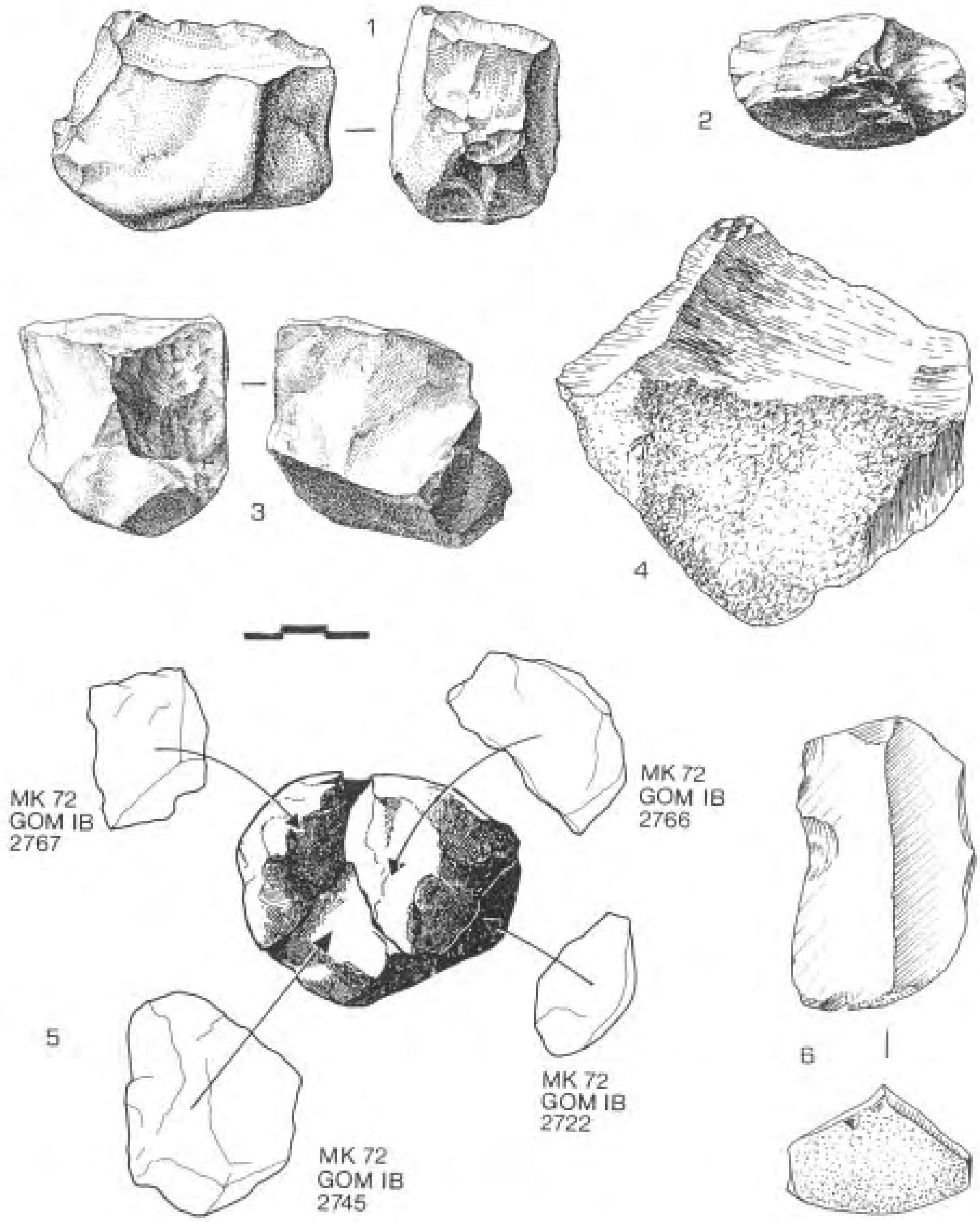

Fig. 12. Gombore I. Lithic industry from Level B. 1: passive hammer and broken pebble (two splits); 2-3: broken pebble (three splits); 4: broken pebble (several splits); 5: broken pebble (refitting with 4 fragments showing from one to several splits); 6: broken (two splits) and battered pebble. Basalt. *Drawings by C. Chavaillon (1-3), M. Bouhey (4), J. Gire (5) and J. Chavaillon (6)*

Finally, 80% of the unbroken battered pebbles have more punctiform percussion marks than the battered and broken pebbles (73%). The opposite applies to diffuse percussion.

2 - Aspects of percussion marks

Some 45% of the artefacts show crush marks and very small removals. However, 31% of them have only small removals or scalings, while 17% show only crush marks. These scalings and crush marks are very frequent and the summary table shows that 80% of the artefacts bear small scales and about 70% have crush traces left by percussion. The beginnings of cupules are rare (7%), but not exceptional.

3 - Location of percussion marks

Percussion marks are found mainly on ridges and extremities, and rarely on flat surfaces. About 57% of the artefacts have percussion marks on only one of these locations (ridge, extremity or surfaces), indicating evidence of brief percussion that was rarely repeated. Artefacts rarely (2.4%) have percussion marks on ridges as well as on extremities or surfaces.

The difference between the class of broken artefacts and the one of whole pebbles is clear and relatively stable. If we consider, for example, percussion on ridges, 16% of whole pebbles have impact marks on the ridges, while only 30% of the battered and broken pebbles do. The difference between broken and not broken battered pebbles is probably due to the fact that the sharp ridge of the fracture of the broken pebble was also used as the working edge. Broken artefacts consequently have fewer percussion marks on the extremities than do unbroken artefacts.

4 - Distribution of percussion marks and their importance

The marks can be distributed on a point or a zone, on two zones or on several zones. A single location is present on 1065 of these temporary hammerstones, or 57%, but 17% of the artefacts bear marks on several points or zones. There are more battered pebbles without fractures in this last class.

Remarks

The battered broken pebbles are temporary hammerstones that were discarded because they were broken, but then recovered and sometimes reused for the ridge of the fracture. Pointed or, more often, rounded extremities were sought after. The size of the stone and its natural shape were what persuaded people to select or simply to pick up nearby artefacts which could be used to break or crush bones, a more probable use than tool making. For this purpose they needed good hammerstones and chose them for their precision and efficacy.

Spatial distribution

The proportion of battered pebbles varies greatly from one sector to another and from one square metre to another. The richest sectors are 1 and 3 in zone A, sector 6 and sector 5 in zone C.

Six squares, F-G / 25-26-27, yielded 240 battered pebbles: an average of 40 battered pebbles per square metre. A-B-C / 25-26-27 also had a high concentration, an average of 26 battered pebbles per square metre. Finally, the battered and broken pebbles are better represented in sector 6 and in sector 7 (zone D) on the eastern side of the excavation.

Active hammerstones

We define an active hammerstone as a manual hammerstone that is impacted against another artefact, usually a stone, to break it or to detach a fragment or flake from it (Chavaillon 1979b).

At Gombore I there are 353 active hammerstones, of which 29 display fractures preceding or following their use or, more often, caused by it.

Active hammerstones represent 7% of the percussion material (hammerstones, battered pebbles and broken pebbles together). Zone A yielded 196 (55%; Fig. 11, *1*, *3-5*, *8*).

The broken active hammerstones represent only 8.2% of the class and have mainly one or two fractures (Fig. 11, *7*). It is very unusual to find artefacts with three or more fractures.

Raw material

The raw material used was clearly selected for its hardness with rocks such as basalt reaching 46%. Battered pebbles show a lower incidence of hard rocks. Finally, obsidian is absent, which is quite logical.

Morphology

Dimensions: The average arithmetical maximum length is about 87 mm. Some 66% of the tools have a maximum length of between 60 and 100 mm with a distinct increase in average dimension from sector 1 (85 mm long) to sector 7 (92 mm long).

Maximum width: 76% are between 50 and 90 mm wide with 45% between 60 and 80 mm. Maximum thickness: 64% are between 40 and 70 mm thick. Some artefacts, especially in sector 4 (zone B), are markedly spheroidal. For example, the dimensions can be 67-65-55 mm or 94-84-83 mm or even 103-100-94 mm. The length and width measurements are very homogeneous and, to some extent, so is thickness.

Elongation: These are short artefacts: from "very short" (14%) to "rather short" (41%). "Rather long" or "long" hammerstones represent only 23% of the whole class.

Flattening: These are thick artefacts: 63% are in the "thick" and "very thick" categories. In sector 2 (zone A), nearly half the artefacts are "very thick".

Shape: Nearly one third of the artefacts are elliptical or circular, which indicates selection of this shape and size for a good hammerstone. The elliptical shapes are particularly abundant in zone A where they reach almost 40%. In contrast, pentagonal shapes predominate in sector 7 (zone D) and especially in sector 6 (zone C).

Weight: This is noticeably homogeneous with 63% of the active hammerstones weighing between 250 and 1000 g. Only 4% of the artefacts weigh less than 100 g.

Percussion marks

1 - Type of percussion

Different types of percussion are often associated on the same artefact and it is unusual for an active hammerstone to display only one percussion type. Thus, artefacts with only diffuse percussion do not exceed 15%. On the other hand, there is an association of diffuse percussion and punctiform percussion on 73%. Finally, the combination on the same artefact, of the three percussion mark types (punctiform, linear and diffuse) reaches 7.3%. This is quite exceptional among battered pebbles.

In short, nearly every active hammerstone shows marks due to diffuse percussion and 84% due to punctate percussion. Linear percussion is seen mainly on broken hammerstones (17%).

2 - Aspects of percussion marks

Chips and crushing are usually found (67%) on the same hammerstone. These characteristics, associated with the beginning of pitting, represent 2% of the total artefacts. Almost all active hammerstones have traces of crush marks and 90% of them show small chip marks. Finally, 28% of these hammerstones have the beginnings of pits, indicating repetitive use. Nearly half the hammerstones from sector 4 have pits in the process of formation, but this characteristic is rarely seen on active hammerstones from zone C.

3 - Location of percussion marks

Two or three characteristics are often associated. For example, 29% of the active hammerstones have percussion marks on ridges, on extremities and also on flat surfaces. While the association of percussion on ridges and percussion on the extremities is rather unusual on the same hammerstone (17.5%), percussion marks are often seen on surfaces and on extremities (42%).

In short, 94% of active hammerstones have impact marks on their extremities and 73% of them have the same impact marks on surfaces. This clearly indicates repeated use.

4 - Distribution and importance of percussion marks

In 76.5% of active hammerstones, percussion marks are found all over the tool, not just in one or two places.

They are therefore artefacts that have been used several times for perhaps different operations such as stone flaking, bone crushing, etc.

Remarks

Active hammerstones have many percussion marks on different parts of the artefact. Sometimes, the percussion has caused stepped removals (zones A and C). On the other hand, diffuse percussion with its more or less scattered crushing action gives the tool a hammered appearance; repetition of this action on the same spot often leads to low concavities we called "*pit starts*" that are the beginnings of pits or cupules. Some active hammerstones look like choppers completely blunted by repeated percussion. Indeed, two artefacts from sector 1 are undoubtedly former bifacial choppers. Other hammerstones look like polyhedrons with the ridges no longer sharp but crushed, particularly where the ridges cross.

Broken hammerstones are rare (8%). Several fracture ridges have impact traces.

The association of an active hammerstone with a rabot, a chopper or a core remains absolutely exceptional (1.7%); either these hammerstones previously had another function, or someone used a disused hammerstone to shape a tool.

Spatial distribution

An interesting distribution is found in zone A, especially in sectors 1 and 3. Zones C and B have more active hammerstones than battered pebbles, but their production was most intense in zone A.

Passive hammerstones

A passive hammerstone is an artefact on which a stone, a bone or a branch to be broken has been placed. This hammerstone can be hand-held (manual), in which case it is of average size and weight. If it is laid on the ground, its size and weight can be of importance. The abundance and distribution of impact marks vary with the frequency with which the tool was used.

There are 119 passive hammerstones, or 2.36% of the percussion material. Among these artefacts, only 23 have sharp fractures that could have occurred either prior to, or as a result of, their use (Fig. 12, *1*).

Raw material

The passive hammerstone had to be made of a hard rock, which is why 56% of the artefacts at Melka Kunture are of basalt. However, some sectors have even higher frequencies: for example, sector 1 yielded 65% and sector 6 nearly 80%.

Morphology

Dimensions: Although not really heterogeneous, there are two classes recognised: one with artefacts of average dimensions smaller than 100 mm long, and another with very large artefacts over 130 mm long. These variations and exceptional proportions affect length and width as well as thickness. In fact, there are really two functional classs: one of hammerstones which can be held in the hand and another, with a maximum length generally over 150 mm, which would be laid on the ground.

The maximum length shows a high arithmetical average of about 120 mm. Of these large artefacts, 80% are over 100 mm long and 23% are over 150 mm long. The choice of large blocks is particularly clear in some sectors. For example, in sector 5 (zone C) 92% of these hammerstones are longer than 100 mm and in sector 7 (zone D) there are 93% longer than 100 mm.

The width and the maximum thickness also indicate very high values. For example, 50% of these hammerstones are more than 100 mm wide and 22% have a maximum thickness also over 100 mm. This clearly indicates a high proportion of large artefacts.

Some passive hammerstones have remarkable dimensions. They are alluvial cobbbles that were picked up along the river and were chosen for their spherical shape and their size, as can been seen from the following hammerstones from sector 3, zone A: 94-93-91 mm; 111-95-93 mm; and 273-235-232 mm.

Elongation: This index shows that there are “short” and “very short” (35%), but also “long” (6%) artefacts. In this latter category its is more usual to find broken artefacts.

Flattening: Two thirds of the artefacts are “thick” or “very thick”. “Flat” or “rather flat” artefacts are also better represented among broken hammerstones (22% of this small class) against 4% of whole artefacts.

Shape: Rounded and quadrilateral shapes each comprise 18%. However, nearly a third of the artefacts are polygonal.

Weight: As in the case of length, weight values have a wide range with hammerstones weighing from 175 g to over 10 kg. More than half of them weigh between 1 and 10 kg.

Percussion marks

They are clear and abundant:

1 - Type of percussion

Punctiform percussion is present on nearly all the passive hammerstones because of their function: impacts are directed onto precise points and this creates scaling. In 18% of the cases there is only punctiform percussion, whereas punctiform percussion and diffuse percussion are associated on 65% of the artefacts.

2 - Aspects of percussion marks

There are small removals and crushing on all of the artefacts. The beginnings of cupules are very rare.

3 - Location of percussion marks

A ridge was chosen in 84% of the cases. Furthermore, there are many passive hammerstones (about 20%) on which impact is located only on the ridges. Marks are also visible on the flat surfaces, as is often the case on hammerstones called anvils. In fact, the two varieties of passive hammerstones, some heavy and laid on the ground, the others light and hand-held, could have been used in the same way. For the latter one the ridge is preferred, and for the heavier one there is more frequent percussion on flat surfaces.

4 - Distribution and importance of percussion marks

Generally, in 80% of the cases percussion marks can be seen on several zones of the passive hammerstone. However, marks limited to a single location are much more frequent on broken hammerstones (43.5%) than on whole hammerstones (7%).

Remarks

The use of a striking platform (natural or anthropogenic) is often typical of the passive hammerstone, whether hand-held or placed on the ground. The search for a sharp ridge and steep edge explains why.

Heavy artefacts (8 to 10 kg) have nearly continuous impact marks on the sharp edge of their ridges. This is the case on one hammerstone from sector 1 on which the edge is punctuated with small removals. Large anvils are localised in squares G-27 and G-26.

Hammerstone laid on the ground could have been struck directly, but an intermediary could also possibly have been used. Shallow natural or artificial cupules could have been used to wedge the artefact that was to have been struck by the active hammerstone. This would have allowed bones and vegetable matter to be broken up more efficiently. The concavity would then deepen in some cases.

Spatial distribution

Passive hammerstones dominate in zone A with 47% and zone C with 36%. In zones A and B some concentrations can be observed. For example, in Z-A-B / 25-26-27, there are 24 passive hammerstones, of which 8 are in B-25 alone.

Most of the broken hammerstones with one fracture are found in sector 6 (23.5%) and in sector 3 (21.8%). There are fewer in zone B with 6.7% and none at all in sector 5.

Pitted hammerstones

In the Early Stone Age, pitted hammerstones are lithic artefacts bearing concavities or artificial cupules caused by repeated impacts on the same place. The hammerstone can be hand-held (active hammerstone) or placed on the ground (passive hammerstone). Compared to other categories, there are a limited number: 60 specimens, or 1.19% of the total percussion material (Fig. 11, *6-9*).

Only two artefacts have one or two fractures.

Finally, 72% come from zone A, mainly sector 1, but also sector 2, that is to say from the north-western part of the excavation. No artefacts of this type came from Zone B (sector 4).

Raw material

Basalts are abundant, but welded ignimbrites are exceptionally numerous. It could be that this more friable rock lent itself better to the formation of cupules. They could have been made in order to hold in place the object or the material to be broken (this is close to Chimpanzee activity), or they could have been created by repetitive percussion on the same spot.

Morphology

Dimensions: The maximum length ranges from 53 to 177 mm and nearly half of the artefacts are over 100 mm long. There is sometimes a clear heterogeneity, as for example in sector 2: out of thirteen specimens two are clearly smaller (60 mm maximum length) and three are more than 130 mm long. The former are hand-held hammerstones; the latter are passive.

The maximum width of 70% of these hammerstones is between 70 and 100 mm.

The maximum thickness of a third of the pitted hammerstones is between 50 and 60 mm.

Elongation: The elongation index of pitted hammerstones indicates that 38% are “rather short” artefacts and 23% are “rather long”.

Flattening: 45% are “thick” artefacts.

Shape: 23% of these hammerstones are elliptical, almond-shaped or circular, but the pentagonal shape is always the most common at 28%.

Weight: More than 20% of the artefacts weigh over 1 kg, but 73% weigh between 250 and 1000 g.

Percussion marks

1 - Type of percussion

Diffuse percussion is present on all artefacts, but 35% have the punctiform type as well.

2 - Aspect of percussion marks

On these hammerstones the cupules are more or less well formed and fairly deep, and crushing is the most common feature. However, in 40% of the cases, scaling is associated with crushing in formation of the cupule. They can be seen on other points of the artefact as well.

3 - Location of percussion marks

Some 88% of these hammerstones have marks on the flat surfaces. In addition, 57% have percussion traces on extremities. Cupules are often located on extremities, but much more often on flat surfaces. One of the two broken artefacts has percussion marks on the ridge of the fracture.

4 - Distribution and importance of the percussion marks

Pitted hammerstones are distributed equally between artefacts with percussion marks in one, two or several locations.

Cupules

Cupules, pits or concavities have quite important dimensions. Length ranges from 20 to 85 mm, but is mainly between 30 and 50 mm. Much the same measurements apply to the width. The depth is obviously shallow and 92% are between 3 and 9 mm deep. More precisely, in 70% of the artefacts, cupules are between 5 and 9 mm deep. What is surprising, however, is that 8% of the cupules are between 10 and 18 mm deep.

To be more concise, one can use the index (L+w) / 2 d, where L = Length of the cupule, w = width, d = depth. This index decreases in proportion to the depth of the cupule. On hammerstones with two or three cupules the distribution is:

Index	Characteristic	N	%
< 3.9	Very deep	1	17.2
4.0-6.2	Deep	34	53.1
6.3-9.9	Rather deep	15	23.4
>10	Shallow	4	6.3

More than half of the cupules are well marked, that is to say deep, whatever their dimensions are, and 17% are very well marked. Cupules can be found on the extremities, the middle of the surfaces, even the edge. They are rarely joined, but are sometimes at opposing angles.

Spatial distribution

Most pitted hammerstones are located in zone A, particularly in sectors 1 and 3. Two areas have 42% of the total: F-G-H / 25-26-27 with 14 pitted hammerstones and 4 in H-26, as well as A-B-C / 26-27 with 11 artefacts (6 in C / 26-27). These are clearly two areas where various activities took place.

Comparisons and conclusions

Out of 2390 hammerstones, 1858 are temporary hammerstones or battered pebbles, making 78% of the whole class. The remainder is made up of undoubted hammerstones with 532 artefacts that are distributed between active hammerstones, passive hammerstones and pitted hammerstones.

It was possible to compare the raw material and morphology of these different types, as well as the aspect of the percussion marks.

Raw material

One class is on hard rocks such as basalt, another is on softer rocks, and yet another class is on welded ignimbrite, although it was seldom used and is more frequently found among the pebbles. The term "*volcanic tuff*" can signify both cinerite and un-welded ignimbrites.

Hard rocks were preferred and 26% of battered pebbles, 44% of active hammerstones and 56% of passive hammerstones were on "*basalts*". The quantity of "*trachyte*" or softer rocks is stable from one category of hammerstones to another, accounting for a quarter of the artefacts. The "*welded ignimbrites*" are seldom seen elsewhere but they are abundant among pitted hammerstones. Undoubtedly this rock was not suitable for anvils, but was suitable for making cupules (40%). "*Volcanic tuffs*" or ignimbrites are rare. Finally, *obsidian* is seldom found among battered pebbles (0.7%) and at Melka Kunture it was never used for true hammerstones because the rock is much too brittle for this function.

Morphology

Dimensions: The dimensions change according to the hammerstones categories. They are heterogeneous for battered pebbles and become more homogeneous with true hammerstones. Of course, the dimensions increase from battered pebble to passive hammerstone.

The maximum length is rather low for battered pebbles: 68% are 50 to 100 mm long. Active hammerstones are a slightly larger with 77% between 60 and 110 mm. There are two classes of passive hammerstones: one where the maximum length ranges from 100 to 130 mm (42%) and another (23%) where it is over 150 mm. Finally, pitted hammerstones do show the heterogeneity of their class: one class is hand-held and is therefore close in length to active hammerstones, and the other class (passive) has large artefacts like the passive hammerstones (Fig. 13).

Maximum width and the maximum thickness follow the variations in length though there are slight differences according to the typological category.

Elongation: From the battered pebbles category to that of pitted hammerstones there is a tendency for the artefacts to become shorter. Values for "very short" and "short" artefacts are stable. On the other hand, 25% of true hammerstones are on average "rather long" and "long", while 37% of temporary hammerstones (battered pebbles) are of similar length and even include some "very long" artefacts, which is exceptional.

Flattening: True hammerstones are thicker than lightly battered pebbles. A third of the passive hammerstones are "very thick" and more than 46% of the pitted hammerstones are classified in the "thick" category.

In contrast, 14% of the battered pebbles are "rather flat" and "flat" but they are poorly represented among true hammerstones; only 3% of the total are pitted hammerstones.

Short thick pebbles were selected for making hammerstones.

Shape: The shape of untrimmed artefacts such as hammerstones is interesting because it indicates a definite choice. Thus, elliptical, oval and circular shapes range from 18% to 30%. This last percentage applies to active hammerstones, the other values being stable. However, pentagonal and hexagonal shapes range from 38% to 43%, which corresponds to natural shapes, though these are largely selected from amongst stones on the river bed.

In fact, these stones are not rolled pebbles like those found on marine beaches, but are mostly small or large angular blocks with blunt rather than sharp ridges.

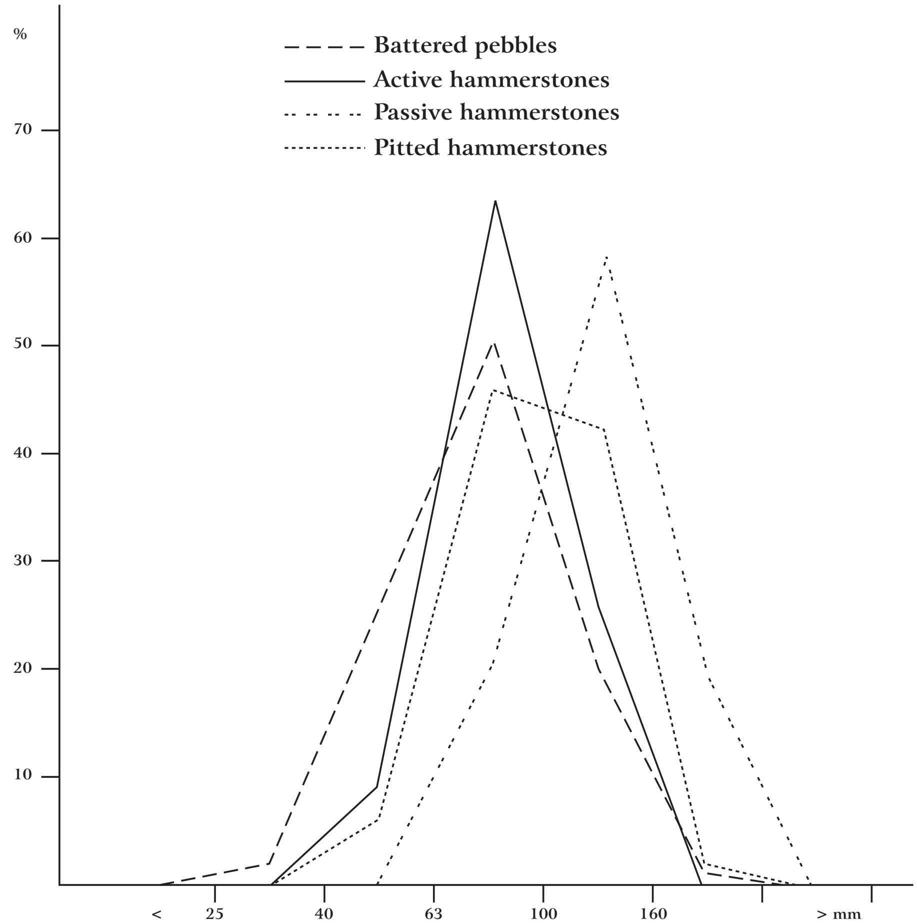

Fig. 13. Gombore I. Lithic industry from Level B. Maximum length of different types of hammers.

Weight: Only the slightly battered pebbles have low values. On the other hand, no passive hammerstones weigh less than 175 g and more than half weigh between 1 and 10 kg.

Percussion marks

1 - Type of percussion

Type	Battered pebbles		Active hammerstones		Passive hammerstones		Pitted hammerstones	
	N	%	N	%	N	%		
Punctiform	739	39.77	11	3.12	21	17.65		
Linear	27	1.45	1	0.28				
Diffuse	398	21.42	52	14.73	4	3.36	39	65
Punctiform+linear	57	3.07	2	0.57	7	5.88		
Punctiform+diffuse	613	33.00	258	73.09	77	64.71	21	35
Linear+diffuse	9	0.48	3	0.85				
Punctiform+linear+diffuse	15	0.81	26	7.36	10	8.40		
Total	**1858**		**353**		**119**		**60**	

Numbers and percentages of percussion types (punctiform, linear, diffuse) in hammerstones categories.

Punctiform or punctate percussion is present on all, or on at least three-quarters, of the artefacts, except for pitted hammerstones where it is present on only 35%. On the other hand, diffuse percussion is present on 100% of the pitted hammerstones. Logically, rare linear percussion is present mainly on passive hammerstones (ridges used).

The three types of percussion are seldom present together on the same artefact, except on 8.5% of the passive hammerstones. They are almost non-existent on battered pebbles (see the account of this activity) and on pitted hammerstones which are too specialised.

2 - Aspect of percussion marks

Marks	Battered pebbles		Active hammerstones		Passive hammerstones		Pitted hammerstones	
	N	%	N	%	N	%	N	%
Removal	576	31	1	0.28	3	2.52		
Crushing	312	16.79	17	4.82	2	1.68		
Pitting	4	0.21					1	1.67
Removal+crushing	844	45.43	236	66.86	106	89.08		
Removal+pitting	2	0.11	1	0.28				
Crushing+pitting	70	3.37	19	5.38	2	1.68	34	56.67
Removal+crushing+pitting	50	2.69	79	22.38	6	5.04	25	41.66
Total	**1858**		**353**		**119**		**60**	
Total removals	**1482**	79.80	**315**	89.24	**116**	97.48	**25**	41.66
Total crushings	**1272**	68.70	**351**	99.43	**116**	97.48	**59**	98.33
Total pittings	**126**	6.80	**99**	28.05	**7**	5.88	**60**	100.00

Numbers and percentages of percussion marks (removals, crushing, and pitting) in hammerstones categories.

Small removals and crushing are the visible marks of percussion. Apart from pitted hammerstones, these seldom create concavities, with the exception of 28% of hammerstones where beginnings of cupules can be observed.

The presence of a single characteristic such as scaling or crushing is more frequent on battered pebbles, which is a sign of infrequent use, than on true hammerstones (only 5 to 1.5%) which were used more often.

3 - Location of percussion marks

Location	Battered pebbles		Active hammerstones		Passive hammerstones		Pitted hammerstones	
	N	%	N	%	N	%	N	%
Ridge	441	23.74	8	2.27	23	19.33		
Extremity	396	21.31	23	6.51	2	1.68	5	8.34
Surface	215	11.57	3	0.85	9	7.56	24	40.00
Ridge+extremity	484	26.05	62	17.56	20	16.81	2	3.33
Ridge+surface	90	4.84	8	2.27	41	34.45	2	3.33
Extremity+surface	188	10.12	148	41.93	8	6.72	25	41.67
Extremity+ridge+surface	44	2.37	101	28.61	16	13.45	2	3.33
Total	**1858**		**353**		**119**		**60**	
Total ridge	**1058**	57.00	**178**	50.43	**100**	84.03	**6**	10.00
Total extremity	**1112**	60.00	**334**	94.62	**46**	38.65	**34**	56.67
Total surface	**537**	30.00	**260**	73.65	**74**	62.18	**53**	88.33

Numbers and percentages of the different locations of percussion marks (ridge, extremity, side) for hammerstones categories.

Percussion marks appear chiefly on the ridges or extremities of battered pebbles or temporary hammerstones. Almost all the active hammerstones show percussion on extremities, and they also appear on flat surfaces. There are almost always percussion marks on the ridges and surfaces of the passive hammerstones. Percussion marks on surfaces dominate on pitted hammerstones.

On the whole, this corresponds well with the different functions of hammerstones.

4 - Distribution and importance of the percussion marks

In a few cases, impact marks cover almost the whole artefact. The importance of the distribution of percussion marks on the pebbles is that 57% of temporary hammerstones or battered pebbles display only a single mark. Some 80% of active and passive hammerstones have several zones of percussion marks. Among pitted hammerstones, 38% have a single percussion zone, but repeated blows on the same spot created well defined concavities indicating extended use.

Spatial distribution

The distribution of all battered pebbles and true hammerstones (active, passive and with cupules), show two significant classes of nine square metres, located in zone A (sectors 1 and 3), or:

- A-B-C / 25-26-27 class: battered pebbles = 233, true hammerstones = 101
- E-F-G / 25-26-27 class: battered pebbles = 295, true hammerstones = 59

The highest density of true hammerstones is in zone A-B-C / 25-26-27 with about a hundred hammerstones of various types. Passive hammerstones and pitted hammerstones are particularly numerous there. Zone E-F-G / 25-26-27 has more battered pebbles than hammerstones in other categories.

Conclusions

These different hammerstones are particularly well characterised. There are, of course, certain characteristics that are common to all. Battered pebbles were very useful in their role as temporary hammerstones, despite the lack of standardization in size, and the reduction and simplification of characteristics linked to percussion marks. On the other hand, active hammerstones are classic examples of hand-held hammerstones. Both the pitted and passive hammerstones are very large, and thick and heavy. They also have the characteristicistics special to their type: percussion cupules on some and chipped sharp edges on others.

Broken pebbles

The artefacts named "broken pebbles" are pebbles or stones with one, two, three or more fractures. Are they natural or anthropogenic? It is sometimes difficult to judge. If thermal fractures or natural rock flaking can easily be dismissed, river action, in contrast, is often similar to human action, especially because the impact marks are often visible.

The criteria chosen for the selection of "anthropogenic" broken pebbles arise to some extent from the nature of the Gombore I excavation. We have only taken sharp fractures into account, even though the solvent action of paleosoils tends to blunt the ridges of these broken pebbles, as it does those of choppers or flake artefacts. If we accept these latter artefacts because they are trimmed (and without considering their previous history), on the other hand, we eliminate every stone with a blunted ridge on a fracture. However, it is not impossible that some of the fractures on these artefacts are due to fluviatile action. The stability of the whole class, and the abundance of artefacts, balances the data and considerably reduces the impact of possible errors.

These artefacts were classified into four typological categories according to the presence of one, two, three or more fractures. Each category shows a different aspect of human action, mostly unintentional.

However, fractures can occur because of the nature of the rock, its alteration, the strength of the person, as well as other factors.

Broken pebbles vary petrologically, with dimensions and weights that are sometimes considerably different.

Methodology

This is a summary of the study method used (Chavaillon 1979) as presented in the chapter on Methodology:

A - Position of the fracture in relation to the main axis or maximum length:

The fracture can be *longitudinal*
perpendicular
oblique

B - Position of the fracture in relation to the length/width plane:

The fracture can be *parallel*
perpendicular
inclined

C - Morphological aspects of the fracture:

The fracture can be *flat*
convex
concave
V shaped (angular)
irregular

Characteristics of the fracture

These three classes of characteristics allow one to describe a fracture and the frequency with which certain characteristics occur. For pebbles with two or more fractures we can see the relationship between these fractures and whether they are joined or not. If so, do they form an acute angle, a right angle or an obtuse angle?

Broken pebbles sometimes retain impact marks made by a previous percussion, before the pebble was fractured, during its use as a hammerstone for example. These marks were studied with the battered pebbles. Sometimes there are marks on the ridges or on the flat surfaces of fractures which indicates they were used after they were flaked.

The fractures can cover the entire surface or part of it. Partial fractures were also noted, as were the impact marks linked to the removal (intentional or not) on part of the pebble. These impacts are probably the result of human action.

During the refitting we noticed that, in the case of pebbles broken into several pieces, each piece could have one or more fractures, some of which had impact marks (Fig. 12, *5*).

Distribution of broken pebbles

Temporary hammerstones or battered pebbles often have fractures that are linked to percussion. However, impact marks, whether acquired after or before the fracture, are not apparent on all the artefacts.

We therefore include broken stones whether or not they have impact marks. A total of 1033 battered pebbles and true hammerstones are also broken. They have been studied twice: first in the battered pebbles and hammerstones class, and a second time in the broken pebbles class.

Table of distribution of broken pebbles by sector and by zone:

zone A = sectors 1 - 2 - 3
zone B = sector 4
zone C = sectors 5 - 6
zone D = sector 7

Broken pebbles	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
One fracture	420	138	172	157	130	138	210	**1365**
Two fractures	313	76	141	132	110	146	184	**1102**
Three fractures	128	34	35	58	42	52	64	**413**
> Three fractures	270	82	93	67	77	108	115	**812**
Total	**1131**	**330**	**441**	**414**	**359**	**444**	**573**	**3692**

The raw material, morphology and weight of the broken pebbles were studied. The characteristics of the fractures were noted, as well as their location on the plan.

Pebbles with one fracture

These are pebbles with a sharp fracture in any position. There are 1365 broken pebbles that represent 27% of the percussion material, hammerstones included. These artefacts are distributed as follows:

- 877 broken pebbles without impact traces 64.25%
- 463 broken and battered pebbles 33.92%
- 25 broken hammerstones 1.83%

Trachyte and basalt are dominant. The maximum length varies from 22 to 260 mm, with an average of 67 mm. Pebbles with impact marks in addition to the fracture (Fig. 11, *2*) are generally larger. They are stubby tools of comparatively low weight: 63% weigh 40 to 400 g.

The fracture is usually *longitudinal*; it can be *perpendicular* or *parallel* to the main plan of the artefact (L x l). The number of pebbles with one fracture varies according to the square, ranging from 0 to 52. Sector 1 (zone A) has the largest number, yielding 420 broken pebbles with one fracture, or 30.8%.

Pebbles with two fractures

These artefacts have two sharp fractures which are sometimes adjacent. There is a total of 1102, or 21.83% of all the percussion material. They are distributed as follows:

- 758 broken pebbles without impact marks 68.8%
- 324 broken battered pebbles and 29.4%
- 20 broken hammerstones 1.8%

Broken pebbles with two fractures are mainly of trachyte or basalt. Welded ignimbrites make up only 4.5% in zone B but reach 17% in zone A and 23% in zone D. A third has traces of percussion on ridges or on surfaces (Fig. 12, *6*).

The average length is about 64 mm, but the artefacts with impact marks are generally larger and heavier. These are stubby artefacts of average weight between 40 and 400 g.

The fractures are mostly *longitudinal*, but can be *inclined* or *perpendicular*. Finally, the surface of the fracture is *irregular*, or sometimes *flat* or *concave*. Most fractures are adjacent forming mainly a right or obtuse angle. Zone A has 530 or 48% of this typological category.

Pebbles with three fractures

These are pebbles which have three sharp fractures, adjacent or not (Fig. 12, *2-3*). There are 413, or 8.18% of the percussion material, and they are distributed as follows:

- 335 broken pebbles without impact marks 81.1%
- 74 broken and battered pebbles 17.9%
- 4 broken hammerstones 1.0%

About 19% of pebbles with three fractures in any area have impact marks. Nearly half come from zone A. Trachyte is most common (40%).

Extreme lengths vary, but the average length is 57 mm. These are "rather short" or "rather long" artefacts. They are stubby or "thick" and "rather thick". The smallest and lightest artefacts come from zones A and B. Pentagonal and quadrilateral shapes dominate.

The most common fracture is longitudinal, inclined and flat. Most fractures are adjacent and form a right or an obtuse angle. No more than 15% have an acute angle.

The main distribution is concentrated in sectors 1, 3 and 4 (zones A and B).

Pebbles with more than three fractures

These are pebbles with between 4 and 10 sharp fractures. Only 15% are broken and battered pebbles. In fact, they are often fragments which represent 16.08% of the total percussion material (Fig. 12, *4*). The 812 artefacts are distributed as follows:

- 689 broken pebbles without percussion marks 84.85%
- 118 broken and battered pebbles 14.53%
- 5 broken hammerstones 0.62%

The best represented rocks are trachyte and basalt. These broken pebbles are small artefacts with an average length of 54 mm, and are stubby but light: 60% are under 100 g. Angular shapes are more common than in other categories of broken pebbles. Despite the rather high number of fractures, numerous artefacts retain traces of cortex. Nearly 95% have 4 to 6 fractures and more than half have 4. The fractures are nearly always adjacent and their junction creates right or obtuse angles.

These broken pebbles were collected all over the site, but mainly in the western sectors of the excavation, or 55% in zone A.

Comparisons and conclusions

More than half of the 3692 broken pebbles were distributed in zone A, and particularly in sector 1. Of these artefacts, 1033 (or 28%) have impact marks resulting from their use. The proportional distribution according to the number of fractures (one, two, three, several) is listed below:

Fractures	**Battered pebbles Broken hammerstones**
One fracture	35.7%
Two fractures	29.4%
Three fractures	18%
Several fractures	15%

Thus there is a decrease in the number of artefacts with impact marks from those with one fracture to those with several fractures. Pebble fragments did not retain impact marks made prior to their fracture.

Raw material

The raw material of different categories of broken pebbles is remarkably stable. However trachyte is a bit more common in categories of broken pebbles with 3 to several fractures (40%). In contrast, the other rock types are very stable: volcanic tuff almost never exceeds 10% and obsidian remains rarely used for this type of activity, such as stone flaking, crushing, etc. (0.6 or 1.7%).

Morphology

Dimensions: Are relatively similar and the maximum length varies in similar proportions among the four categories of broken pebbles. However there is a certain general heterogeneity in all these categories so that they never reach an Eiffel Tower peak of very similar values. This is because the maximum lengths are evenly distributed. The same remarks can be made for the width and thickness. In other words, for length all values are classed mainly between 40 and 100 mm.

Different artefact classes with 1, 2, 3 or more fractures, peak slightly towards the lower values. Two classes are evident: artefacts with 1 or 2 fractures and artefacts with 3 and several fractures which maximum length is lower.

Elongation: The stability of the elongation index is clear. Broken pebbles with 3 fractures show more "very short" and "short" artefacts (a third of the class). The "long" and "very long" artefact categories account for 8.5% for the artefacts with a single fracture, and for 11% for broken pebbles with several fractures. It is possible that fragmentation is responsible for a higher elongation index, that is to say for longer artefacts.

Flattening: Is also very stable with little change from the broken pebbles with 1 fracture to the pebbles with several fractures, except for a slight increase in the percentage of "rather flat" and "flat" pebbles. For example in the flat artefacts category there are 15.6% pebbles with 1 fracture and 18,6% with several fractures. The flattening could be one of the main indicators of considerable fragmentation.

Shape: The shape of broken pebbles shows little variability with the single exception of those that are rounded (circle, ellipse, half or quarter ellipse). It therefore ranges from 21.8% for elliptical pebbles with 1 fracture to 5.7% for pebbles with multiple fractures. This is explained by the increase in the number of facets which tend to give the artefacts an angular shape. Moreover, the "elliptical" artefacts in this category with several fractures are half or quarter ellipses. Between 25 and 30% are pentagonal. The fragmentation thus tends to reduce the number of rounded artefacts.

Weight: There are two opposing tendencies. On the one hand, there is an increase in the number of artefacts under 25 g from amongst pebbles with a single fracture (9.5%) to broken pebbles with several fractures (18.5%). On the other hand, in counterpart of the first observation, there is a decrease in the number of artefacts that weigh over 400 g from 19% for broken pebbles with a single fracture to 9% for broken pebbles with several fractures. Artefact fragmentation thus correlates with lighter weight, with a few exceptions.

Fractures

Each fracture has three characteristics deriving from three classes. The association of the three characteristics defines a fracture. The formula representing the fracture recurs several times, but there is a great variety of possible formulas. However, the most frequent combination, which reaches 14%, is identified in 195 broken pebbles with 1 fracture which have the following code: *longitudinal*, *parallel* fracture with *irregular* surface. Apart from this type, the most frequent formulas with three similar characteristics never exceed 10%.

These characteristics come from three classes or series (see Methodology in this volume):

- The first series of characteristics concerns the position of the fracture in relation to the main axis. The characteristic "*longitudinal*" is the most common. It is better represented among broken pebbles with 1 fracture (68.5%) than among artefacts with multiple fractures (51.5%). Conversely, "*oblique*" or "*transverse*" fractures are mainly located in the class of artefacts with multiple fractures.

- The second series of characteristics concerns the position of the fracture in relation to the L / l plan: the "*perpendicular*" characteristic is stable from one class of pebbles to another (36.7 to 35.4%), but the "*parallel*" characteristic is common (35.6%) for the pebbles with a single fracture. However, broken pebbles with several fractures have more "*inclined fractures*" (45%) than broken pebbles with 1 fracture (28%).

- The third series concerns the morphological characteristics of the fracture. From 35 to 25% of broken pebbles in different categories have fractures on which the surface is sometimes "*irregular*", sometimes "*flat*" or sometimes "*concave*". The "*convex*" fractures do not exceed 7% and the "*V shaped*" fractures do not reach 5%.

Pebbles broken two, three or more times often have adjacent fractures. This is the case in 88% with two fractures and 94% with three fractures. When these artefacts have more than three fractures, they are all adjacent.

The angle formed by two adjacent fractures is mostly right or obtuse.

Spatial distribution

The western part of the excavation is clearly the richest and the eastern part (zone D) is the poorest. This is also applies to the distribution of trimmed artefacts.

However, for broken pebbles, six squares, F-G / 25-26-27, contain 518 broken pebbles, or an average of 86 artefacts per square metre. In zones, B, C and D, the content ranges from 1 to 30 artefacts per square metre. Sometimes there are none at all.

Conclusions

Broken pebbles are of trachyte or basalt. Most are fractured and few have percussion marks. Broken pebbles with 1 or 2 fractures are on average larger than those with 3 or more. A broken fragment is usually small, light, elongated and flat and its outline is almost always angular, thus losing its more or less elliptical form.

The broken pebble is very often a waste product created by the prior use of a stone picked up on the spot and used without trimming or flaking. As a type of hammerstone or broken crusher it suggests temporary use, however purposeless or disorganised. The reconstitution by refitting of several pebbles (stones broken in 2 or in several fragments) confirms this point of view.

The percussion material and particularly the various types of hammerstones are surprisingly abundant indicating remarkable flaking and crushing activity.

Whether sharp or not, the ridge of the broken pebble was used as the cutting edge of a chopper. In this way, the broken pebble unites casually trimmed choppers and some lateral and distal choppers, as much for the shape of the tool as for its function and its efficiency. There is a progression from a pebble that has been simply used, to the flaked pebble used as a rough chopper or as a hammerstone-grinder. The transition from the rough tool to the casually trimmed tool and the carefully trimmed tool was often observed in Gombore I.

Tools on pebble

A tool is a manufactured artefact, even if flaked very roughly, so hammerstones and broken pebbles are not included under the heading "tools on pebble". The distinction is subtle but essential. A hammerstone can be a tool as well as a chopper when it comes to function. But, while the hammerstone was chosen for its size and for its suitability for gripping, even the simplest chopper is a stone which has been transformed for a particular use. It is the difference between a passive hammerstone or anvil and a passive chopper. They sometimes play the same part and both receive knocks, one on its surfaces, the other one on its cutting edge. But one is rough and has removal scars caused by utilization, whereas the chopper has intentional shaping, even when rough, which allows it to be classified as a manufactured tool.

The category of tools on pebble includes all artefacts on pebbles or on chunks with the exception of hammerstones and cores. If the latter were trimmed and used as choppers, polyhedrons or rabots after their first function as cores, they would also be studied as tools on pebble.

Choppers, polyhedrons, rabots and heavy end-scrapers, various artefacts on pebbles such as notches, denticulates and beaks, and archaic handaxes, as well as artefacts with abrupt fractures and, finally, debris or waste, and fragments, are described below:

Tools	**A**	**B**	**C**	**D**	**Total N**	**Total %**
Choppers	382	99	260	105	**846**	44.32
Polyhedrons	163	23	115	44	**345**	18.07
Heavy end-scrapers	139	42	104	47	**332**	17.39
Diverse tools on pebble	175	37	83	34	**329**	17.23
Archaic handaxes	7	2	4		**13**	0.68
Tools with abrupt fractures	28	4	9	3	**44**	2.31
Waste	50		10	10	**70**	
Total	**944**	**207**	**585**	**243**	**1979**	

Distribution of tools on pebble according to zone.

Apart from waste, 1909 flaked pebbles are present. Choppers are by far the most numerous with 44%. Then come three categories represented in equal proportions: the polyhedrons, the heavy end-scrapers and the class of diverse tools on pebble; and finally, the archaic handaxes, which represent only 0.7% of tools on pebble.

Distribution

The distribution map highlights the particular concentrations and the empty spaces. Three activity areas show up clearly: one to the north and two others to the west (north-west and south-west). Fifty-two tools on pebble were found in the single square metre in B-25 and 45 in F-22, but most of the squares (a quarter of the excavated surface) have from 10 to 30 tools. However out of the 262 square metres of the excavation, 28% have no tools on pebble and 31% have yielded only a small group of 1 to 5 tools.

Choppers

Choppers constitute the best represented and most complete of the tools on pebble category from the Oldowan site of Gombore I. There are 846 tools representing 44.32% of the total tools on pebble, debris excepted.

The chopper distribution is densest in zones A and C with 45 and 31%, while zones B and D each have 12%. Lateral choppers are the most numerous and the combination of lateral and distal choppers reaches 57% of the total choppers.

Tools	A	B	C	D	Total N	Total %
Lateral choppers	141	40	87	43	**311**	36.80
Distal choppers	77	15	52	27	**171**	20.20
Chisel choppers	52	10	23	4	**89**	10.50
Double-edged choppers	11	3	6		**20**	2.35
Truncated choppers	50	13	48	13	**124**	14.65
Pointed choppers	12	5	12	3	**32**	3.80
Choppers with peripheral working edge	15	6	15	5	**41**	4.85
Lateral-distal choppers	6	2	4	1	**13**	1.55
Passive choppers	2	1	2	2	**7**	0.80
Diverse choppers			2		**2**	0.25
Casually trimmed choppers	16	4	9	7	**36**	4.25
Total percentage	45.2	11.7	30.7	12.4		
Total	**382**	**99**	**260**	**105**	**846**	

Number and percentage of different types of chopper by zone.

Proportion of chopper categories by zone

The number of tools naturally varies from one zone to the other, but taking into account the proportions of chopper categories in each zone, the typological categories of choppers are relatively similar. Lateral, distal, truncated or with peripheral working edge choppers show a constant percentage in the four zones. On the other hand, there is a marked contrast between other typological categories such as chisel choppers and pointed choppers. Zone D has very few in these last two categories, and in fact they are almost non-existent.

There is a considerable variation in numbers from one sector to another, so that some sectors have low and others have high numbers.

Below is a list of choppers of all categories (mixed) with the average numbers of tools per square metre according to zones:

Zone	Choppers per square metre
A	6.80
B	2.47
C	5.00
D	0.90

In conclusion, zone A (sectors 1, 2, 3) is representative in numbers (383 tools), if not in quality, of tools found in the whole excavation area (zones A, B, C, D, 846 tools). In each typological category the number of tools varies from one zone to another, but the proportions remain very similar, with rare exceptions. There are sectors or zones that are richer in choppers than others where a particular activity could have been more important. On the other hand, the preference for some choppers categories seems to be much the same from one zone to another. This could be due to chance but is more probably due to a functional necessity.

Choppers and chopping-tools or unifacial and bifacial choppers

The unifacial chopper is the equivalent of H.L. Movius's *chopper* and the bifacial chopper corresponds to the *chopping-tool* (Movius 1948, 1957). Even though we have chosen another method, technically this differentiation exists. The following table expresses these variations in numbers and percentages. The bifacial tools are the most numerous and their proportion ranges from 60 to 98%. There are variations according to the tool type but also, for a same type, from one zone to another.

Diverse choppers are not included. There are two such tools, one unifacial and the other bifacial. Also excluded are *casually trimmed choppers* because the method of preparation is doubtful.

Tool	Trimming	A	B	C	D	Total N	Total %
Lateral choppers	unifacial	37	8	24	8	**77**	24.75
	bifacial	104	32	64	35	**234**	75.25
Distal choppers	unifacial	40	2	18	7	**67**	39.20
	bifacial	37	13	34	20	**104**	60.80
Chisel choppers	unifacial	6		6	1	**13**	14.60
	bifacial	46	10	17	3	**76**	85.40
Double-edged choppers*	unifacial	7	3	5		**15**	37.50
	bifacial	7	15	3		**25**	62.50
Truncated choppers	unifacial	14	3	19	4	**40**	32.30
	bifacial	36	10	29	9	**84**	67.70
Pointed choppers	unifacial	2		5		**7**	21.90
	bifacial	10	5	7	3	**25**	78.10
Choppers with peripheric working edge	unifacial	1				**1**	2.40
	bifacial	14	6	15	5	**40**	97.60
Lateral-distal choppers	unifacial	1				**1**	7.70
	bifacial	5	2	4	1	**12**	92.30
Passive choppers	unifacial			1		**1**	14.30
	bifacial	2	1	1	2	**6**	85.70

Numerical distribution of unifacial and bifacial tools. * The working edges of double-edged choppers are counted twice. There are 20 double-edged choppers, thus 40 working edges.

The table of percentages highlights the often noticeable differences between one zone and another. The *unifacial distal choppers* are numerous in zone A (52%) but not in zone B (13.3%). *Chisel choppers* are present in equal quantities in zones C and D with a quarter of unifacial choppers and three-quarters of bifacial tools, while in zone B there are only bifacial choppers.

In summary, there are 810 unifacial and bifacial choppers, excluding casually trimmed choppers. However there are 20 working edges in addition because the double-edged choppers are counted twice. The total amounts to 830 chopper working edges. The distribution is as follows:

Unifacial choppers (Movius *choppers*) 223 or 26.9%

Bifacial choppers (Movius *chopping-tools*) 607 or 73.1%

This shows clearly that the technique of bifacial flaking was commonly practised and was not difficult technologically.

Lateral choppers

The trimmed edge of lateral choppers is parallel to the main axis of the pebble. It is a *Lateral chopper* if unifacial or bifacial removals occupy a part or the whole of the lateral edge. These tools are among the best represented in Gombore I. Thus, out of 846 choppers, 311 (37% of the total choppers) are lateral choppers.

Other typological categories of choppers also show a lateral working edge. They are, for example, truncated choppers, double-edged choppers and passive choppers:

- 73 truncated choppers
- 16 double-edged choppers

- 5 passive choppers
- 1 atypical chopper
- 21 casually trimmed choppers

The study of these tools will be presented in the corresponding category, but the above data indicate that the choice of one long working edge occupying the longer axis of the pebble was particularly sought and therefore appreciated. One tool out of two has a lateral working edge.

Functionally double-edged choppers are counted twice as they have two separate working edges. So, out of 866 working edges, 427 are on the longitudinal axis of the pebble.

Raw material

Most of these choppers derive from beach pebbles. Their typological distribution shows that hard rocks like basalt are dominant with 46%. In some zones they are more numerous, for example there are 57.5% in zone B and 60.5% in zone D. The poor quality rocks such as volcanic tuffs, vuggular lava or welded ignimbrites are poorly represented, though together they reach 15.4%.

Obsidian represents only one tenth, which is clearly more than the average of pebbles from the fossil beach. However, in zones A and B we have:

sector 1: 15.4%

sector 2: 11.3%

sector 4: 20.0%

In contrast, in sector 7 (zone D) there is only one obsidian tool (2.3%). Finally, choppers of obsidian are localised in a limited zone, as can be seen in the following table:

	27	**26**	**25**	**24**	**23**
H				2	
G	2	1	2		
F			2	1	1
E				1	
Z		1	2	2	

Morphology

Dimensions: The maximum length is between 40 and 140 mm, with an important class of tools 60 to 110 mm (67%) long. Large choppers with a length between 125 and 160 mm are in zones B and C, mainly grouped in sectors 2 and 6, namely: D-20 (2 tools), D-21, F-17, G-16, H-14, H-15 (1 tool each).

The maximum width varies accordingly, but the values are more often grouped between 40 and 100 mm (84%).

The maximum thickness is even more narrowly distributed with 67% between 30 and 70 mm. There is a noticeable concentration of 38% between 40 and 60 mm.

The tools from zone A have extreme values and this is where most lateral choppers are found.

Elongation: The elongation index shows remarkable homogeneity from one sector to another. This perhaps indicates a choice or simply a constraint linked to the raw material. The tools range between “short” and “rather long” tools. “Very short” tools represent nearly 12%.

Flattening: This index highlights two aspects: stocky tools (“thick” and “very thick”) reach 42.5%, and “rather thick” 40%. Finally, “flat” choppers are almost non-existent (0.65%).

Shape: One tool out of four is pentagonal and this is the best represented shape. There are also many hexagonal, circular or elliptic tools (21%). In sector 2 oval or elliptic choppers reach 30%. Triangular shapes are rare (3%) and are only located in zones A and C.

Weight: Chopper weights are very variable: 14 to 2095 g. The heaviest come from sectors 1, 2 and 6. Tools of basalt are mostly between 400 and 1400 g, while tools of obsidian are small and light and weigh only 14 to 274 g.

Lateral choppers base

On lateral choppers, the edge opposite to the working edge is generally thick, whatever the raw material. In the width/thickness plan, therefore, bases appear flat or slightly rounded and sometimes V shaped and slightly rounded.

The bases are frequently cortical, even if a removal or a fracture roughly shapes some tools. This was observed in sector 1 in 7 out of 52 choppers.

Cortex

The cortex of these pebbles always occupies, even if only partially, one or both worked sides as well as the base of lateral choppers. In most cases the cortex occupies three-quarters of the sides, rarely half, and exceptionally a fifth. In sector 4 (zone B), 5 out of 7 obsidian choppers have almost no cortex at all.

Blunted ridges of some lateral choppers

In this class of 311 tools, only a few have slightly or partially blunted ridges. One of these blunted choppers has clear resharpening which indicates subsequent reworking, then re-use after being sharpened again. Two other choppers have blunted ridges. The abrasion of soft rocks such as volcanic tuffs can also affect some basalts. The cause is the runn-off or seasonal flooding of the river, since the camp was probably below the maximum flood level most of the time.

Shaping

Lateral choppers are distributed in two classes: unifacial choppers (25%) and bifacial choppers (75%).

Unifacial choppers show:

- one removal A1 (Fig. 14, *5*)
- two removals A1-A2. This is the best represented
- three or more removals (Figs. 14, *3*; 15, *4*; 16, *6*)

Bifacial choppers are distributed in two classes of nearly equal importance:

- A single removal on one side, one or several on the other side (36.7%).

Single removals (A1-B2) represent 8% of the total choppers, but the most common are single removals on one side and multiple removals on the other. In this last class of 46 tools, 24% show the A1-B2-A3 formula, while for 35% it is the A1-A2-B3 formula which dominates and 41% follow the A1-B2-B3 formula.

- Two or more removals on each side (38.6%).

This is usually a complex matter. Firstly there are simple types such as A1-B2-A3-B4, or A1-B2-B3-A4. Some complex formulas A1-B2-B3-A4-A5-A6-A7-B8-B9, or A1-B2-B3-B4-B5-A6 occur frequently. In contrast, other formulas are exceptional such as A1-B2-A3-B4-A5 or A1-B2-A3-B4-A5-A6-B7-B8-B9. The toolmaker alternated the blows consistently in a series of two or three removals (Fig. 14, *1-2*, *4*, *6-7*; 15, *1-3*; 16, *1-5*; 17, *5*).

In fact, without including reworking and resharpening, the toolmaker tried to create a straight or slightly curved working edge. The number of removals is an indicator of the difficulty caused by the raw material, as well as the ability of the toolmaker. For example, tools with only 3 removals, whether they alternate or not, represent 48.3% of the all lateral choppers. To detach two flakes on either the same side or alternately, was not a real technical problem at this cultural stage. A hierarchy or technical chronology has been imagined too often. If it was followed, it would mean that the *chopper* (a unifacial tool according to Movius), which is technically simpler, would in fact be older than the bifacial *chopping-tool* the technique of which is more complex. In fact, some unifacial choppers, particularly in Acheulian sites, can have from

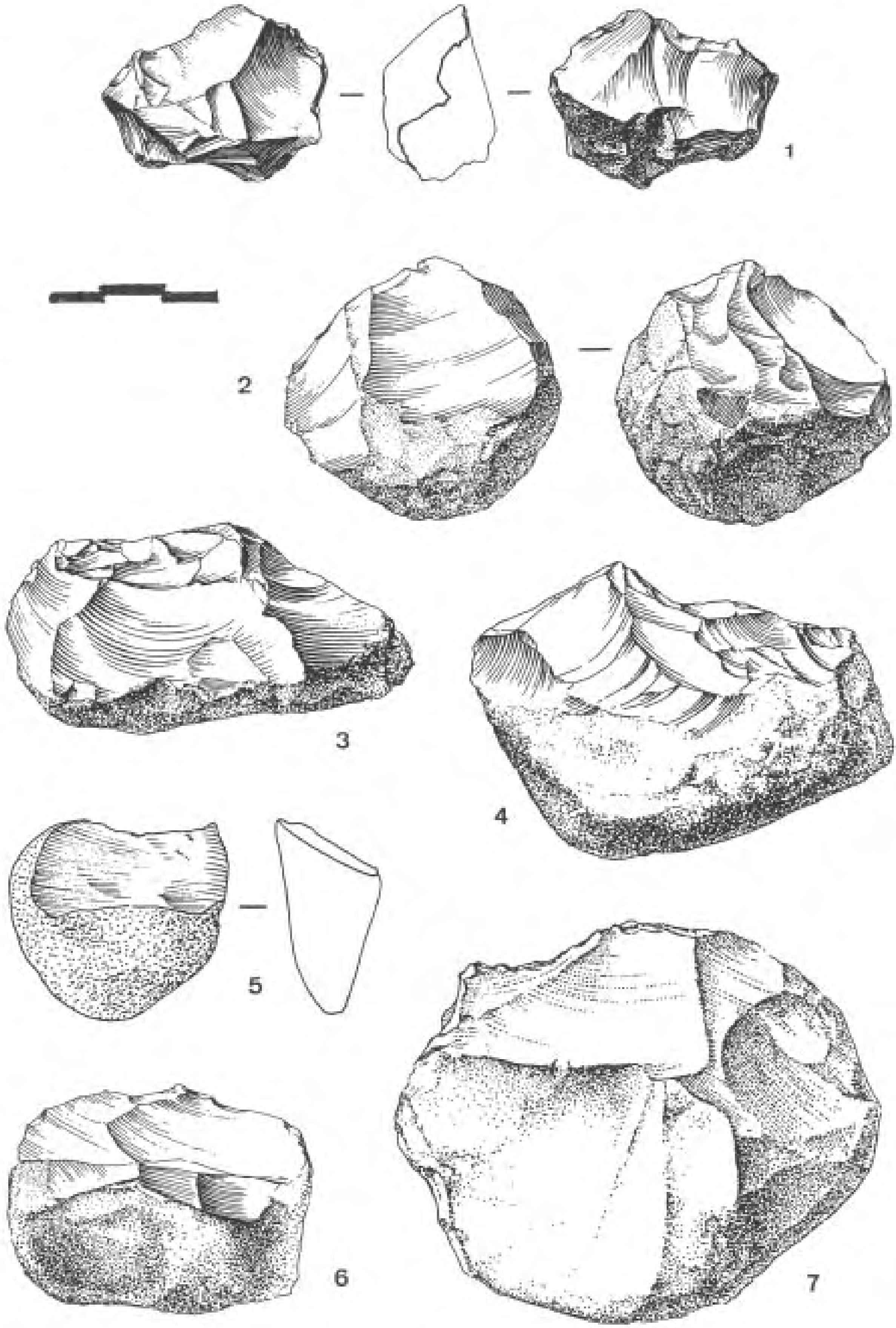

Fig. 14. Gombore I. Lithic industry from Level B. 1, 2: bifacial lateral choppers; 3, 4-7: unifacial lateral choppers. 1-4, 6: obsidian; 5, 7: basalt. *Drawings by C. Chavaillon (1-4, 6, 7) and J. Chavaillon (5)*

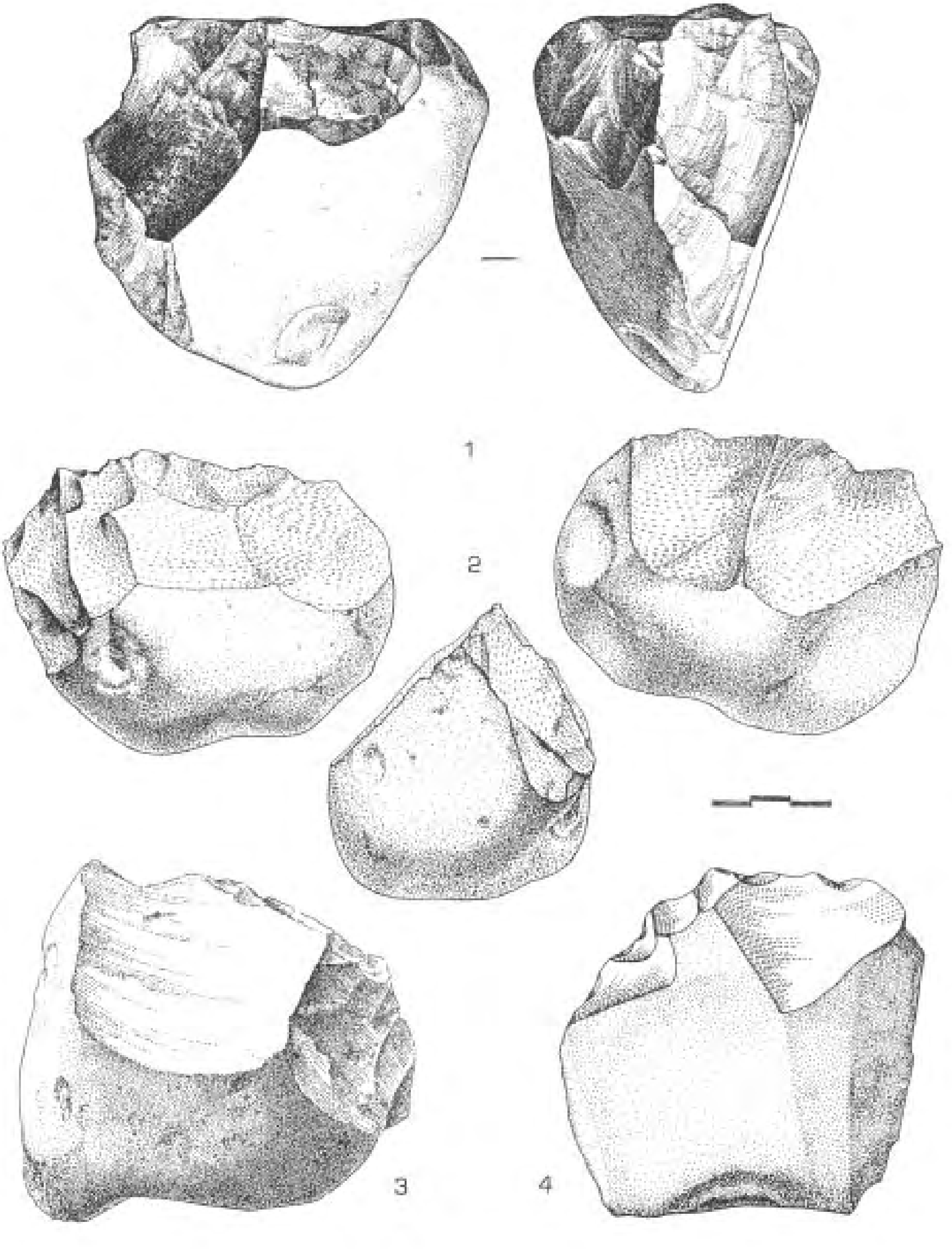

Fig. 15. Gombore I. Lithic industry from Level B. 1, 3: bifacial lateral choppers; 4: unifacial lateral chopper. Lithic industry from Level C. 2: bifacial lateral chopper. Basalt. *Drawings by C. Chavaillon (1, 3) and M. Bouhey (2, 4)*

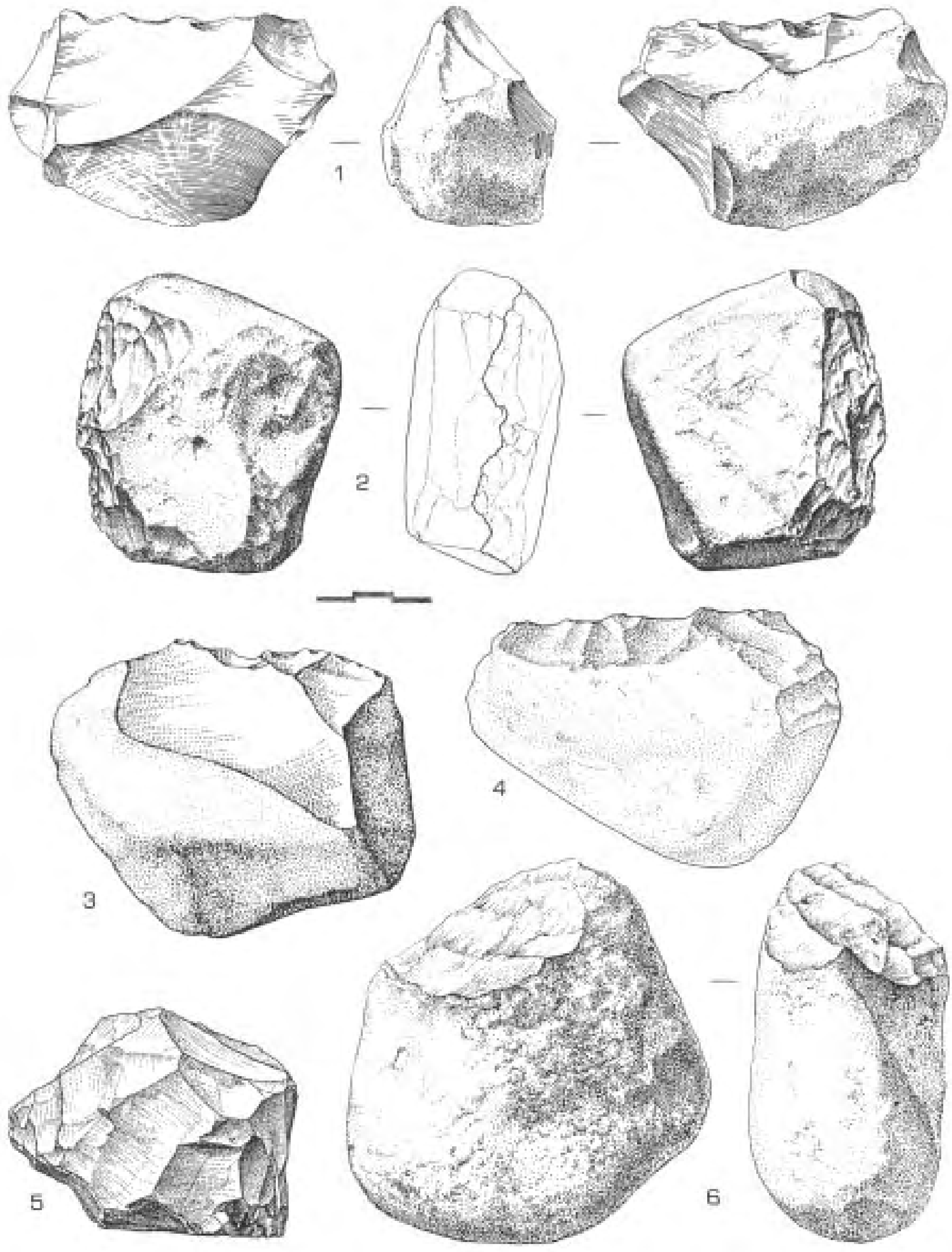

Fig. 16. Gombore I. Lithic industry from Level B. 1: bifacial lateral chopper and bipolar core; 2-4: bifacial lateral choppers; 5: bifacial lateral chopper and rabot; 6: unifacial lateral chopper. 1: obsidian; 2-6: basalt. *Drawings by C. Chavaillon (1, 2, 5, 6) and J. Jaubert (3, 4)*

6 to 7 removals on the same edge. They are more complex than the bifacial chopper with 3 alternate removals. Rather, the refinement of the curving or sinuosity of the working edge is a sign of technical evolution. Among bifacial choppers, the first removal is sometimes a fracture. Finally, some obsidian choppers have elaborate shaping.

Working edge	**Unifacial Choppers**		**Bifacial Choppers**		**Total**	**Total**
	N	%	N	%	N	%
Angle						
< to 60°	6	7.80	6	2.57	**12**	3.85
60° to 69°	11	14.28	23	9.83	**34**	10.93
70° to 79°	33	42.86	50	21.37	**83**	26.69
80° to 89°	18	23.38	95	40.60	**113**	36.34
90° to 99°	9	11.68	54	23.07	**63**	20.26
> to 100°	6	2.57	6	1.93		
L w.e. / L pebble						
< to 40%	6	7.80	2	0.85	**8**	2.57
40 to 59%	21	27.28	27	11.54	**48**	15.44
60 to 79%	25	32.47	79	33.76	**104**	33.44
80 to 100%	25	32.47	126	53.85	**151**	48.55
In lateral view						
Sinuous	52	67.53	215	91.88	**267**	85.85
Straight	25	32.37	19	8.12	**44**	14.15
In frontal view						
Straight	10	12.99	16	6.84	**26**	8.36
Angular	10	12.99	52	22.22	**62**	19.93
Broken line	9	11.68	41	17.52	**50**	16.08
Convex	32	41.86	78	33.34	**110**	35.37
Concave	13	16.88	25	10.68	**38**	12.22
Irregular	3	3.90	22	9.40	**25**	8.04
Total	**77**		**234**		**311**	

Main characteristicistics of the working edge of lateral choppers.

Working edge

Angle of the working edge: The most common value is between 80° and 90° and is present in 36.4% of the class. Numerous tools have an acute working edge of 70° to 80°, and 22% have an obtuse angle over 90°.

In this class of more than 300 choppers, the variety of working edge angles results from the shaping technique used on the unifacial or bifacial chopper. Tools with an angle of 70° to 80° thus represent 43% of unifacial choppers and only 21.5% of bifacial choppers. Conversely, tools with an angle between 80° and 90° represent only 23.5% of unifacial choppers, but 41% of bifacial choppers. The same observations apply to tools with a working edge angle of over 90°. What can be deduced from this? It can only be concluded that bifacial choppers have mainly a right or obtuse angle and unifacial choppers have a more acute angle. Is this linked to flaking and an increase in retouching? The frequent shaping of the bifacial chopper reinforces the strength of the working edge but often makes it obtuse. Carefully trimmed bifacial tools with an acute angle await the discovery of Acheulian bifacial preparation and use of the soft hammer technique. This will take several hundred thousand years.

Length of working edge in relation to maximum length: The working edge can occupy from 30 to 100% of the tool length. However, nearly half of the tools have a working edge that is from 80 to 100% of the maximum chopper length. Differences can be seen between unifacial and bifacial tools. Thus, a third of unifacial choppers, but more than half of bifacial choppers, have a working edge that occupies from 80 to 100%

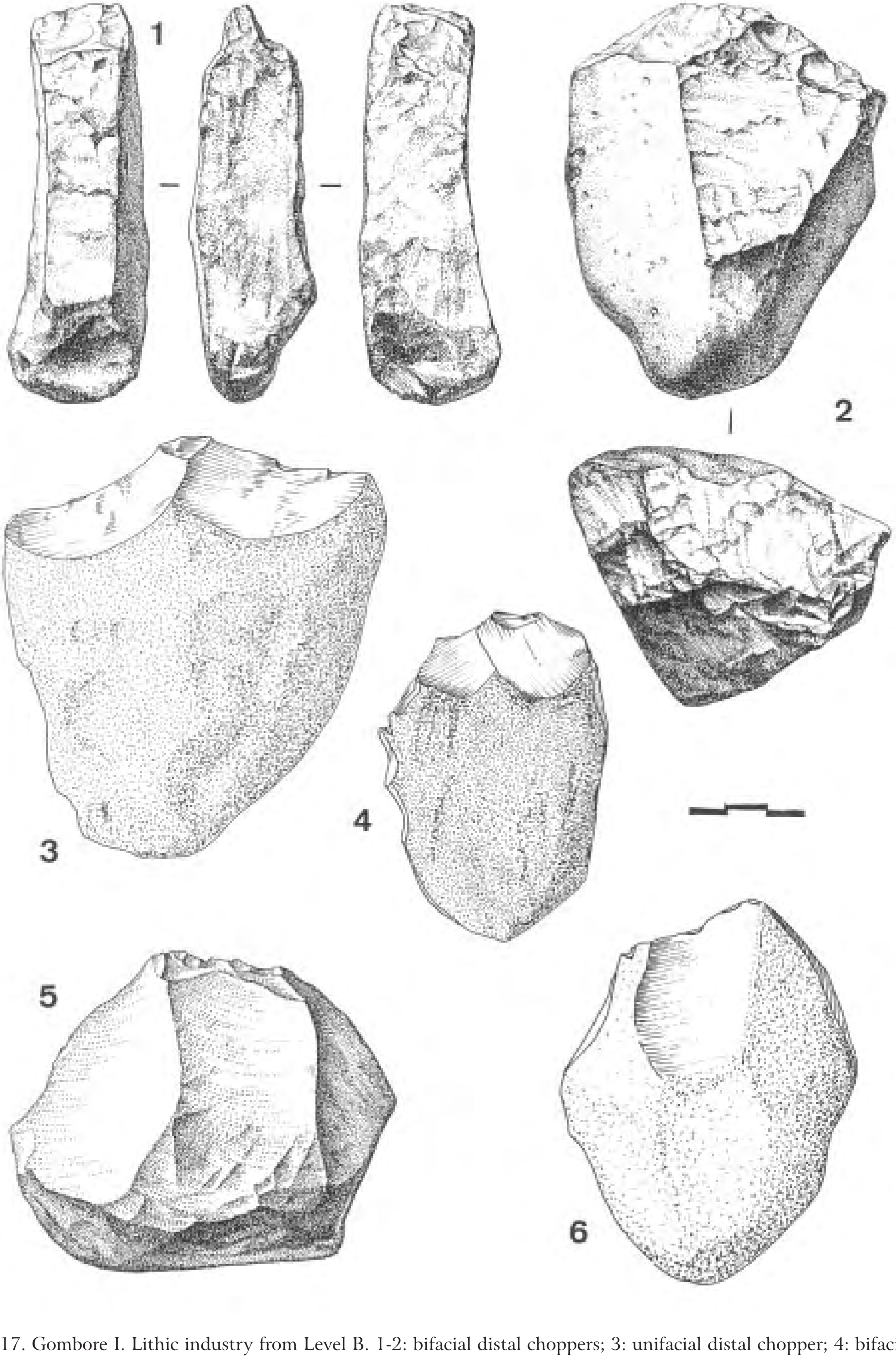

Fig. 17. Gombore I. Lithic industry from Level B. 1-2: bifacial distal choppers; 3: unifacial distal chopper; 4: bifacial distal truncated chopper; 5: bifacial lateral chopper; 6: bifacial double truncated distal chopper. 1, 2, 4-6: basalt; 3: welded ignimbrite. *Drawings by C. Chavaillon (1, 2, 5) and J. Chavaillon (3, 4, 6)*

of the initial pebble length. The more elaborate shaping of bifacial tools in which the extremities were retouched led to the maximum length of the pebble being used.

Length of working edge in relation to total perimeter: This is the ratio between the usable perimeter and the total perimeter. The majority of lateral choppers (64%) show technical progress with a working edge length that occupies 20 to 40% of the total perimeter.

An analysis of 142 lateral choppers provided the following percentages:

Lenght w.e.	N	%
< 10%	1	0.71
10 - 19%	23	16.20
20 - 29%	43	30.28
30 - 39%	48	33.80
40 - 50%	27	19.01

Unifacial choppers are well represented in the 10/20 and 20/30% categories.

In plan, the length/thickness of the working edge can be straight or curved. Analysis shows 14% straight working edges and 86% curved working edges. However there are differences; for instance, straight working edges represent 8% of bifacial tools but 32.5% of unifacial tools. The bifacial technique favours curved or sinuous working edges. In contrast, in the Acheulian, multiple retouch creates a straight but reinforced working edge.

Index	Tools		Characteristics	%
	N	%		
5	4	6.67	Less sinuous	16.67
6	1	1.67		
7	5	8.33		
8	3	5.00	Sinuous	41.67
9	5	8.33		
10	9	15.00		
11	8	13.34		
12	9	15.00	Very sinuous	41.66
13	5	8.33		
14	6	10.00		
15	5	8.33		

Sinuosity index of lateral choppers working edges.

The *sinuosity index* is obtained by multiplying the maximum length of the largest curve by its maximum depth. This number is then divided by the number of curves.

The preceding table represents a group of 60 tools chosen from the seven sectors. The lateral choppers are mainly sinuous and very sinuous and the highest index (14 to 15) reaches 18%.

Outline of the working edge: In the length/width plan, the contour of the working edge can be straight, convex, concave, angular, chevron patterned (broken line, serrated) or irregular. The working edge is convex on more than 35%, but 20% are angular and 16% chevron patterned. A convex working edge is more common among unifacial choppers (42%) than among bifacial choppers (33.5%) and angular shapes are better represented among tools with bifacial flaking.

Utilization marks: Out of 311 choppers, utilization marks have been observed on 214 tools. The rest have no marks at all, or have uncertain, altered or blunted marks. There is crushing or scaling visible on the working edge; 46.7% have small scaling marks and 66.8% have crush marks. The same tool can have crush marks as well as scaling. Some working edges are completely crushed. The occurrence of these marks is distributed as follows:

Slightly marked	61 choppers	or 28.50%
Marked	63 choppers	or 29.45%
Heavily marked	90 choppers	or 42.05%

About 70% of lateral choppers have clear utilization marks with 42% “heavily marked”.

Some also have percussion marks on the unretouched part which sometimes extends the trimmed working edge when the latter does not occupy the whole length of the pebble.

Utilization marks are not only seen on the working edge, however. In fact, the base, which is often large and cortical, can have traces of crushing. These traces are from the same period as the working edge but could also have been made before, during or after use of the working edge. The chopper could have been placed with the working edge downwards on the ground, and the base could then have been used as a wedge. There are about ten such tools, two of which were found in same square (A-7).

Obsidian tools have some characteristics that result from their glassy composition. For example the working edge occupies a major part of the length and thus the ratio between used perimeter and total perimeter is high. The working edge was of better quality, but was also more fragile. In this material, an oblong chopper, of triangular section and with a flat cortical base, shows a working edge trimmed by 7 alternate removals, curved but with a chevron shaped outline in the length/width plan. An identical chopper was found in 1995 in the “Butchery site” with hippopotamus bones, aged about 0.72 Ma (Gombore II, locality 2). The Oldowan tool is separated from the Acheulian tool by a million years. The latter was found in a sedimentary layer about ten metres higher than the Oldowan living floor.

Spatial distribution

The sectors best provided with lateral choppers are sectors 1 and 2 as well as the western part of sectors 3 and 4. Zone C (sectors 5 and 6) also has some, but in a smaller proportion.

The greatest number of lateral choppers is in sector 2, with 10 choppers in F-22. Likewise, ten squares, F-G / 22-23-24-25-26, yielded 52. In other words, a sixth of this tool category is distributed in these 10 squares (out of 262 squares). A second concentration was found in the south-west, in Z-A-B / 24-25-26.

Distal choppers

The distal chopper is distinguished by a trimmed and utilized edge which occupies the width of the pebble. It is M.D. Leakey’s “*End-chopper*” (Leakey 1971) or J. Collina-Girard’s “*transverse chopper* or *chopping-tool*” (Collina-Girard 1975). They are 171, or 20% of the total choppers.

As with the lateral chopper, other typological categories show a transverse working edge; so there are:

Double-edged choppers	18
Truncated choppers	49
Passive choppers	2
Atypical choppers	1
Casually trimmed choppers	11

Only the 171 distal choppers, as strictly defined, will be studied here.

Raw material

Once more, they are beach pebbles of which 46% are of basalt and 28.6% of trachyte. There are only 3% of obsidian, or 5 tools in all.

Morphology

Dimensions: Maximum lengths range from 29 to 146 mm. The longest tools are located in all sectors except for sector 5. In 54%, the length is between 60 and 100 mm. With regard to the maximum thickness, 61% of the tools are between 30 and 60 mm wide.

Elongation: The majority of tools, or 61%, are in the "rather short" and "rather long" categories, and 9% are between "long" and "very long" tools. Distal choppers are more elongated than lateral choppers.

Flattening: "Thick" and "very thick" tools comprise 48% of the class, but 20% are "flat" and "rather flat".

Shape: Pentagonal shapes are well represented, or a third of the class. Ellipses and circular shapes are less frequent: 16%, and polygons are rare: 4%. Triangular shapes are exceptional with only two tools, one in sector 6, the other in sector 7.

Weight: In all zones, weights range from 10 to 1530 g, but nearly 23% of distal choppers are in the 250-400 g category. Finally, heavy tools are equally distributed in all four zones.

Distal choppers base

The base is nearly always thick. It can be very large, flat, cortical, as well as rounded or simply angular. Only 4 of the 171 choppers in this class have a trimmed base.

Cortex

Cortex is always very common on the surfaces but it also covers the base. The fact that the working edge is positioned at the end of the tool, and the shaping is less elaborated than in lateral choppers, makes the larger cortical surface more prominent on these tools. The cortex can occupy three-quarters or four fifths of the sides of the tool.

Blunted ridges of some distal choppers

A few tools (7) show blunted ridges, mostly at the level of the working edge. Four are located in sector 3. Utilization can also create slight blunting.

Shaping

Distal choppers are divided into unifacial (40%) and bifacial choppers (60%).

A - Unifacial choppers

The simplest formula (A1) represents 17% of the class total, but comprises only 7% among lateral choppers. The formula A1-A2 comprises 15% of the class (Fig. 17, *3*). However the relative proportion of unifacial and bifacial choppers varies from one zone to another. In zone B there are only 13%, while in zone A, which is close by, there are 52%

B - Bifacial choppers

The simplest type A1-B2 (Fig. 18, *1*) is present in 19.3% (only 8% for the lateral choppers). The formula 1+2 removals has (Fig. 17, *1*) the following distribution in a progressive order of preference: A1-A2-B3, A1-B2-A3, A1-B2-B3. The more complex class of 2+2 removals represents only 3.5%, but with 2+n and moreover n+n the complexity increases (Fig. 17, *2*). However, they are three times less numerous than in lateral choppers and are often in alternate series such as A1-B2-B3-A4-A5-B6-B7 or more simply A1-B2-B3-A4-A5-A6.

Summary

The simple shapes dominate for both unifacial and bifacial choppers. For instance, the more complex formulas, 2+2 or 2+n, reach 38.6% of lateral choppers but only 21% of distal choppers. This simplified shaping is perhaps the result of the form of these choppers. A single removal is enough to shape the width of a pebble while two or three are needed to obtain a lateral working edge. But the cause can also be the function. If the distal chopper was used more frequently as an axe, trimming of the working edge would not be so necessary.

Working edge

Angle of the working edge: The angle is between 70° and 90° for 77% of the tools, but there are angles from 45° to more than 100°. So, 9% of distal choppers have an angle of over 90° (there were 22% among lateral choppers).

Working edge	**Unifacial Choppers**		**Bifacial Choppers**		**Total**	**Total**
	N	%	N	%	N	%
Angle						
< to 60°	3	4.48	2	1.92	**5**	2.92
60° to 69°	13	19.40	6	5.77	**19**	11.1
70° to 79°	31	46.27	33	31.73	**64**	37.42
80° to 89°	16	23.88	52	50.00	**68**	39.77
90° to 99°	3	4.48	10	9.62	**13**	7.60
> to 100°	1	1.49	1	0.96	**2**	1.17
L w.e. / L pebble						
< to 40%	3	4.48	4	3.85	**7**	4.09
40 to 59%	11	16.42	21	20.19	**32**	18.70
60 to 79%	27	40.30	41	39.42	**68**	39.77
80 to 100%	26	38.80	38	36.54	**64**	37.44
In lateral view						
Sinuous	43	64.18	85	81.73	**128**	74.85
Straight	24	35.82	19	18.27	**43**	25.15
In frontal view						
Straight	8	11.94	17	16.35	**25**	14.62
Angular	8	11.94	22	21.15	**30**	17.54
Broken line	4	5.97	9	8.65	**13**	7.60
Convex	21	31.34	35	33.66	**56**	32.75
Concave	22	32.84	19	18.27	**41**	23.98
Irregular	4	5.97	2	1.92	**6**	3.51
Total	**67**		**104**		**171**	

Characteristics of the working edge of distal choppers.

Most angles are right or acute. With regard to the difference between unifacial and bifacial tools, half the bifacial choppers have an 80°-90° angle, but only a quarter of unifacial choppers do. Consequently, the angle of unifacial tools is more acute than that of bifacial tools. In other words, by chance or design, the more elaborate the shaping the more the angle tends towards 90° (at least with the Oldowan flaking technique). This was also observed in the lateral choppers typological category.

Length of the working edge in relation to the maximum width of the tool: This ratio ranges from 30 to 100% with a quarter of the tools between 70 and 80%. There is little difference between unifacial and bifacial tools.

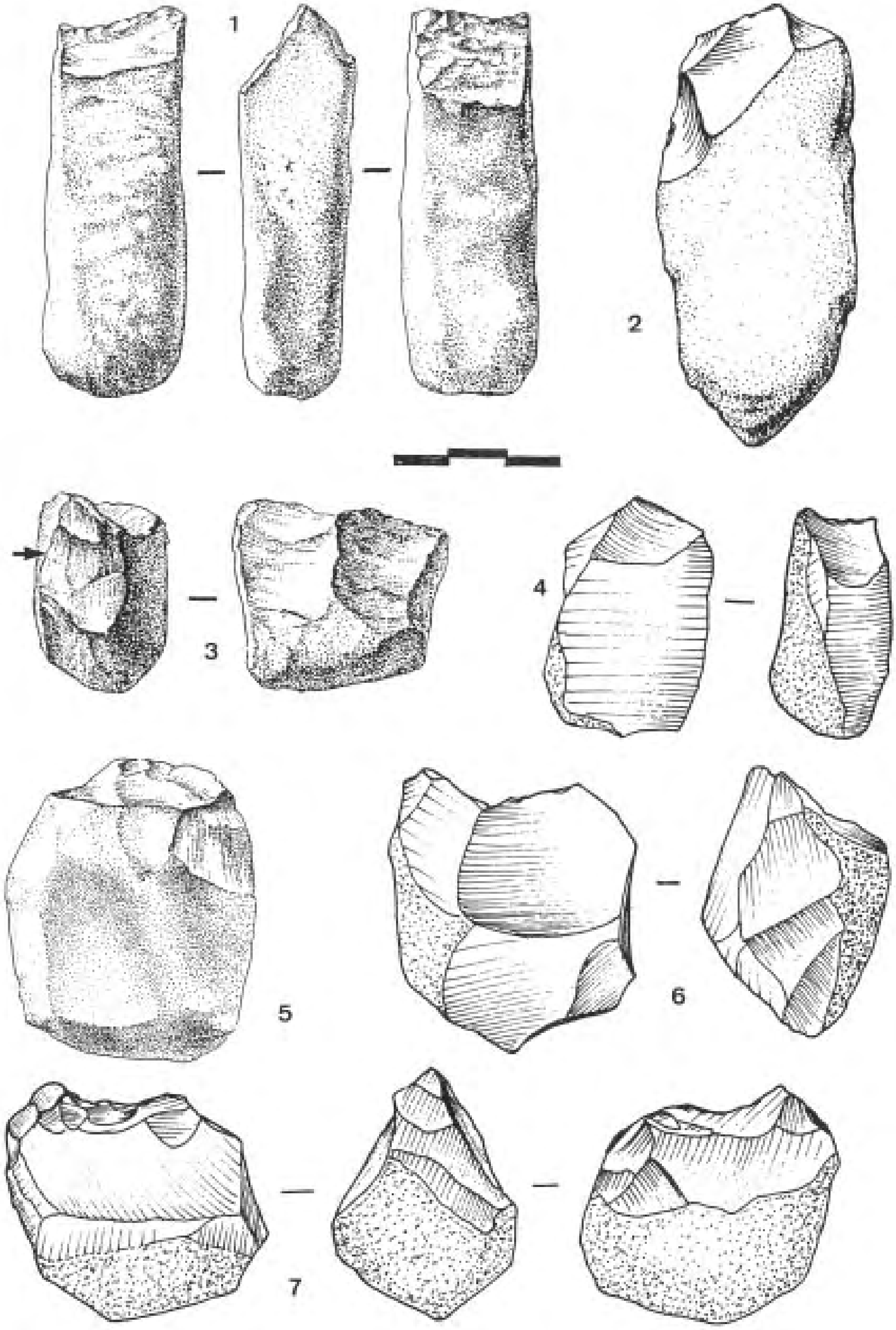

Fig. 18. Gombore I. Lithic industry from Level B. 1: bifacial distal chopper; 2-3: bifacial truncated distal choppers; 4: bifacial chisel chopper; 5: unifacial distal chopper; 6-7: lateral truncated bifacial choppers. 1, 3, 5: basalt; 4: trachyte; 6-7: obsidian. *Drawings by C. Chavaillon (1-3), J. Chavaillon (4, 6, 7) and J. Jaubert (5)*

Length of the working edge in relation to total perimeter: Of the distal choppers, 70% have a used or usable working edge which occupies 10 to 30% of the total perimeter. Because the working edge is transverse, the usable part is necessarily less important than that of lateral choppers.

Sinuosity of the working edge: This is the line of the working edge seen in profile in the width/thickness plan. The sinuous tools represent three-quarters of distal choppers. The sinuosity index indicates the following distribution:

Slightly sinuous working edges	6.67%
Sinuous working edges	60.00%
Very sinuous working edges	33.33%

On average, distal choppers have a well defined sinuosity, but it is shallower than that of lateral choppers.

Outline of the working edge: this is the working edge as seen from the front in the length/width plane. The convex working edge dominates with 33%. Concave (24%) and angular (17.5%) working edges are well represented. The difference between unifacial and bifacial choppers is that unifacial choppers have a concave (33%) or convex (31%) working edge while bifacial choppers have a convex (34%), angular (21%) or concave (18%) working edge. The simplified shaping favours concave working edges.

Utilization marks: nearly 77% of distal choppers have clearly attested utilization marks, so out of 131 choppers:

Slightly marked	44 choppers	or 33.60%
Marked	4 choppers	or 25.95%
Heavily marked	53 choppers	or 40.45%

The marks are from crushing of the working edge as well as scaling. On a simple unifacial (A1), the scaling is visible on the edge, on the retouched side but also on the cortical side. Impacts, certainly violent, have sometimes produced denticulated working edges. Some tools have percussion marks on the extremity opposite to the working edge. This is the case in 11.5% of the choppers from zone B that have already been pointed out for the presence of this same characteristic in the lateral choppers study. These tools could have been used as splitters.

Some tools had a double function as a chopper as well as a rabot. This second function is studied with rabots.

Spatial distribution

There are two particularly rich areas: one near G-26, the other one around B-26. There are 24 choppers in A-B / 24-25-26 six square metres. Finally, 11 tools are in D / 18-19-20.

Chisel choppers

The sharp narrow working edge is on the same plane as length/thickness. The working edge can be perpendicular or oblique to this plane. It is the same tool as the *Chisel chopper* described by M.D. Leakey (Leakey 1971). Of 846 choppers, this definition applies to 89 tools representing 10.5%.

Other typological categories that also show a narrow working edge are:

Double-edged choppers	5
Choppers with truncation	2
Casually trimmed choppers	2

Only chisel choppers *sensu stricto* will be described here.

It is interesting to note that whereas zone A has 68% of this type, zone D has only 4.5% or thirteen times less. Numerically, sectors 2, 3 and 6 each have about twenty tools in this category.

Raw material

The distribution of raw materials is similar to that of side- and distal choppers with 47% of basalt and 29% of trachyte. Despite important numerical differences between zones, the percentage of basalt remains stable from one zone to another.

Morphology

Dimensions: Lengths fall between two extremes, 32 and 166 mm. The longest choppers come from zone C. The average is between 80 and 110 mm, and includes 48% of the tools. In fact, the dimensions remain very close to those observed in distal and lateral choppers categories where 35% of the tools are longer than 100 mm. The average width in 80% of the tools is between 40 and 90 mm. However, a quarter of the tools are between 80-90 mm wide. Thickness ranges from 30 to 70 mm for three-quarters of chisel choppers with a preference for 50 to 60 mm.

Elongation: There is a certain statistical homogeneity from one zone to another. For example, “short” and “very short” tools are relatively abundant (35%). In zone C, these categories reach 43.5%, but long tools represent only 8%.

Flattening: The majority of tools are “thick” and “very thick” (52%), but “rather thick” tools make up 40%. Stubby tools are more common than amongst distal and lateral choppers.

Shape: Chisel choppers are distinct from distal and lateral choppers. There are fewer rounded shapes (8%), but there are a few triangles, quadrilaterals (27%), pentagons (35%) and quite a number of unclassifiable tools, called irregular (14.5%).

Weight: Chisel choppers weigh from 18 to 2086 g. The lightest tools, less than 40 g, are located in sectors 2, 3 and 5. Nearly half (46%) of these choppers weigh between 400 and 1000 g. They are heavy tools, which could suggest a violent use for some of them.

Chisel choppers base

The base can be broad and is often cortical, but is sometimes the result of a fracture. Thus, in sector 2, out of 22 chisel choppers, 9 have bases truncated by fractures. When these tools are heavy it suggests they possibly had a passive function and were placed on the ground, so, once again. Although the base is often flat, it can also be rounded, straight, sharp or flared in a V-shape.

Cortex

The cortex is very invasive whether on the base or surfaces. However, obsidian choppers have negative flake scars that spread from the working edge over a large part of the surfaces.

Shaping

There are only 13 *unifacial chisel choppers* (Fig. 18, *5*) or 14.6%. Simple unifacial choppers, i.e. with a single removal, predominate and account for 11% of this chopper category.

Bifacial chisel choppers, usually with a simple removal on one side and simple or multiple removals on the other (Fig. 18, *4*; Fig. 19, *1*, *3*, *5*), account for 62% of the class total. The A1-B2 formula represents 24.7% of the total chisel choppers. A1-B2-B3 and A1-B2-A3 formulas are the most common, but A1-A2-B3 are also found and account for 30.3%.

Bifacial choppers with multiple removals on two faces are less numerous. The simplest type (2+2) represents 13.5%. They are, in order of importance, A1-A2-B3-B4, then A1-B2-A3-B4, which means a series of removals or alternate removals in limited numbers.

Working edge

Working edge	Unifacial Choppers		Bifacial Choppers		Total	Total
	N	%	N	%	N	%
Angle						
< to 60°						
60° to 69°	1	7.69	8	10.53	**9**	10.11
70° to 79°	6	46.16	12	15.79	**18**	20.23
80° to 89°	3	23.07	34	44.74	**37**	41.57
90° to 99°	2	15.39	21	27.63	**23**	25.84
> to 100°	1	7.69	1	1.31	**2**	2.25
L w.e. / L pebble						
< to 40%	4	5.26	4	4.49		
40 to 59%	8	61.53	24	31.58	**32**	35.96
60 to 79%	3	23.08	79	32.90	**28**	31.46
80 to 100%	2	15.39	126	30.26	**25**	28.09
In lateral view						
Sinuous	9	69.23	57	75.00	**66**	74.16
Straight	4	30.77	19	25.00	**23**	25.84
In frontal view						
Straight	5	38.47	15	19.74	**20**	22.48
Angular	1	7.69	14	18.42	**15**	16.85
Broken line	4	5.26	4	4.49		
Convex	4	30.77	18	23.69	**22**	24.72
Concave	3	23.07	24	31.58	**27**	30.34
Irregular	1	1.31	1	1.12		
Total	**13**		**76**		**89**	

Characteristics of chisel choppers working edges.

Angle of the working edge: The angle of the working edge is between 70° and 90° on 88% of chisel choppers. There is a clear predominance of working edges with an angle between 80° and 90°. These are stubby tools made to crush or cleave by throwing. However 46% of unifacial tools have an angle between 70 and 80°, while 45% of bifacial choppers have an angle between 80° and 90°. The shaping is the reason for this gap and thus played a part in the function of the tool. It is interesting to observe that the angle increases as the working edge is sharpened, at least in hard hammerstones and the pre-Acheulian flaking techniques.

Relationship between the length of the working edge and tool thickness: Mostly, the working edge fairly regularly occupies 40 to 90% of the maximum thickness of the chisel chopper. Unifacial choppers have a straighter working edge than bifacial choppers because of the shaping technique.

Length of the working edge in relation to the total perimeter: The working edge occupies only a small part of the total perimeter, or 5 to 20%.

Curve of the working edge: A straight working edge is present on 25% of chisel choppers. However, in the case of unifacial choppers only, the proportion (31%) is higher than the general average. The sinuosity index confirms that there is a majoirty of 'curved' tools.

In the width/thickness plane, the chisel chopper has a concave (30%), convex or straight working edge.

Utilization marks: These can be seen on 75% of the tools and are distributed as follows:

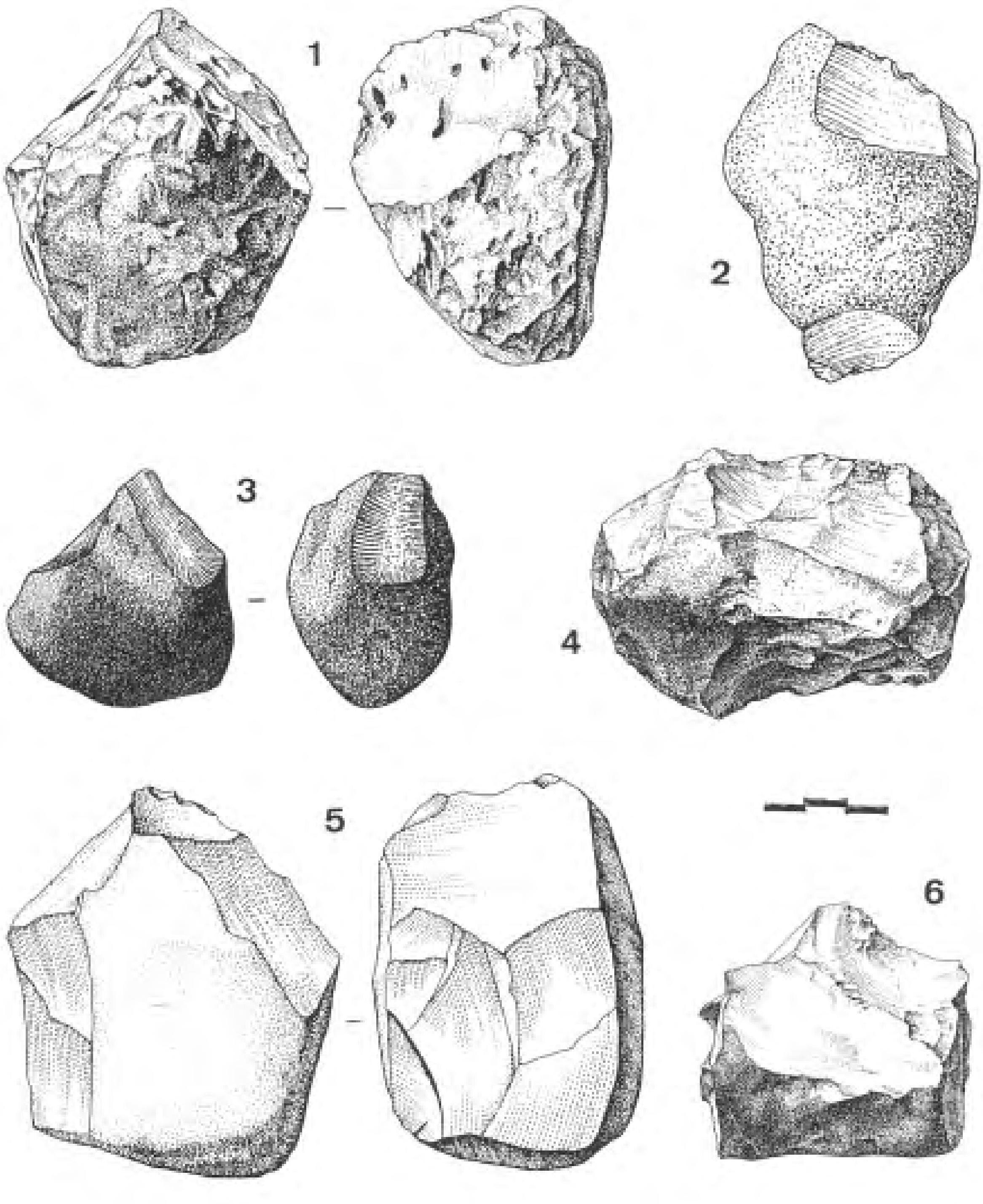

Fig. 19. Gombore I. Lithic industry from Level B. 1, 3, 5: bifacial chisel choppers; 2: unifacial distal double chopper; 4: unifacial and bifacial lateral chopper; 5: unifacial truncated lateral chopper. 1: lava; 2-6: basalt. *Drawings by C. Chavaillon (1, 4, 6), J. Chavaillon (2), J.Gire (3) and J. Jaubert (5)*

Slightly marked	13 choppers	19.40%
Marked	19 choppers	28.36%
Heavily marked	35 choppers	52.24%

Among tools with traces of utilization, more than half are "heavily marked". There is crushing on 77% of the surfaces and scaling on 57%, and the same tool can have both characteristics.

Some chisel choppers have crush marks on the base, as do some distal and lateral choppers. In sector 2 (zone A), 23% of chisel choppers show this particularity. Utilization as cleavers cannot be excluded and could provide a reasonable explanation.

Spatial distribution

These choppers are almost completely absent in the eastern part (zone D). They are concentrated mostly in the north-west (sectors 1, 2, 6). E-23, F-22 and G-22 together have 11 chisel choppers, which means that 12% of these tools are found in three squares.

Double-edged choppers

This type of tool shows two sharp non-adjacent working edges, generally opposite each other. It is the same as the *two-edged chopper* of British prehistorians.

At Gombore I, double-edged choppers represent only 2.35% of choppers. These 20 tools thus have 40 working edges.

The double-edged chopper is a kind of modern knife with several possible uses. It is an advanced tool and probably needed a handle, whether temporary or not, since the rounded base of most others types of chopper makes them easier to hold. Perhaps people used these choppers on leather or bark.

There are lateral and distal double-edged choppers, as well as choppers that are both distal and chisel, but the latter are in a different, usually perpendicular, plane.

Raw material

The small number makes one cautious about drawing conclusions, but basalt tools dominate with 13 choppers out of 20.

Morphology

Dimensions: Maximum length is most commonly between 80 and 100 mm. There are 9 tools or (45%) in this class. Extreme lengths reach 65 and 152 mm and 30% are over 100 mm long. In half the class, the maximum width is between 60 and 70 mm.

Maximum thickness is mainly distributed in two classes: one, the most important, between 50 and 60 mm and the other between 30 and 40 mm.

Elongation: Despite the small number, the basic categories of "rather short" and "rather long" tools (65%) are present, but 20% are "very short".

Flattening: Distribution is between "very thick" and "rather flat" choppers. These are stubby tools, but some of them are rather flat because of the two working edges. They could have been used as double-edged axes.

Shape: The quadrilateral form, which is found less often in others categories, dominates with 45%. This is probably linked to the double shaping.

Weight: The extreme values extend from 130 to 1680 g, but the average is between 160 and 400 g for 13 tools out of 20.

Cortex

These tools have less cortex because of the double working edge, and in fact, the base is often trimmed. Two thirds of the tools have limited cortex, while the rest have retained a large amount of cortex.

Working edge associations

We observe the following couples:

Double lateral chopper	7	(Fig. 19, *4*)
Double distal chopper	6	(Fig. 19, *2*)
Double lateral chopper	1	
Chisel - lateral chopper	1	
Chisel - distal chopper	4	
Pointed - distal chopper	1	

This distribution needs some comment. First, 65% are choppers with two working edges of the same type. Moreover, the association of the lateral or distal chopper with a chisel working edge can only occur in another plane which is perpendicular (5 tools out of 20). Finally the chopper with a double lateral and distal working edge differs from the "distal-lateral chopper" type because the double-edged chopper shows two working edges, one lateral and the other distal, but they are separate, not adjacent. On the other hand, the "distal-lateral chopper" has a single continuous working edge. In addition, lateral and distal working edges are also the most numerous and represent 85%.

One particular tool from sector 2 is a double-edged lateral chopper with two unifacial working edges with alternate retouching; in other words, the retouch is on side A on one working edge, and on side B on the other.

Shaping

Unifacial working edges are relatively numerous (37.5%), in particular on unifacial simple A1 or multiple A1-A2 (Fig. 19, *2*) choppers. Bifacial choppers are of course the most numerous. There are simple and multiple formulas or multiple for both faces (Fig. 19, *4*), but they represent only 22.5% out of 40 working edges. The most often observed formulas are A1-B2 or A1-B2-B3, or even A1-B2-B3-B4.

Working edge

Angle of the working edge: They have the same characteristics as have been observed for lateral, distal and chisel working edges, but one particular feature is that choppers with a unifacial working edge have an acute angle (60° to 70°) while bifacial working edges are usually right or obtuse (80° to 100°).

Relationship between the length of the working edge and length, width or maximum thickness: The working edge usually only occupies a small part of the perimeter but ranges from 30 to 70%.

Curve and outline of the working edge: Seen in lateral view, the working edge is curved in 60% of the cases. Seen in frontal view, the convex outline clearly dominates with 42%. More than half the unifacial working edges have this characteristic.

Utilization marks: All the tools show signs of use. Most are "heavily marked". Some rare working edges are "slightly marked". The traces of crushing are always very numerous but scaling can often be seen. These tools have been used often and violently.

Truncated choppers

The truncated chopper "generally shows a lateral or distal working edge, truncated on one extremity, or both (opposite ends), by one or two removals or fractures. In this category are P. Biberson's tools with one or two truncations (Biberson 1967). These choppers are technically advanced tools". In fact, the truncation aimed to balance the tool by removing a useless protuberance.

There are 124 truncated choppers and they represent 14.25% of all choppers.

The working edges can be lateral (Figs. 18, *7*; 19, *6*), distal (Figs. 17, *4-6*; 18, *2-6*) or in the length/thickness plane (chisel choppers), so:

Lateral choppers with truncation	73	or 58.9%
Distal choppers with truncation	49	or 39.5%
Chisel choppers with truncation	2	or 1.6%

Truncated choppers are distributed in all four zones, but are proportionally more numerous in zone C. While they are frequently found in sector 6 with 34.7%, they are rare in sector 5 with only 4.0%.

Raw material

Raw material distribution is the same as in other chopper categories. The similarity of percentages with lateral choppers is remarkable. Obsidian choppers are rare, but mainly localised in sector 2 (zone A). Hard rocks dominate: basalt with 46%; but also 29% of trachyte.

One truncated chopper is of interest because it was found on a large piece of bone in zone B, square E-7.

Morphology

Dimensions: Zone A has rather small tools and 28% have a maximum length under 60 mm. On the other hand, the largest choppers come from zone D where 31% of the tools are longer than 100 mm.

Elongation: The index confirms that they are "short" tools, even if sometimes "rather long". The percentages are very similar to those among lateral choppers and data from distal and lateral choppers confirm that tools with a lateral or distal working edge are generally "rather short" or "rather long".

Flattening: The index shows quite a heterogeneous distribution, as is the case for lateral choppers. However, truncated choppers with a distal working edge are often flat while those with a lateral working edge are rather thick.

Shape: Pentagonal and hexagonal shapes account for 60%. Truncated choppers with a distal working edge are usually hexagonal.

Weight: The average weight is between 160 and 630 g (60%), but 17% are under 100 g.

Chopper base

The base is often broad, rounded (as in choppers with a lateral working edge) or flat; this is sometimes the result of one or two fractures (choppers with a distal working edge). The bases are often cortical.

Cortex

Cortex is often retained on the surfaces and on the base. However, when the removals are large - as is quite often the case - the surface occupied by cortex is reduced. Some tools have almost no cortex, as in one chopper with a double truncation.

Shaping of the working edge

Unifacial choppers make up one third of the class. The best represented category is that of simple bifacial or simple-multiple choppers (45%). The various formulas range from the most simple A1-A2, A1-B2-B3-B4, A1-A2-B3, A1-B2-B3-B4-A5, to the most complex that has six removals on face A and four removals on face B.

Working edge

Angle of the working edge: Angles between 80° and 100° can be seen on 30% of the choppers, but on the other hand they characterise 49% of bifacial choppers. During the Oldowan, bifacial shaping tended to reinforce the strength of the working edge with a higher angle.

Length of working edge in relation to length of tool (lateral working edge), of the width (distal working edge) or of the maximum thickness (chisel working edge):

The working edge occupies nearly 40 to 100% of the length, width or thickness of the tool. More than half of the choppers have a working edge that occupies 70 to 100% of the edge. Maximum utilization of the length is more common than in other chopper categories, perhaps due to the simple or double truncations that could reduce or remove unusable parts.

Length of working edge in relation to total perimeter: The utilized working edge occupies 15 to 38% of the total perimeter.

Curve of the working edge: The proportion with a curved working edge is normal for this class (78% of general average). Unifacial choppers are less curved (65%), but bifacial ones are more curved (85%). This characteristic is linked to shaping.

Outline of the working edge: Seen in frontal view, the working edge is convex or angular; 17% of unifacial tools have a concave working edge, while 20% of bifacial tools have a chevron-shaped working edge.

Utilization marks: About 72% of the truncated choppers have noticeable utilization marks. Among these, nearly 40% are "heavily marked". Traces of crushing are more frequently observed, but scaling is also very common.

Truncation

What characterises this chopper category is the presence of large single or multiple flake scars on one or both extremities. Truncation limits the length of the working edge and often either removes or reduces anomalies in the shape of the pebble.

The truncation can be single or double (Fig. 20, *2*), so 85 tools (68.5%) have a single and 39 have a double truncation. To obtain this truncation, blows were struck from the working edge, or laterally, or from the base. Three tools could not be classified because the point of impact could not be located.

Whether there are one or two truncations, they were made in the same way. In 68% of the cases, truncation was caused by lateral impact, that is to say impact was perpendicular to the face. Thus:

- Bifacial choppers generally have a double truncation and unifacial choppers one truncation, especially those with lateral working edges.
- Thirteen truncations seem to have occurred before the working edge was shaped.
- Three choppers have a fracture that performs the function of a truncation.
- Several choppers were truncated with three or four removals (Fig. 20, *1*), but most were truncated with two removals.

Truncation was in fact desired. Although such cases are rare, there is sufficient indication from the use of an old tool that already had removals that the intention was to select such an object. Truncated choppers are elaborate tools that enabled a variety of blanks to be used and made more efficient.

Orientation of removal impact	One truncation	Two truncations	Total N	Total %
From the working edge	11	8	**19**	12.02
Laterally	55	52	**107**	67.72
From the base	18	14	**32**	20.26
Number of truncations	84	74	**158**	
Number of observed tools	84	37	**121**	

Orientation of removals to obtain truncation.

Spatial distribution

This type of chopper is found mainly in the western and the central-northern areas of the excavation. The highest concentration is in square F-22 which has five truncated choppers.

Pointed choppers

The working edge of these choppers is formed by two convergent edges that meet to form a point. The section of this point can be diamond-shaped or triangular. It is suggestive of some handaxes or Acheulian trihedral picks.

There are relatively few of these choppers (32) or 3.8% of total choppers. A blunted and probably older tool of unestablished age can be linked to this class. It is a large trachyte chopper weighing 800 g, 122 mm long, that is bifacial with two removals and a curved working edge.

Most of these tools are in zones A and C. Among the sectors with the highest concentration are sector 6 with 34.4% and sector 2 with 22%.

Raw material

The proportion of hard rocks is similar to that in other choppers categories. An aspect worth noting is the relatively high proportion of tools of welded ignimbrite (16%) and obsidian. The latter show utilization traces mainly on the working edge with a few on the point.

Morphology

Dimensions: With one exception, the maximum length is between 47 and 130 mm. The most important group (45%) has a maximum length between 80 and 100 mm.

Maximum widths and thicknesses tend to separate into two classes: for example, 53% of the widths are between 63 and 100 mm, and 50% of the thicknesses are in the 40-62 mm category. Observations by sector show that sector 6 (which has nearly a third of the pointed choppers) has tools with a maximum length between 50 to 100 mm. Conversely, sector 4 has tools of various dimensions.

Elongation: Three-quarters are “rather short” or “rather long” tools.

Flattening: The various indices are close to those of other chopper categories. More than half are “rather thick” choppers.

Shape: Nearly 60% have a pentagonal shape. These choppers with a broad base and an angular working edge perhaps lend themselves better than other types to this geometrical form.

Weight: Ranges from 40 to 1235 g. The average weight of 69% is 160 to 630 g. However there are some that are lighter between 40 and 60 g.

Pointed choppers base

Most are broad, flat or rounded, and generally cortical. They can be on a simple or double fracture.

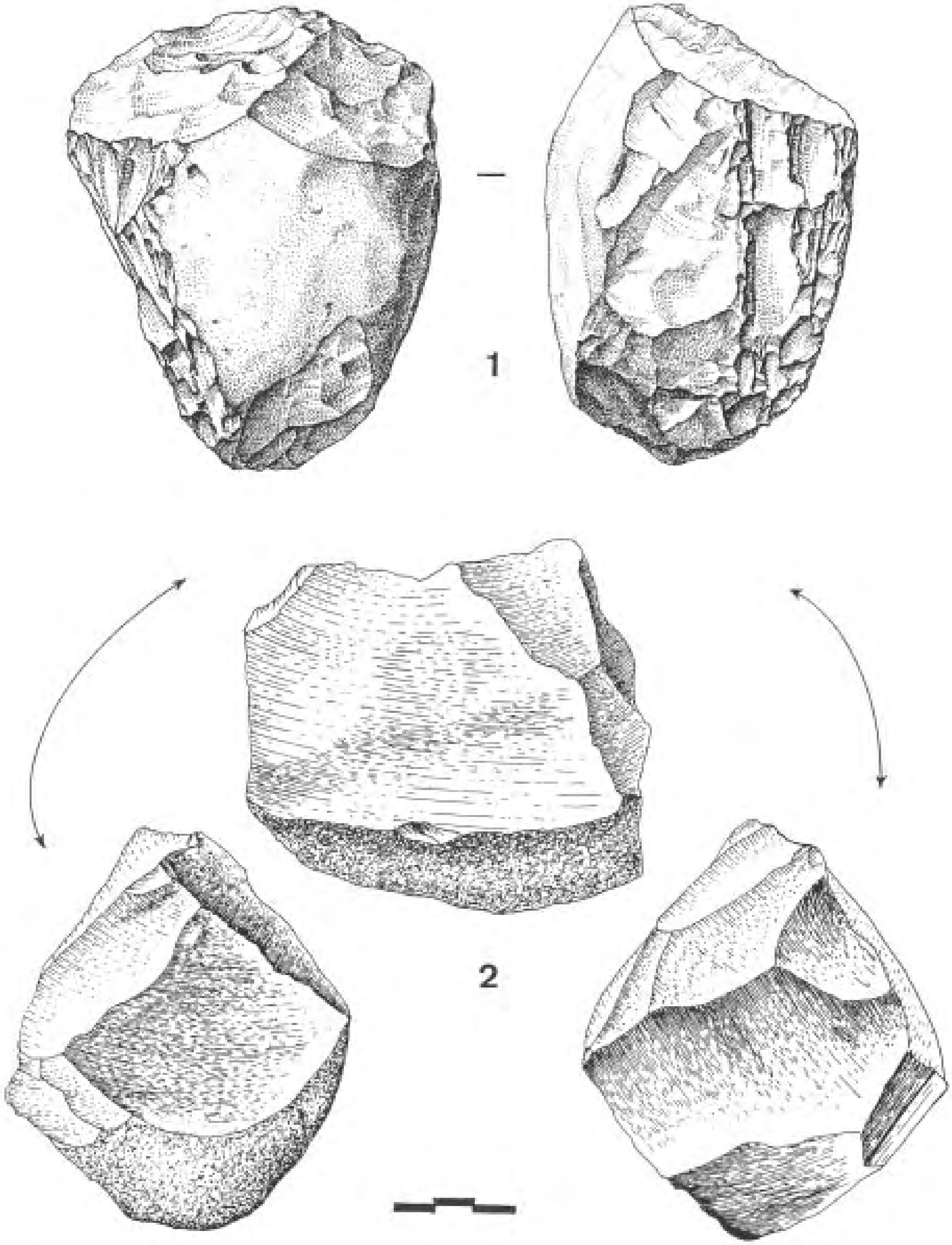

Fig. 20. Gombore I. Lithic industry from Level B. 1: unifacial truncated distal chopper; 2: bifacial double truncated lateral chopper. Basalt. *Drawings by C. Chavaillon (1) and M. Bouhey (2)*

Cortex

It is extensive and invasive, even though it scarcely exists on some tools.

Shaping

Unifacial choppers are less numerous at 22% of the class (Fig. 21, *1-4*), but bifacial choppers have rather complex formulas (Figs. 21, *2-6*; 22, *5*). Up to 13 removals were counted, either alternately or in alternate series. It seems that, by comparison with other classes, the relatively high number of removals could be linked to the desired shape and function of the tool.

Working edge

Because the working edge is pointed, the usual measurements of the working edge could not be taken systematically. Accordingly, only 17 out of 29 tools were taken into account.

Angle of the working edge: This is measured on both faces of the point and it is relatively low. Obtuse as well as acute angles are represented. On the whole, the angles are similar to those of other classes. In other words, 80% of the tools have an angle between 60° and 90° with 36% more precisely between 80° and 90°.

Length of working edge in relation to length or maximum width of chopper: Utilization of the maximum length or width can be complete or more or less limited. Most of the time the utilized part occupies 80 to 100% of the length or width.

Sinuosity: Seen in lateral view the working edge is sinuous in 83% of the cases. Seen in frontal view, the working edge is mostly angular, which corresponds perfectly with the actual definition of the pointed chopper type.

Length of utilized perimeter in relation to total perimeter: This index shows that from 21 to 40% of the perimeter was utilized.

Chopper point: The angle of the point itself is never really acute, but 47% of the tools have a point with an angle between 80° and 100°, close to a right angle. It is, of course, a point, but these choppers are not like handaxes or picks.

Utilization marks: They are often present and are generally localized near the point, which is sometimes crushed. The point on five tools has been broken in different places, probably due to utilization. The edges of the point on both faces are often heavily marked with scaling as well as crushing.

Spatial distribution

These tools are most numerous in the north-west area of the excavation. Squares F-17 and F-22 each have 3 tools of this type.

Chopper with peripheral working edge

By definition (Chavaillon and Chavaillon 1981, p. 286), the working edge of this chopper "can occupy the whole or only a part of the perimeter of the pebble (this part is generally over 50%). The retouch can be continuous or discontinuous. Some of M.D. Leakey's *discoids* (Leakey 1971) can be included in this category". These tools differ from double-edged and distal lateral choppers. They are usually bifacial and even if similar to handaxes, they lack symmetry. However, they are transitional between choppers and handaxes. They are quite rare in the Oldowan. With 41 specimens, they represent 4.85% of total choppers.

As with other categories, these tools are numerous in zones A and C.

Raw material

A high proportion of these tools are of basalt (56%), particularly in zone C.

Morphology

Dimensions: These are large choppers and one out of two has a maximum length above 100 mm. The maximum width is mainly between 80 and 100 mm and the maximum thickness is between 50 and 70 mm.

Elongation: These choppers are short and 83% are in the “very short”, “short” and “rather short” categories. In other words, the length and width measurements are very similar.

Flattening: They are mostly “thick” and “rather thick” tools (78%). “Rather flat” tools represent only 17%. This is very different from the smaller, flatter and more circular discoidal tools of the Acheulian.

Shape: Polygonal shapes are very common in this category (56%) which is due in part to the type of chopper.

Weight: About 30% of the choppers weigh between 400 and 630 g. However, as the weight correlates with the size of the tool, there is a certain heterogeneity that is emphasised in the larger choppers with 25% of these tools weighing between 600 and 1500 g.

Choppers base

As they are choppers with a peripheral continuous or discontinuous working edge, the base, in the sense of the part opposite to the working edge, is not always present. One of the choppers is axially symmetrical, which relates it to an archaic handaxe. Another tool, with a semicircular outline, is retouched with sixteen bifacial removals.

Cortex

These choppers often show only one cortical area that may be more or less extensive on either surface. While some tools have large areas of cortex, it is almost non existent on others.

Shaping

There is a single unifacial tool. All the others show bifacial removals (Figs. 21, *3-5*; 22, *1*, *2*, *4*), in particular n+n type (83%). Two tools with the 1+n formula also show some complexity. These choppers with a peripheral working edge are tools which are shaped by multiple removals. The number of these removals varies from 4 to 23, so 58% have 1-10 removals, while 17% have more than 15. This typological category has the highest number of removals among the choppers. Two choppers are, besides, reminiscent of centripetal cores. If the shape and removals are reminiscent of this type of core, the crush marks and scaling clearly show that they were last used as choppers.

The shaping is similar to that of archaic handaxes. The chopper with a peripheral working edge could, with its technical similarities, have led to the archaic handaxe.

Working edge

Angle of the working edge: The angle follows that of other choppers, that is to say, for 64% it is between 80° and 100°. These archaic characteristics of the working edge angle contrast with the flaking technique closer to that of Acheulian handaxes.

Length of working edge and total perimeter: Retouch can be seen on 50 to 90% of the perimeter. On 5% of the tools the retouch is complete (100%) but for a little more than one third, retouch occupies 70 to 90% of the perimeter.

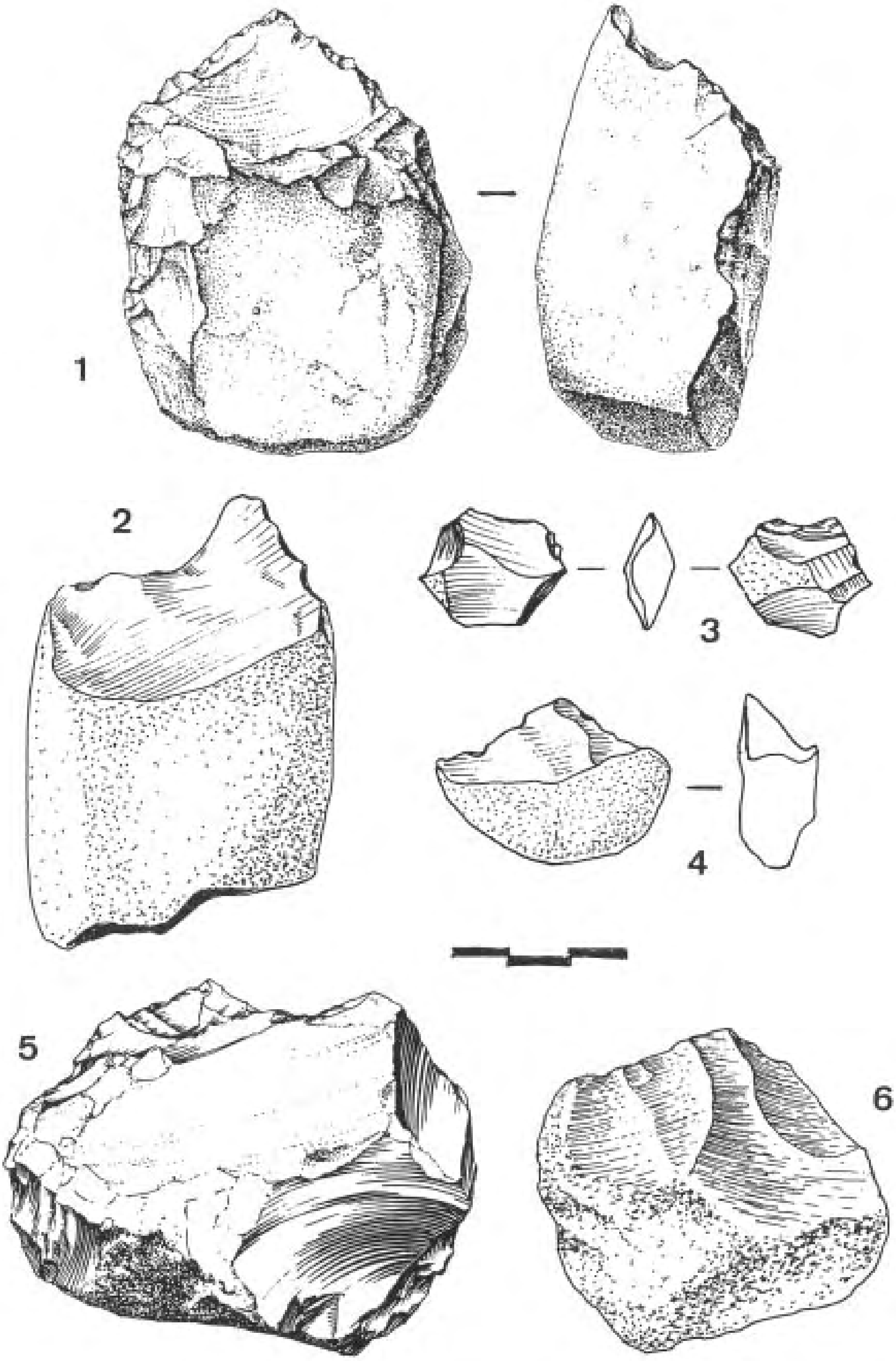

Fig. 21. Gombore I. Lithic industry from Level B. 1, 4: unifacial pointed choppers; 2, 6: bifacial pointed choppers; 3, 5: bifacial peripheral choppers. 1, 2, 6: basalt; 3: obsidian; 4: trachyte. *Drawings by C. Chavaillon (1, 5) and J. Chavaillon (2-4, 6)*

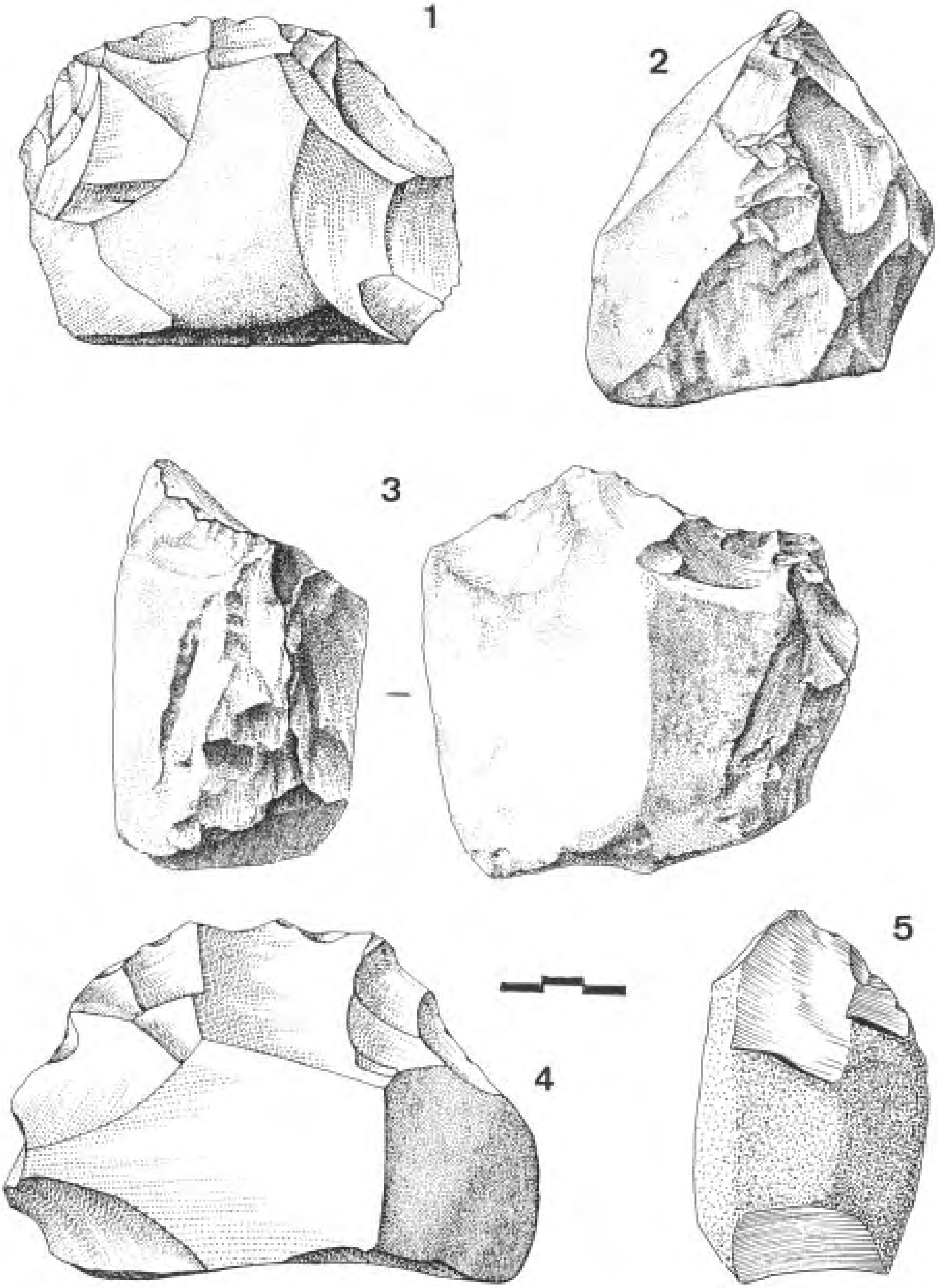

Fig. 22. Gombore I. Lithic industry from Level B. 1, 2, 4: bifacial peripheral choppers; 3: bifacial latero-distal chopper; 5: bifacial pointed chopper. Basalt. *Drawings by J. Jaubert (1, 3, 4), C. Chavaillon (2) and J. Chavaillon (5)*

Sinuosity of the working edge: With one exception, the working edge is always sinuous in the length/thickness plane, a natural result of bifacial working of several zones.

Utilization marks: They are not necessarily found all along the retouched edge, but all the tools have some and the main section has a "heavily marked" working edge. Crushing is more abundant and frequent than scaling. Some tools, after having functioned as cores, were clearly then used for their working edge.

Spatial distribution

There are three groupings in the three zones A, B and C. This type of chopper is also found in zone D and sector 6 has the most with 32%.

Lateral-distal choppers

The "lateral-distal" chopper has two working edges, one lateral and the other distal, that are joined in the length/width plane. The angle formed by the two working edges (lateral and distal) varies from 90° to 100°. It is the same type as J. Collina-Girard's (1975) lateral-distal chopper. In previous publications, they were sometimes called "recurrent chopper" (Chavaillon and Chavaillon 1981).

The working edge is continuous and occupies about half of the total perimeter. Less common in the Oldowan of Gombore I, the lateral-distal chopper is represented by only 13 tools or 1.55% of the total choppers. It is an interesting tool halfway between the lateral chopper (or distal) and the chopper with peripheral working edge. Zone A has nearly half of them.

Raw material

Despite the small number of these choppers, basalt tools remain dominant.

Morphology

Dimensions: Even if we take the extreme values of the typological categories that are best represented, 77% of the class have a maximum length between 70 and 110 mm. However, 38% of the tools between 100 and 110 mm have larger dimensions. The maximum width is between 60 and 90 mm for 61%. Maximum thickness is heterogenous, ranging from 20 to 70 mm.

Elongation: A high proportion of tools are "very short" (31%) but also "rather short" (38%).

Flattening: The choppers are "thick", "rather thick" (46%) and "rather flat".

Shape: 77% are pentagonal and hexagonal.

Weight: It is very heterogeneous. It ranges from 22 g to 2 kg, and is between 150 and 1000 g for two-thirds.

Choppers base

The base is often thick, broad, rounded or flat. This base is generally cortical but can also be a fracture.

Cortex

Cortex is seldom preserved on the surfaces because of the lateral-distal preparation, but on the other hand it often covers the base.

Shaping

One single chopper is unifacial, although few of the tools have simple shaping. This one nevertheless has 3 removals. More than half of the class has complex formulas (n+n) (Fig. 22, *3*). There are either numerous alternations of A1-A2-B3-B4-A5-B6-B7-A8 type, or a large number of removals, from 10 to 13. One tool shows the negative flake scars of blades or bladelets, mainly on one face.

Working edge

Angle of the working edge: The angle is close to 90° and indeed 70% of the tools have an angle between 80° and 100°. In fact, this lateral-distal form is rather “modern” and unusual but, at least during the Oldowan, bifacial shaping always yields stocky tools with a high angle.

Length of working edge in relation to total perimeter: The working edge occupies only half of the perimeter of the tool, and sometimes less.

Sinuosity of the working edge: The working edge seen in profile is nearly always sinuous.

Contour of the working edge: Seen in frontal view in the length/width plane, the lateral-distal working edge is, by definition, angular. If the angle is not always clearly defined, because it can be more or less rounded, it can nevertheless be measured. The lower value is 93° and the highest 115°. Shaping of the working edge therefore tends towards a slightly obtuse angle for this tool category.

Utilization marks: These choppers are always well marked by utilization. Crushing is very common and scaling is present, but less abundant.

Spatial distribution

The tools are widespread, but are absent in the eastern part of the excavation.

Passive choppers

The passive chopper is a heavy tool which, when placed on the ground, was struck on the upper edge to break objects such as bone, wood, etc. It could be called a *fixed chopper*. These tools are rare. There are only seven (0.8%), a negligible number, but nevertheless of interest because of their possible function. They are found in sectors 2, 6, and 7. The passive chopper has a lateral working edge (5 tools) or a distal working edge (2 tools).

Raw material

The number is too low to be significant, but 5 tools out of 7 are of basalt, which is logical because this hard rock is well suited to this activity.

Morphology

Dimensions: The extreme values for maximum length are 118 and 320 mm and five tools out of seven are longer than 150 mm. Maximum width and thickness are also exceptional.

Elongation: These are “rather short” and “rather long” tools.

Flattening: These choppers are “rather thick” rather than “rather flat”.

Shape: Three tools out of seven are polygonal.

Weight: Varies from 1200 g to about 10 kg: 4 choppers out of 7 weigh over 1600 g; two tools are over 10 kg.

Choppers base

The base is thick, mostly flat and cortical.

Cortex

Cortex is extensive and sometimes overlaps the edges and the base.

Shaping

One tool, a lateral chopper with two removals, is unifacial. The bifacial tools have been simply and quite roughly shaped. Only one tool has a fairly complete A1-A2-A3-B4-B5 formula.

Working edge

Curiously, these tools, which are simply and roughly shaped for their function, show in contrast to other chopper categories, a working edge with a relatively low angle that is clearly acute; for example, six tools out of seven have an angle between 50° and 80°. In contrast, the sinuosity index confirms a sinuous working edge. The utilized part covers 70 to 100% of the length or of the maximum width. Finally, in the length/width plane of the tool, the contour of the working edge is convex on 86%.

Utilization marks: There are clear signs of utilization of the *fixed chopper* with either scaling or crushing on the working edge. One of the tools shows a naturally sharp edge on the continuation of a flaked working edge, which was used as well.

Spatial distribution

As a result of the very low number, these tools appear to be grouped in Z-A-B-C / 21-22 where three out of seven tools were found.

Diverse choppers

This category assembles tools unclassifiable in other typological classes. It is the equivalent to the choppers in F. Bordes's "shapeless handaxes" category (Bordes 1961). There are only two examples:

The first is a lateral chopper but with a clearly inclined working edge. The raw material is a volcanic rock of jasper type. It is bifacial and the sinuous working edge has a low angle of 60° to 70° with a group of impact marks.

The second tool is a pebble fragment of vuggular lava. It has 5 to 6 negative flake scars. The thinnest part of the tool was retouched by two unifacial removals on one end. The working edge is sinuous.

These two tools come from zone C, sector 6: F-14 and G-16.

Casually trimmed choppers

The casually trimmed chopper as its name indicates, is a "tool on which retouch is rough and rare. They are pebbles or stones showing a sort of natural working edge. Some very small removals or rough retouch were enough to make these tools quite efficient" (Chavaillon and Chavaillon 1981).

It is an object that was slightly modified or simply utilized as it was, like an unmodified flake, but it was utilized and has utilization marks like those on retouched flakes. These 36 tools represent only 4.25% of the total. Typologically, their working edges classify them among:

Choppers	N	%
Lateral	21	58.3%
Distal	11	30.5%
Chisel	2	
Pointed	1	
Lateral-distal	1	

Zone A has a third of the lateral choppers, but on on the other hand three-quarters of distal choppers.

Raw material

Trachyte and basalt dominate with a preponderance of trachyte, which is not as hard as basalt.

Morphology

Dimensions: Maximum length is distributed in two classes: one 60-80 mm with 39% and the other 110-120 mm with only 17%, but the extreme values range from 57 to 153 mm. Maximum width is equally heterogeneous with one class from 40 to 60 mm and another between 70 and 90 mm. Maximum thickness is more homogeneous and falls mainly between 20 and 70 mm.

Elongation: The heterogeneity of the elongation index is notable. "Long" and "rather long" tools represent half of this class.

Flattening: "Flat" and "rather flat" tools are common (44%). It should be noted that in other categories the choppers are thicker.

Shape: More than half of the class are polygonal or hexagonal.

Weight: There is some heterogeneity with a range from 35 to 1340 g. Only a tenth of the tools weigh over 1 kg.

Shaping

About 36% of the tools have no evident shaping. On others there are small irregular, often discontinuous removals that define a working edge. Thus, 17 tools are unifacial and 6 have a bifacial working edge. Removals can also be in the form of two fractures or truncations that determine the working edge, or two alternate A1-B2 type removals.

Working edge

Analysis cannot be done as for the other chopper categories. However, there are some observations:

The angle of the working edge is sometimes low, but two thirds of the angles are between 50° and 80°, which indicates a choice of raw material for minimal shaping.

The sinuosity index indicates that the working edge, seen in profile, is generally "rather sinuous" and that, for 36%, it is "straight".

The outline of the working edge in the length/width plane is either convex (42%), straight, angular or concave.

Spatial distribution

There is no particular concentration of these choppers and they are fairly equally distributed in the four zones.

Comparisons and conclusions

The following remarks are the result of comparison between the different chopper categories, but it also sums up previously discussed data.

Raw material

From the raw material point of view, there is a high proportion of choppers on hard rocks with 46% of basalt. However, the softer trachyte rocks represent 29%. Other categories like obsidian are under 8%. It is not by chance that 62 specimens of this rock are present, even if it is rare in the alluvium.

Differences observed in the raw materials from one typological category to another are distorted by low or high tool numbers. However, except for “atypical choppers” (with only 2 tools), basalts are always well represented. Obsidian is constant between 5 and 10%, except for distal choppers where only 5 tools out of 171 were made of obsidian. This could indicate a more violent function with the distal chopper being used as an axe.

Morphology

Dimensions: Maximum length varies greatly, ranging from 25 to 320 mm. They are rather large tools with more than a third of the total choppers being longer than 100 mm. Regarding variation from one category to another, passive choppers are distinguished by the fact that they are all longer than 100 mm. Conversely, the smallest is the chopper with a peripheral working edge. The maximum width for 85% of all the choppers is between 40 and 100 mm. The maximum thickness of total choppers indicates that 40% are in the 40-60 mm category.

Elongation: This index places choppers in the “very short”, “short” and “rather short” (67%) categories. Among the typological variations, “long” tools are more frequent among distal choppers and chisel choppers. In contrast, “very short” tools are more abundant (20% and more) among double-edged choppers and choppers with a peripheral working edge.

Flattening: The “very thick”, “thick” and “rather thick” categories dominate with 81%, against 19% of “flat” and “rather flat” tools. Comparing the typological categories, “thick” and “very thick” tools are in the majority among chisel choppers, double-edged choppers and distal choppers. The flattest tools are casually trimmed choppers and truncated choppers.

Shape: Nearly a third of the choppers are pentagonal, even if hexagonal, quadrilateral and elliptical shapes represent 19 to 14% (for example, in distal choppers).

Some variations can be observed: only 7% of chisel choppers and truncated choppers are elliptical or circular, while 27% of the chisel choppers are quadrilateral. Finally, a third of lateral choppers and double-edged choppers are hexagonal or polygonal. With regard to choppers with a peripheral working edge, more than half are polygonal.

Weight: More than 70% of the choppers weigh between 160 and 1000 g, with a preponderance in the 400 to 600 g class (20%); 1.5% weigh less than 25 g and 8.5% weigh more than 1 kg, such as passive choppers. The weight distribution varies only slightly from one class to another, but weight distribution is clearly heterogeneous in most typological categories.

Shaping

Unifacial choppers represent 27% of total choppers. Notably, this is the same proportion as that of the lateral chopper category. On the other hand, unifacial shaping is more common among distal, double-edged and truncated choppers. Conversely, less than 15% of chisel, lateral-distal and peripheral working edge choppers are unifacial. They are nearly all bifacial.

Slightly less than half of the bifacial choppers have a removal formula of 2+2 to n+n. This latter formula represents only 14% of the total choppers. Thus a large majority have quite simple shaping that is sometimes even rough. Tools with the most complex formulas are choppers with a peripheral working edge, lateral-distal, pointed and lateral choppers, but these last represent only 16%. Conversely, more than half chisel choppers have a simple bifacial flaking formula for removals of 1+1 and 1+2.

In the following tables summarising unifacial and bifacial shaping it is important to remember that double-edged choppers have two working edges; their number (20) must be therefore doubled, and for that reason there are 40 working edges. There are, therefore, 866 working edges for 846 tools.

However, the working edge of the 36 casually trimmed choppers was not counted, which lowers the number of working edges to 830.

Chopper shaping	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total %**	**Total N**
Unifacial	24.75	39.18	14.6	37.5	32.25	21.87	2.44	7.69	14.29	50	26.87	**223**
Bifacial	75.25	60.82	85.4	62.5	67.75	78.13	97.56	92.31	85.71	50	73.13	**607**
Number of cutting edges	311	171	89	40	124	32	41	13	7	2		**830**

Percentage of unifacial and bifacial choppers in the 10 typological groups: 1, lateral choppers; 2, distal choppers; 3, chisel choppers; 4, double-edged choppers; 5, truncated choppers; 6, pointed choppers; 7, choppers with peripheral working edge; 8, lateral-distal choppers; 9, passive choppers; 10, atypical choppers.

Chopper shaping	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total %**	**Total N**
Unifacial												
Simple (1)	7.07	16.96	11.25	12.5	12.1						9.76	**81**
Multiple (2)	9.32	15.2	1.12	15	10.48	12.5			14.29	50	9.76	**81**
Multiple (n)	8.36	7.02	2.24	10	11.67	9.37	2.44	7.69			7.35	**61**
Total	**24.75**	**39.18**	**14.61**	**37.5**	**32.25**	**21.87**	**2.44**	**7.69**	**14.29**	**50**	**26.87**	**223**

Chopper shaping	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total %**	**Total N**
Bifacial												
Simple 1+1	8.04	19.3	24.72	2.5	11.29	12.5			28.57		12.17	**101**
Simple/Multiple 1+2	14.8	12.28	30.34	22.5	16.94	3.12			14.29		15.18	**126**
Simple/Multiple 1+n	13.81	8.19	6.74	15	16.94	9.38	4.88	15.39	14.29		11.81	**98**
Total	**36.65**	**39.77**	**61.8**	**40**	**45.17**	**25**	**4.88**	**15.39**	**57.15**		**39.16**	**325**

Chopper shaping	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total %**	**Total N**
Bifacial												
Multiple 2+2	8.04	3.51	13.48	5	7.26	15.63		7.69			7.13	**60**
Multiple 2+n	14.8	12.28	6.74	15	10.48	18.75	9.76	15.69	28.57		12.77	**106**
Multiple n+n	15.76	5.26	3.37	2.5	4.84	18.75	82.92	53.84		50	13.97	**116**
Total	38.6	21.05	23.59	22.5	22.58	53.13	92.68	76.92	28.57	50	33.97	**282**
Total cutting edges	**311**	**171**	**89**	**40**	**124**	**32**	**41**	**13**	**7**	**2**		**830**

Frequency of shaping classes of the 10 typological groups of choppers: 1, lateral choppers; 2, distal choppers; 3, chisel choppers; 4, double-edged choppers; 5, truncated choppers; 6, pointed choppers; 7, choppers with peripheral working edge; 8, lateral-distal choppers; 9, passive choppers; 10, atypical choppers.

Working edge of choppers

Angle of the working edge: For more than half the choppers. the angle of the working edge is between 80° and 100°, that is to say close to a right angle. It is quite normal if more than a third have an angle from 80° to 90° and 17.5% have a working edge with an angle over 90°. On the other hand, it is unusual to have 42% with an acute working edge (60° to 80°).

The proportion of tools with an active angle of over 90° differs according to the typological category. In the first group are 9% of the distal choppers and 14% of the truncated choppers and in the second group are 22% of the lateral choppers, 28% of the chisel choppers and 27% of the choppers with a peripheral working edge. This last type, mostly bifacial, has high angles, whereas the same tools in the advanced Oldowan and especially the Acheulian have an acute angle.

Profile of the working edge: The working edge, seen in profile, is straight or sinuous and only 20% have a straight working edge. The curvature of the working edge of tools classed as "sinuous" is generally well marked. Lateral choppers have a sinuous working edge more often (86%) than distal choppers or chisel choppers (75%).

Working edge	1	2	3	4	5	6	7	8	9	10	11	Total %	Total N
Angle													
<60°	3.85	2.92		2.5	5.65	4	2.44	7.69	14.29		11.11	3.84	**33**
60° to 69°	10.93	11.11	10.11	20	18.55	16	9.76	7.69	28.57	50.50	22.22	13.15	**113**
70° to 79°	26.69	37.42	20.23	25	29.84	28	21.95	15.39	42.85		33.33	28.64	**246**
80° to 89°	36.34	39.77	41.57	40	32.35	36	39.02	58.84	14.29		25	36.79	**316**
90° to 99°	20.26	7.6	25.84	12.5	10.48	8	24.39	15.39			5.56	15.48	**133**
> 100°	1.93	1.17	2.25		3.23	8	2.44				2.78	2.1	**18**

Profile	1	2	3	4	5	6	7	8	9	10	11	Total %	Total N
Sinuous	85.85	74.85	74.16	60	78.23	82.76	97.56	92.31	85.71	100	64	79.84	**689**
Straight	14.15	25.15	25.84	40	21.77	17.24	2.44	7.69	14.29		36	20.16	**174**
N of cutting edges	311	171	89	40	124	29	41	13	7	2	36		**863**

Frequency of different working edges of the 11 typological groups of choppers: 1, lateral choppers; 2, distal choppers; 3, chisel choppers; 4, double-edged choppers; 5, truncated choppers; 6, pointed choppers; 7, choppers with peripheral working edge; 8, lateral-distal choppers; 9, passive choppers; 10, atypical choppers; 11, casually trimmed choppers.

Spatial distribution

Choppers in every category are very numerous in the west and north sectors of the excavation. They are found mainly in zone A (sectors 1, 2, 3) and zone C (sector 6). The richest square is F-22 with 24 choppers. In addition, 23 other squares have from 10 to 17 choppers. There are few in Zones B and D, and finally it is worth noting that 80 squares have not a single chopper.

Conclusions

With 846 choppers the Oldowan site of Gombore I yielded reliable qualitative and quantitative information. The analysis of each typological category clearly showed archaic shaping characteristics such as the simple formulas of the flaking technique of these tools. Bifacial tools make up three-quarters of the choppers: these are the ‘chopping tools’ of some authors. Furthermore, the sinuous working edge is a primitive characteristic but the angle formed by the two faces is frequently acute (42%) although half the choppers have an angle of 80° to 90°.

These choppers had different functions: knives, choppers, and perhaps even heavy end-scrapers. The outline and dimensions of the tool, the weight, the shape and the orientation of the working edge, undoubtedly had a precise function. The tools were handled to discern the characteristics proper to each tool type: the heavy passive chopper was not used as a small lateral chopper. The Oldowan toolmakers of Melka Kunture, probably *Homo ergaster*, had some intuitive knowledge of the capabilities of their tools. They often did not hesitate to make a technical choice for different manual operations.

Finally, the chopper, unifacial or bifacial, was the dominant tool in this period of the Stone Age, to such an extent that it became as representative of the Oldowan as the handaxe is of the Acheulian. But, like the handaxe, this term designates different tools with very varied functions.

Polyhedrons

Polyhedrons are tools with multidirectional shaping that can appear to be disorganised. In fact, the aim of these tools, when they are not former cores or simply polyhedral cores, is to create multiple facets that provide ridges. These are sometimes well marked and have obtuse or right angles that may be erased or crushed, and which transform the tool into a ball with facets, or even into a completely spherical bola. At Gombore I polyhedrons represent 18% of tools on pebble.

Distribution of different categories of polyhedrons

The distribution into typological categories is fairly even, except for prismatic polyhedrons which are more common with 35%, and various polyhedrons which are less common. Polyhedrons with preferred working edges are similar to choppers and represent 21% of these tools.

Proportions of the main polyhedrons categories by zones

Like choppers, zones A and C include the majority of the polyhedrons and these two zones have yielded 80%. Their presence is generally low in zone B. In contrast, this same zone indicates a high percentage of spherical polyhedrons (35%). Finally, in zone D, polyhedrons with preferred working edge are the most numerous (32%).

Polyhedrons	**A**	**B**	**C**	**D**	**Total N**	**Total %**
With preferred working edge	28	5	25	14	**72**	20.88
With several working edges	20	2	13	5	**40**	11.59
Pointed	21	2	14	2	**39**	11.30
Prismatic	64	5	38	13	**120**	34.78
Spherical	24	8	22	7	**61**	17.68
Various	6	1	3	3	**13**	3.77
Percentage	47.25	6.67	33.33	12.75		
Total	**163**	**23**	**115**	**44**	**345**	

Distribution of polyhedrons by typological categories and by zone.

Spatial distribution

Sector 6 in zone C is the best provided in polyhedrons with 27%, followed by sector 1, zone A with 20%, the poorest being sectors 4 and 5 with about 6.5% each.

Polyhedrons with preferred working edge

These polyhedrons have a circular or partially peripheral working edge which is sometimes reminiscent of that of the chopper with a peripheral working edge or that of some lateral choppers. Polyhedrons with a preferred working edge, 72, represent 21% of the polyhedrons. They are common in zones A and C, but seem proportionally numerous in zone D (32%). Their function is close to that of choppers.

Raw material

There is a very high proportion of hard rocks with 60% basalt. Obsidian polyhedrons are rare and are mainly from zones A and C. Finally, raw material in the "various" category includes volcanic jaspoids.

Morphology

Dimensions: Tools with extreme dimensions are from zone C and the largest tools are in zones A and C. Lengths range between 50 and 143 mm, but most are between 80 and 130 mm (72%). They are relatively heterogeneous with a third of the tools between 80 and 100 mm and another third between 110 and 130 mm.

There is also a certain heterogeneity in the maximum width values. First, there is a class between 40 and 60 mm (20%), and secondly a class between 80 and 110 mm with 53%.

Although it varies, thickness is more homogeneous. More than half of the polyhedrons are between 60 and 90 mm thick.

Elongation: According to this index, "short" and "very short" tools account for 53%. Only 8% of the polyhedrons are "rather long".

Flattening: The data are clear: half of the tools are "very thick" and the class formed by "thick" and "very thick" polyhedrons together amounts to 93%. It is a characteristic that distinguishes them from choppers, which are flatter, even those in the category of choppers with peripheral working edge.

Shape: Polyhedrons of pentagonal, hexagonal and polygonal shape account for 85%. On the whole, elliptical shapes are rare but are present mainly in zone D. It is not surprising to note that 40% of these polyhedrons have a polygonal outline.

Weight: Weight values indicate great variability, ranging from 50 to 1600 g. As a whole, these tools are heavier than choppers and 25% of the polyhedrons of this category weigh more than 1 kg.

Shaping

The number of removals ranges from 5 to 23 (Figs. 23, *2*; 24, *3-5*). However two lots can be distinguished. First, there is a group of polyhedrons with 7 to 9 removals (35%); second, there is a group with between 11 and 14 removals (37%). Finally 10% have 20 removals or more.

It is worth noting the following distribution which shows the importance of shaping in relation to the presence of areas of cortex of difference size:

Partial	59.55%
Nearly complete	33.30%
Complete	7.15%

The tools without cortex with overall shaping are rare (7%). The presence of the cortex is a rather archaic characteristic while the large number of removals can be considered as an advanced characteristic.

Working edge

The working edge can be partial, nearly complete or complete, i.e., peripheral.

Angle of the working edge: For 71% the angle of the working edge is equal to or greater than 90°, but for 25% it is between 80° and 90°, which is a very particular characteristic in comparison with choppers:

Angle	**%**
70° to 79°	3.75
80° to 89°	25.00
90° to 99°	47.50
> 100°	23.75

Length of working edge in relation to total perimeter: The working edge occupies only a part (low percentage) of the periphery:

	%	%
	< 30	17.65
Partial working edge	30 to 39	19.12
	40 to 49	26.47
	50 to 59	16.18
Nearly complete working edge	60 to 69	5.68
	70 to 79	7.35
	80 to 89	4.41
Complete working edge	90 to 100	2.94

Thus, the working edge can be partial (63%), nearly complete (34%) and complete (3%). The partial working edge can be lateral if it is more or less parallel to the axis of the tool, or distal if, in the same plane as previously, it occupies the width. Among tools with a partial working edge, 80% have a lateral working edge, as for the choppers where tools with lateral working edges represent nearly three-quarters of the "lateral chopper + distal chopper" class.

Sinuosity: The working edge is sinuous in 96% of the cases. It is exceptionally straight on only 4% of the tools.

Contour of the working edge: It is rather difficult to define the contour of the working edge in the length/width plane. However, when it is not peripheral, that is to say polygonal, the working edge can be angular, jagged and largely convex (35%).

Utilization marks: Like choppers, many polyhedrons first functioned as cores.

The absence or scarcity of utilization marks does not necessarily mean that they have been not utilized, merely that percussion might have beem less violent and less frequent. Polyhedrons have percussion marks on surfaces, on extremities – that is to say at the intersection of ridges – and on the ridges themselves.

Ridges 72%
Extremities 7%
Surfaces 12.5%

As for the importance of these marks, it is interesting but not surprising to note that ridges, in other words the working edges, have the most "heavily marked" utilization traces on 42% of the tools.

Utilization marks	Surface	Ridge	Extremity
Slightly marked	2.78%	20.83%	
Marked	2.78%	9.72%	4.17%
Heavily marked	6.94%	41.67%	2.78%

Finally, according to this table we see that crushing is twice as common as scaling. On the whole, some tools have more crushing on the working edge than the best marked choppers.

Spatial distribution

Polyhedrons are evenly distributed through the excavated area with one to two tools per square metre, except for two zones: part of the central-northern area (zone C) and part of the northern-western area (zone A). Three polyhedrons were found in square Y-26.

Polyhedrons with several working edges

The removals from these tools are always multidirectional, but they determine two or several working edges, generally at intersections. This typological category is represented by 40 tools or 12% of total polyhedrons and the same proportion is found in zones A, B and D.

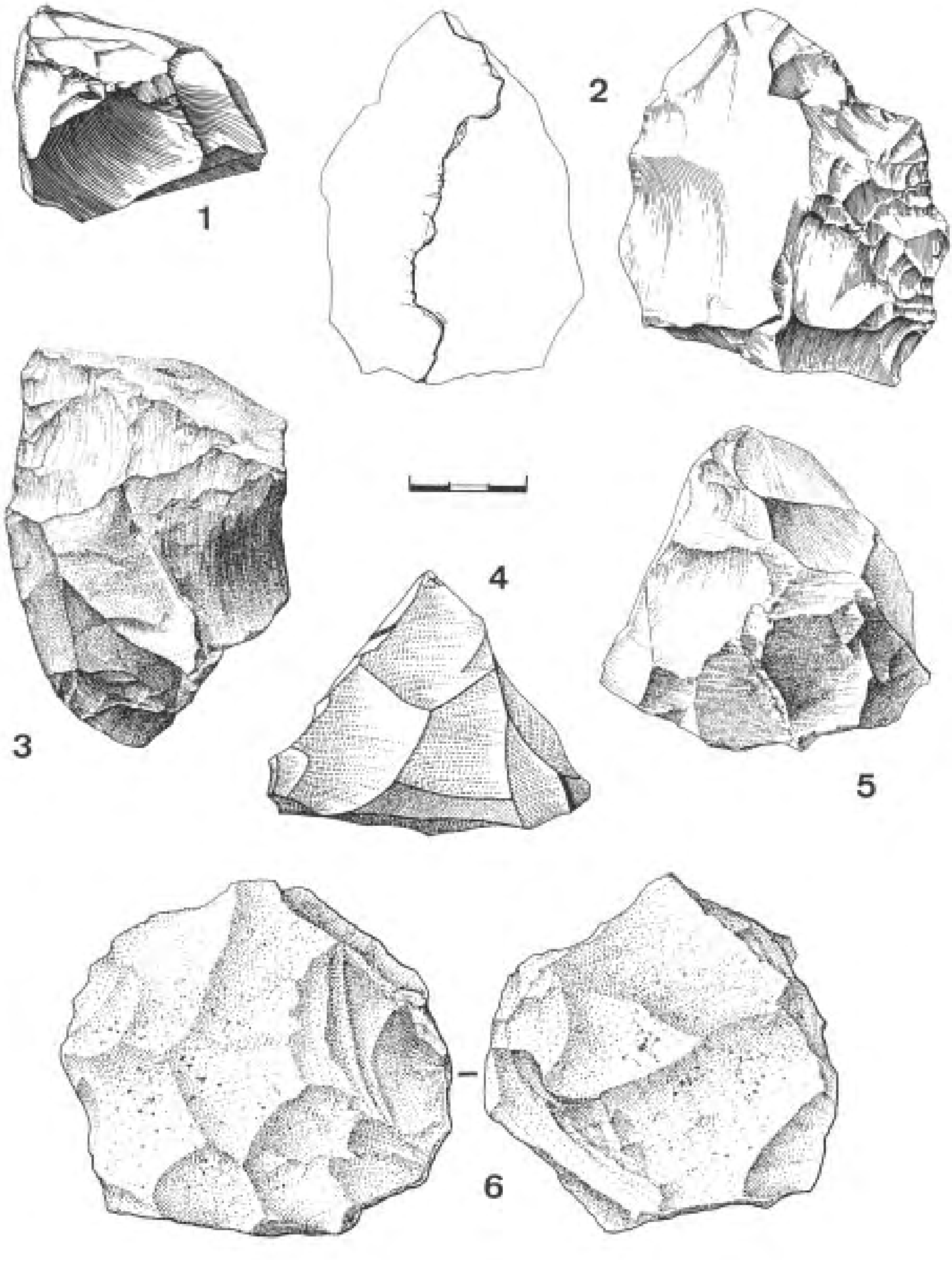

Fig. 23. Gombore I. Lithic industry from Level B. 1: polyhedron with several working edges; 2: polyhedron with preferential working edge; 3: polyhedron with several working edges and rabot; 4, 5: pointed polyhedrons; 6: spherical polyhedron. 1: obsidian; 2, 6: trachyte; 3, 4: basalt; 5: tuff. *Drawings by C. Chavaillon (1, 2, 3, 5) and J. Jaubert (4, 6)*

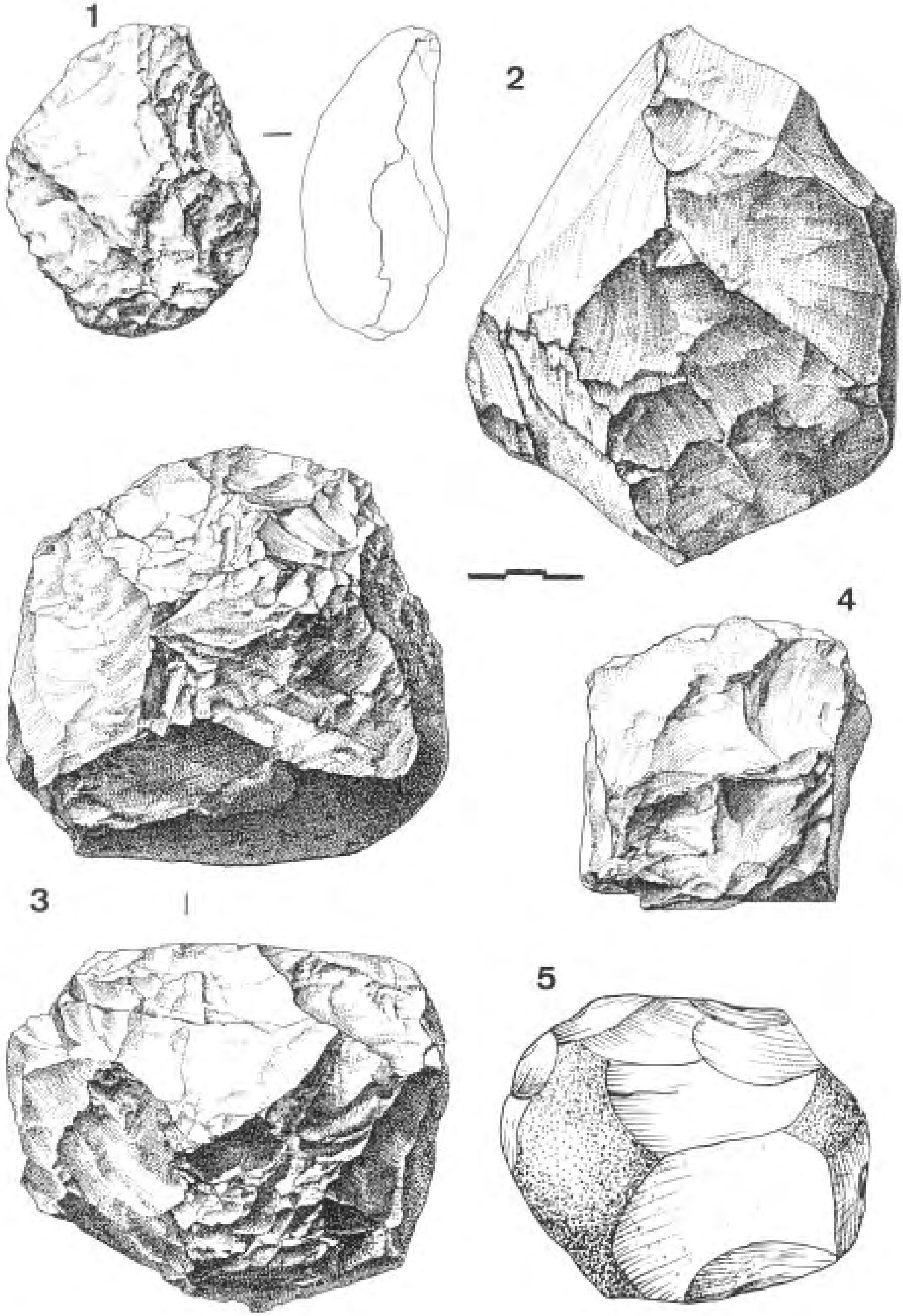

Fig. 24. Gombore I. Lithic industry from Level B. 1: unifacial shaped tool; 2: polyhedron with preferential working edge; 3, 5: spherical polyhedrons; 4: prismatic polyhedron. 1: trachyte; 2-5: basalt. *Drawings by C. Chavaillon (1-4) and J. Chavaillon (5)*

Raw material

There is a particularly high proportion of basaltic rocks (70%), but there are only 3 tools of obsidian.

Morphology

Dimensions: Zone A has half of the polyhedrons as well as tools with extreme maximum length values between 41 and 141 mm. The average length is between 90 and 100 mm, the average width between 80 and 90 mm and the thickness between 70 and 80 mm, which makes these tools stocky.

Elongation: Nearly half of the polyhedrons are “very short”. However, there is a slight variation with 25% “rather short” and 15% “long” or “rather long”.

Flattening: 92% of these polyhedrons are “very thick” and “thick”, with a large majority of “very thick” tools.

Shape: Most polyhedrons have a pentagonal, hexagonal or polygonal outline, which is quite logical.

Weight: Extreme values go from 40 to 2063 g. Half of these polyhedrons weigh between 400 and 1000 g, but 22% weigh over 1 kg.

Shaping

There is a smaller number of tools with more than 18 removals in this category than in that of polyhedrons with a preferred working edge. On the other hand, in this latter category there are 37% of tools with 11 to 14 removals. Here, the class with 12 to 15 removals represents 55%, which indicates more important shaping (Fig. 23, *3*). The following distribution shows this quite well:

Partial	37.5%
Nearly complete	47.5%
Complete	15.0%

The shaping of these polyhedrons is thus more comprehensive than that of polyhedrons with a preferred working edge.

Working edge

Most of these tools have two working edges, rarely three (5%).

Angle of the working edges: Nearly 70% of the polyhedrons have an angle between 90° and 120°. On the other hand, the angle formed by facets with one another is clearly more obtuse at 90° to 140°:

Angle	%
70° to 79°	3.65
80° to 89°	26.85
90° to 99°	43.90
> 100°	25.60

Length of working edge in relation to total perimeter: The working edge only occupies a small part of the total perimeter:

	%	%
Partial working edge	< 30	36.20
	30 to 39	20.70
	40 to 49	15.50
Nearly complete working edge	50 to 59	12.10
	60 to 69	6.90
	70 to 79	3.45
Complete working edge	80 to 90	5.15

A peripheral working edge is exceptional. A partial working edge is found on 72%. It is noted that among the latter, one working edge in two (or 36%) occupies less than one third of the periphery.

Sinuosity: All these working edges are sinuous.

Utilization marks: Nearly 90% of the tools have use marks, a higher proportion than for polyhedrons with a preferred working edge. It is apparent that:

Utilization marks occur on

Ridges	88%
Extremities	20%
Surfaces	32%

Polyhedrons with utilization marks can be:

Slightly marked	20%
Marked	25%
Heavily marked	55%

These tools could have been used as hammerstones or rabots and could have been cores (polyhedral cores) previously. Crush marks are clearly more important than scaling. Two tools show some gloss on one working edge, but also numerous crush marks.

Spatial distribution

The distribution is rather disorganised and this type of tool is present everywhere, but is rare in zone B. A quarter of the class is located in four adjacent squares, namely: H / 23 with five polyhedrons, G / 23 and F / 23-24.

Pointed polyhedrons

From the technical point of view, the 39 pointed polyhedrons have multidirectional removals that form a pointed end and a pyramidal section. Functionally, this polyhedron was probably worked for its point, more especially because it was often broken during utilization. Like all polyhedrons, they could be former cores. Nearly as numerous than polyhedrons with several working edges, they represent 11% of all polyhedrons. They are numerically and proportionally abundant in sectors 6 (zone C) and 3 (zone A).

Raw material

Basaltic rocks are the most numerous, which is normal for Gombore I, but it is important to note the presence of 18% of obsidian. It is also worth noting that pointed polyhedrons of obsidian represent 42% of this typological category in sector 6 (zone C). This is remarkable given the fragility of this brittle rock and suggests a function other than that of hammerstone, crusher or pick.

Morphology

Dimensions: 8% of the tools (3 polyhedrons) have a maximum length under 60 mm. In contrast, 41% are over 100 mm long. The maximum width and maximum thickness are more homogeneous: 75% of the tools are between 60 and 100 mm.

Elongation: More than 56% of these polyhedrons are “very short” and “short”; but 10% are “rather long”, a characteristic that is probably due to the point. The long tools are mainly in zone A, while “very short” tools dominate in zone C.

Flattening: These polyhedrons are mainly in the "very thick" and "thick" categories (82%) and comprise a lower percentage than in other polyhedron categories. They are, however, stubby tools, even with the point.

Shape: Pentagonal and hexagonal tools are most abundant (54%). However, triangular shapes, generally exceptional among polyhedrons, represent 15% and they are found in zone A. Quadrilateral shapes, also rare, are represented by 23% and, although uncommon in the polyhedron class, are linked in this case to the trimming of the point.

Weight: Extreme values range between 21 and 1410 g. The lightest tools are of obsidian. A group representing 66% of these pointed polyhedrons is between 400 and 1000 g.

Shaping

The number of removals is very variable and ranges from 4 to 27. However, these polyhedrons are less trimmed than polyhedrons with one or several working edges. Thus, 25% have 11 to 14 removals and 51% have only 4 to 8 removals. One set of removals converges to form a point (Fig. 23, *4-5*) and for the most part the shaping is nearly complete or complete (65%):

Partial	35%
Nearly complete	25%
Complete	40%

The tools with partial shaping have often a more or less flat base (opposite to the point), slightly convex and cortical.

These tools are sometimes reminiscent of pyramidal cores with a point that would have been used a second time. The point is broken in 15% of the cases.

The point

The angle formed by sides converging towards the extremity indicates that the point has an angle ranging from 50° to 110°.

Angle	N	%
50° to 69°	3	7.75
70° to 79°	3	7.75
80° to 89°	15	38.46
90° to 99°	9	23.07
100° to 110°	9	23.07

Thus 46% of the tools have an obtuse angle of over 90°, but for 38% it is between 80° and 90°. The points are stubby, sometimes broken, crushed or blunted (18% of the cases), which presupposes utilization.

Impact marks are present. Not counting the tools with a broken point, 85% of the remaining tools have marks on their extremity, most of which are very pronounced. Some tools have also percussion traces on the surfaces (13%). In fact, it is definitely the point that was deliberately used, without doubt violently enough to lead sometimes to fracture. The point is nearly always hammered.

Large and fine flake scars on the surfaces leads to the belief that they were previously cores. Thereafter, they might have served as picks and perhaps hammerstones on this extremity that was now blunted.

Spatial distribution

Pointed polyhedrons are sometimes highly clustered, in particular in sector 3 where a quarter of the tools have been found in four squares, namely B-25 with five tools, A-24, A-25 and Z-24. Moreover, there are two groups, one in zone A and the other in the eastern part of sector 6: E-F-G-H / 14-15-16-17 where perhaps a particular activity that required the utilization of such tools took place.

Prismatic polyhedrons

Prismatic polyhedrons have a pentagonal or hexagonal form and sometimes have parallel sides. The impression is that the aim was to produce flakes so that these polyhedrons could be therefore be close to cores. However, if they are classified as polyhedrons, it is because other characteristics make them different from true cores, such as, for example, removals that are not orderly and the removal of small flakes that do not seem to have been intended for use. Finally, some of the tools have impact marks on the ridges, such as on polyhedrons in other typological categories.

With 120 specimens, prismatic polyhedrons represent 25% of the polyhedrons.

Raw material

A dominant characteristic of polyhedrons at Gombore I worth noting is the large proportion of basaltic rocks (more than half of the class). On the other hand, the presence of several obsidian tools (22% of this class) highlights the “core-like” appearance of some polyhedrons.

Morphology

Dimensions: Most have an average length, width and thickness between 60 and 100 mm. They are rather small tools: a quarter are over 100 mm long and hardly 10% are longer than 110 mm, which contrasts with polyhedrons of others categories.

Elongation: The l/w index shows that prismatic polyhedrons are “short” tools. There are only 10% of “long” or “rather long” tools.

Flattening: They are “very thick” and “thick” tools.

Shape: Pentagonal, hexagonal and polygonal shapes dominate. However, the quadrilateral is well represented with 11%.

Weight: Weight ranges from 17 to 2260 g. The two smallest and lightest tools are of obsidian and come from sector 2 (zone A). Half of the tools weigh between 400 and 1000 g.

Shaping

Flakes have been removed in every direction. The negative of one was often the striking platform of another (Fig. 24, *4*). The number of removals ranges from 3 to 27. Polyhedrons with 6 to 11 removals amount to 67%, which is a good average for the preparation of a polyhedron, even if other categories have more negative flake scars.

The presence of cortex is common, thus:

Partial shaping	47.5%
Nearly complete shaping	32.5%
Complete shaping	20.0%

This distribution is rather similar to other polyhedrons categories, where complete shaping is quite rare. In fact, more than three-quarters of the tools have cortex. Even the polyhedron with 27 flake removals still has two small cortical areas!

The angles between facets are very variable. Moreover, the same tool can show different angle values, thus:

Angle	%
80° to 89°	7.2
90° to 99°	24.8
100° to 109°	25.2
110° to 119°	26.1
> 120°	16.7

Most ridges are obtuse and 43% have an angle higher than 110°.

Utilization marks

Utilization marks on some of these prismatic polyhedrons are so pronounced that after being used as cores, they could have been used a second time as hammerstones. Some polyhedrons have impact marks surfaces and ridges (67%) as well as extremities. Impact and utilization traces are "heavily marked" on nearly half of the tools. They were therefore probably used as crushers and hammerstones.

Location of utilization marks:

On ridges	67%
On surfaces	10%
On extremities	37%

Intensity of utilization marks:

Slightly marked tools	24%
Marked tools	28%
Heavily marked tools	48%

Spatial distribution

They are the most numerous in zone A, a tool flaking area. Two areas are well provided: one in squares F-G / 23-24-25-26 with about 20 tools, the other with an equal number around B/25 with 6 tools in this square alone.

Spherical polyhedrons

These are tools that, after multiple multidirectional removals, take the form of a more or less spherical ball of variable dimensions and weight. The ideal form that was sought was a sphere, whether natural or manufactured. Like prismatic polyhedrons, several of these tools are probably former cores or even trimmed hammerstones. The spherical form would be so much sought after and appreciated by Acheulians that these tools, however rough, were to become the Acheulian bolas with its nearly perfect spherical shape.

Spherical polyhedrons amount to 61 and represent 17.7% of polyhedrons (Figs. 23, *6*; 24, *3-5*). They are the *polyhedrons* described at Olduvai and in several Kenyan sites.

Raw material

As with all polyhedrons, hard rocks are dominant and basalts reach 57%. Obsidian occurs only in zones A and C (nearly 10%) where there are three-quarters of the spherical polyhedrons. In fact, the use of the obsidian tools is enigmatic. Being fragile and brittle, it is doubtful that they were intended to be crushers or hammerstones. That they were first used as cores is not strange: these multiple crush traces could then be linked to the flaking unless they are natural alterations or the result of real utilization as a tool.

Morphology

Dimensions: These are among the largest polyhedrons at Gombore I. The most extreme values are from zone A where length is from 38 to 172 mm, width from 35 to 161 mm, thickness from 32 to 137 mm, and 57% of the tools have a maximum length over 100 mm. Nearly three-quarters (72%) have a maximum length between 90 and 140 mm. With a few exceptions, they are large and heavy tools.

Elongation: Some 82% of these tools are "short" and "very short".

Flattening: This index highlights the unusual "very thick" characteristic (84%) of these polyhedrons. This is in fact not surprising, since the elongation and flattening index supports the metric data and confirms the globular characteristic of these tools which are sometimes very nearly spherical in shape.

Shape: The spherical polyhedron is almost never a complete sphere for then it would be a bola typologically, but it shows various, often small, facets that give it a polyhedral shape. More than half of these tools have a polygonal outline and more than one third a hexagonal one.

Weight: Although the weight is variable, it is also particularly high as spherical polyhedrons are heavy: 48% weigh over 1 kg.

Shaping

The number of removed flakes is highly variable and can exceed 20. However, 62% of the tools have from 8 to 12 flakes removed, which is not many.

The preparation of the polyhedron leaves flat or concave negatives scars. The shaping is rarely complete. In sector 6, one tool out of twenty is completely trimmed.

Preparation	Gombore I Oldowan	Garba XII Acheulian
Partial preliminary flaking	46%	11%
Nearly complete preliminary flaking	44%	78%
Complete preliminary flaking	10%	11%

Spherical polyhedrons from the Acheulian at Melka Kunture, even those of the Lower Acheulian (Garba XII), have very little cortex and do not even keep any.

At Gombore I, the number of removals is mostly proportional to the extent of shaping:

Partial polyhedrons	shaping under 50%	4 to 7 removals
Partial polyhedrons	shaping from 50 to 99%	8 to 11 removals
Polyhedrons without cortex	complete shaping	6 to 21 removals

The result is logical: the more removals, the more the shaping tends to be complete and the tools have less cortex.

Angle of removals

The angles between removals are generally greater than 90°.

Angle	%
80° to 89°	2.44
90° to 99°	8.13
100° to 109°	16.26
110° to 119°	34.14
120° to 129°	31.71
> 130°	7.32

The facet angles range from 85° to 140°. Most are between 100° and 130°, with 66% between 110° and 130°.

Utilization marks

Most tools have crush and hammer marks, and ridges have been blunted. There are, very rarely, the beginnings of small pits on the facets. Some tools have impact marks on facets as well as on ridges or extremities. Thus, 5 polyhedrons out of 6 have percussion marks on ridges and 1 in 2 is heavily marked.

Some polyhedrons began as polyhedral cores before becoming tools and some of the preparation flakes could have been retrieved and used either in their raw state (as knives), or with added retouch. But at least 85% of spherical polyhedrons were used as crushers, grinders and perhaps missiles. Spherical polyhedrons with characteristics close to those of bolas are large and heavy, however, and are better regarded as hammerstones or crushers than as hunting weapons.

Spatial distribution

The distribution has little significance. However, spherical polyhedrons occur mainly in two zones, A and C. For example in D-G / 18-19, there are 10 tools, or 16.5%. D-F / 25-26 and C / 24-27, yielded 14 specimens (23%).

Diverse polyhedrons

The thirteen “diverse” polyhedrons are tools that are not classifiable in other categories.

Raw material

Eight tools in this class (61%) are of basalt.

Morphology

Dimensions: The maximum length is under 100 mm: 70% are from 60 to 100 mm long.

Elongation: This index is rather heterogeneous with a dominance of “rather short” tools (5 specimens).

Flattening: This class is rather homogeneous: 61% are “thick”.

Shape: Of course, the outline of these tools is mainly pentagonal, hexagonal, and even polygonal. However, a third of the class has an irregular outline, which characteristicises well the “diverse” and shapeless polyhedrons.

Weight: They are rather light tools from 78 to 598 g; half weigh from 400 to 600 g.

Shaping

The number of removals is variable, like the others polyhedron types: three tools have 6 removals and five have from 10 to 12 removals. Curiously, these tools show less cortex than polyhedrons of other categories.

Utilization marks

In comparison with other polyhedrons, this category comprises tools that seem to have been seldom used. One tool out of three has more or less clear utilization marks, except for one well marked tool which was battered on ridges and moreover on extremities.

Spatial distribution

More than half of the diverse polyhedrons are found in the western sector of the excavation.

Comparisons and conclusions

The term polyhedron has the merit of not carrying functional assertions. Choppers, side-scrapers and rabots are provided, by their definition, with a purpose linked to use. However, if technically one is concerned with a polyhedral or even spherical shape, little information is given about their use.

Many tools could have been cores, but some were reworked or undoubtedly trimmed for a purpose other than obtaining flakes. One does indeed find *core-polyhedrons* which are on the path from core to tool, and there is also the confusing distinction between a prismatic polyhedron and a polyhedral core. There are polyhedrons with one or even two working edges which puts them in the same functional category as some choppers. Finally, some polyhedrons have a point that can be suggested as the ancestor of the pick.

The 13 “diverse polyhedrons” were not included because there are too many uncertainties regarding their typology and function. This leaves 332 polyhedrons distributed in five categories.

Raw material

First, there is a high proportion of hard rocks, particularly basalt. This characteristic is shared by other typological categories but the proportion here is particularly high at 58%, 60%, and 70%. The relatively high frequency of obsidian can be surprising: 18% for pointed polyhedrons, 22% for prismatic polyhedrons, with a general average of 15%.

Rocks	**1**	**2**	**3**	**4**	**5**	**Total N**	**Total %**
Welded ignimbrite			7.70	0.83	1.64	**5**	1.51
Trachyte	18.00	22.5	20.50	17.5	26.2	**67**	20.18
Basalt	59.7	70.0	43.6	52.5	57.3	**186**	56.02
Vuggular lava	6.95			4.17	1.64	**11**	3.31
Volcanic tuff			10.2	2.50	3.28	**9**	2.71
Obsidian	11.1	7.50	17.9	21.6	9.83	**50**	15.06
Various	4.17			0.83		**4**	1.21
Tool number	**72**	**40**	**39**	**120**	**61**	**332**	

Raw material of polyhedrons, in percentage and according to the 5 typological categories: 1 - Polyhedron with preferred working edge; 2 - Polyhedron with several working edges; 3 - Pointed polyhedron; 4 - Prismatic polyhedron; 5 - Spherical polyhedron.

Morphology

Dimensions: Except for prismatic polyhedrons which are generally small, polyhedrons of other categories are quite large: 40 to 54% have a maximum length over 100 mm (general average is 38%).

Elongation: The elongation index indicates that 53 to 82%, according to categories, are “very short” and “short”. The most elongated are among polyhedrons with a preferred working edge and prismatic polyhedrons; the shortest stubby tools are spherical polyhedrons with 40% of “very short” tools.

Flattening: Except for prismatic polyhedrons, more than half are “very thick”: 51 to 84%. The thickest are indisputably spherical polyhedrons.

Shape: The length/width plane of polyhedrons is mainly hexagonal or polygonal (61% of general average). These shapes are particularly frequent in the spherical polyhedrons category (87%).

Weight: Polyhedrons are heavy: 35 to 68% weigh over 600 g. The lightest are prismatic polyhedrons and pointed polyhedrons. The heaviest are spherical polyhedrons.

Shaping

The practice of removing flakes in several directions is the basis of the definition of the word polyhedron. However, if complete shaping was not necessary, then the number of removals could be limited.

The number of negative flake scars can exceed 20 but can also be limited to 4 or 5. Most tools have between 7 and 12 removals. Some categories of polyhedrons with several working edges show numerous negative flake scars: 32% have 15 or more removals.

Angles between facets are always high, particularly for spherical polyhedrons.

Utilization marks are mainly on ridges of possible working edges, or simply at the meeting of facets.

Spatial distribution

Zones A and C are especially well provided with polyhedrons indicating zones where various activities linked to crushing as well as stone flaking took place. Eleven squares have from 6 to 8 polyhedrons and square B-25 alone had 13. This sector is therefore well-supplied and in 6 squares (B-C / 25-26-27) there were 41 polyhedrons. This indicates a well-defined activity area, even if the nature of the activity remains rather a mystery to us.

Conclusions

What were polyhedrons used for? Many of them were at first cores or flake providers. But on the whole, the finishing touches to make a type of ball or an obtuse working edge required that the shaping be reworked, which lead to the removal of small waste flakes (that were not retrieved). These artefacts, cores turned into tools, are similar to certain choppers because of their double use. In fact their use is rather imprecise: hammerstone, bone, stone or wood crusher. For polyhedrons with a preferred working edge, and even for those with several working edges, the sharp, strong ridge is reminiscent of some choppers, specifically heavy choppers.

Many spherical polyhedrons could have been missiles, which was probably how the Acheulian bolas and faceted balls of the Upper Acheulian were used. At Gombore I, these spherical polyhedrons could also have been fitted with a handle to act as hammers, clubs or crushers. Spherical polyhedrons and sometimes bolas are well represented at butchery sites. This is the case at Barogali, in the Republic of Djibouti, where the butchery site with *Elephas recki ileretensis* was proportionally well provided with polyhedrons and even bolas from a stratum dated 1.3 to 1.6 Ma (Berthelet *et al.* 1992; Berthelet 2001).

Heavy end-scrapers on pebble

Thick end-scrapers and rabots are part of the pebble end-scraper category. They are *heavy scrapers*, even though sometimes their size and weight are not much greater than those of tools on flake. These are tools meant for scraping. The rabot shows a high, vertical and blunt working edge. The heavy end-scraper shows a more acute utilization angle and a shorter working edge. The rabot could have started as a core, whereas the heavy end-scraper is less likely to have done so.

The following observations can be made:

1 - The class of heavy end-scrapers and rabots is clearly just as important as that of polyhedrons on the one hand and that of diverse tools on pebble on the other. This class represents 17.4% of all 332 tools on pebble. Three former rabots that are blunted and were therefore not included, come from sector 2 (zone A).

2 - In the heavy end-scraper class, the distribution of the two tool types is clearly the same from one zone to another with an average ratio of 27.7% of heavy end-scrapers to 72.3% of rabots. In other words, one heavy end-scraper to three rabots. However, heavy end-scrapers represent 30.2% in zone A, while in zone B there are only 19.1%.

3 - The proportion of heavy end-scrapers varies clearly from one zone to another. In zones A and C they make up 42 and 31% respectively of all tools on pebble, while in zones B and D they represent only 14 and 13%. This variability has already been noticed for other categories.

Heavy end-scrapers

There are 92 heavy end-scrapers. They represent an interesting category but are technically and functionally different from rabots. They are tools on flake in the making (Figs. 25, *1*, *3*, *5*; 26, *2-5*) and sometimes resemble the famous "rostro-carinates" from South Africa (Van Riet Lowe 1937).

A relatively significant number of tools had several uses (7.6%). Except for a double heavy end-scraper, a heavy end-scraper could be functionally associated with:

Lateral choppers	1 tool
Rabots	1 tool
Beaks on pebble	2 tools (Fig. 27, *1*)
Unipolar cores	2 tools
Hammerstones	1 tool

Raw material

One end-scraper in two is of basalt. However, seven tools are of obsidian with three in sector 3 of the excavation, and two tools are in a jaspidian volcanic rock.

Morphology

Dimensions: The maximum length is between 39 and 171 mm and 71% are between 50 and 100 mm long, but only 16% measure more than 100 mm, mainly in zones A, B and D. The maximum width for 58% is between 60 and 80 mm. Thickness ranges between 21 and 85 mm.

Elongation: The tools are "rather short" and "rather long" (64%). However, 20% are "very short" tools. This type of stubby tool is particularly well represented in sector 2 (zone A).

Flattening: Not all these tools are thick. Nearly 30% are "rather flat" or "flat", but there is a clear dominance of 45% in the "rather thick" category.

Shape: Most of the tools are pentagonal or hexagonal, but 10% are rounded, for example in a semi-ellipse, which is characteristic of this tool type. They come particularly from sectors 2 and 3 in zone A. Some 20% have an irregular shape.

Weight: Weights are very variable: 28 to 1273 g. The heaviest end-scrapers are in zone D, but the arithmetical average is about 300 g. Some 50% weigh between 250 and 650 g. On the whole, heavy end-scrapers are fairly light tools.

Shaping

The number of removals ranges from 2 to 19. These are extreme numbers because in fact the shaping and preparation of the working edge involve very few removals and 65% have negative scars of 2 to 6 removals.

Working end

The analysis includes 93 heavy end-scraper working ends, one tool being a double end-scraper.

The usable or used part of a heavy end-scraper, that is to say the active part or working end, is restricted to a third of the complete perimeter and often much less in nearly half of the end-scrapers.

The angle formed by the basal platform and the retouched part ranges from 55° to 92°. However, 81% have an angle between 55° and 80°, with a clear dominance around 70%.

The ratio of the height h (at the front or working edge of the end-scraper) *to the length l of the worked end*, is *h* x 100 / *l*. This ratio is often low: 95% have a ratio under 100, while height and length have the same value. In 28% of these tools, the height of the working end does not reach half the length of the active part. In other words, heavy end-scrapers have a low front and a long working edge. This characteristic distinguishes them from rabots.

The basal platform is the part from which heavy end-scrapers and rabots were trimmed. This base can be cortical (28%), it can also be a prior fracture. Most of the time, the platform was obtained by a large removal or by a fracture, in the course of manufacturing the end-scraper (57%). A rare possibility (3%), is the shaping of this platform by the removal of a few flakes. The platform or base is generally flat (62%), but can also be concave (33%).

The outline of the working end: In a plane perpendicular to the front, the end-scraper can be convex (50%), straight (18%) or angular (11%). Finally, the working end on four tools resembles a beak.

Utilization marks: Nearly 90% of the heavy end-scrapers have utilization marks. They can be seen on the sharp working edge, on the front end and on the platform side of the same edge, that is to say on the two faces of the working edge (18%) or only on the front edge of the retouched side of the end-scraper (82%). A light blunting or gloss appears sometimes on the active edge, but this particularity was only noticed on five tools. Utilization marks can be in the form of scaling (78%) or crushing (50%).

Spatial distribution

Some concentrations occurred in the west and north with squares G-14, F-25, C-18, C-22 each having 3 end-scrapers and Z-26 with 4. On the other hand, they are also often scattered and are particularly rare in the south and east.

Rabots

Rabots are perhaps the most characteristic tools of the Oldowan, even if their use is sometimes ambiguous. These stubby, often heavy tools look like polyhedrons but also like cores, which some might have been. However, their most recent use seems to be as large and heavy end-scrapers. The term "rabot" is probably excessive because it is too precise. There are 240 rabots and they constitute an important category of tools on pebble (Figs. 23, *3*; 25, *2-4*; 26, *3*, *4*, *6*, *7*; 27, *7*).

Three clearly blunted tools that probably belong to an older period or another up-stream settlement, have not been counted. These tools come from sector 2, zone A and are from 97 to 102 mm long. Two have 5 and 6 removals respectively, and the third has 12. The angle of the active part ranges from 90° to 95°.

Tools with double utilization: There are numerous tools (20% on average) with shaping or utilization marks that indicate two different uses, generally successive. Very often the second use is as a chopper (62%), sometimes a core or even a hammerstone. In addition, many tools look like double or triple rabots. Thus a tool can have been trimmed a second time for the same use (double rabot), or for another function (for example, lateral chopper).

Double and triple rabots: The numerical distribution is as follows:

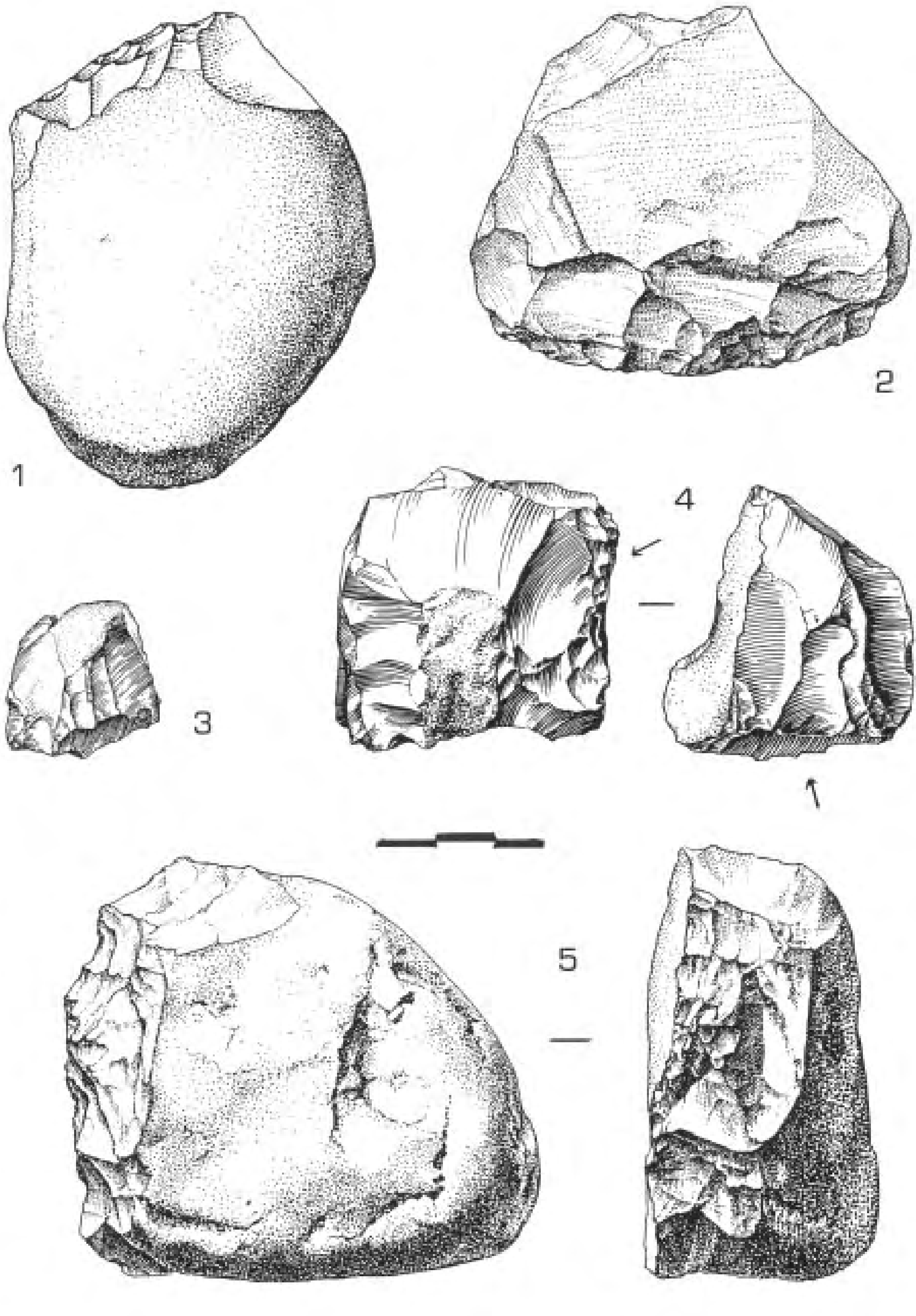

Fig. 25. Gombore I. Lithic industry from Level B. 1, 3, 5: heavy end-scrapers on pebble; 2: rabot; 3: double rabot. 1, 2, 5: basalt; 3, 4: obsidian. *Drawings by J. Chavaillon (1) and C. Chavaillon (2-5)*

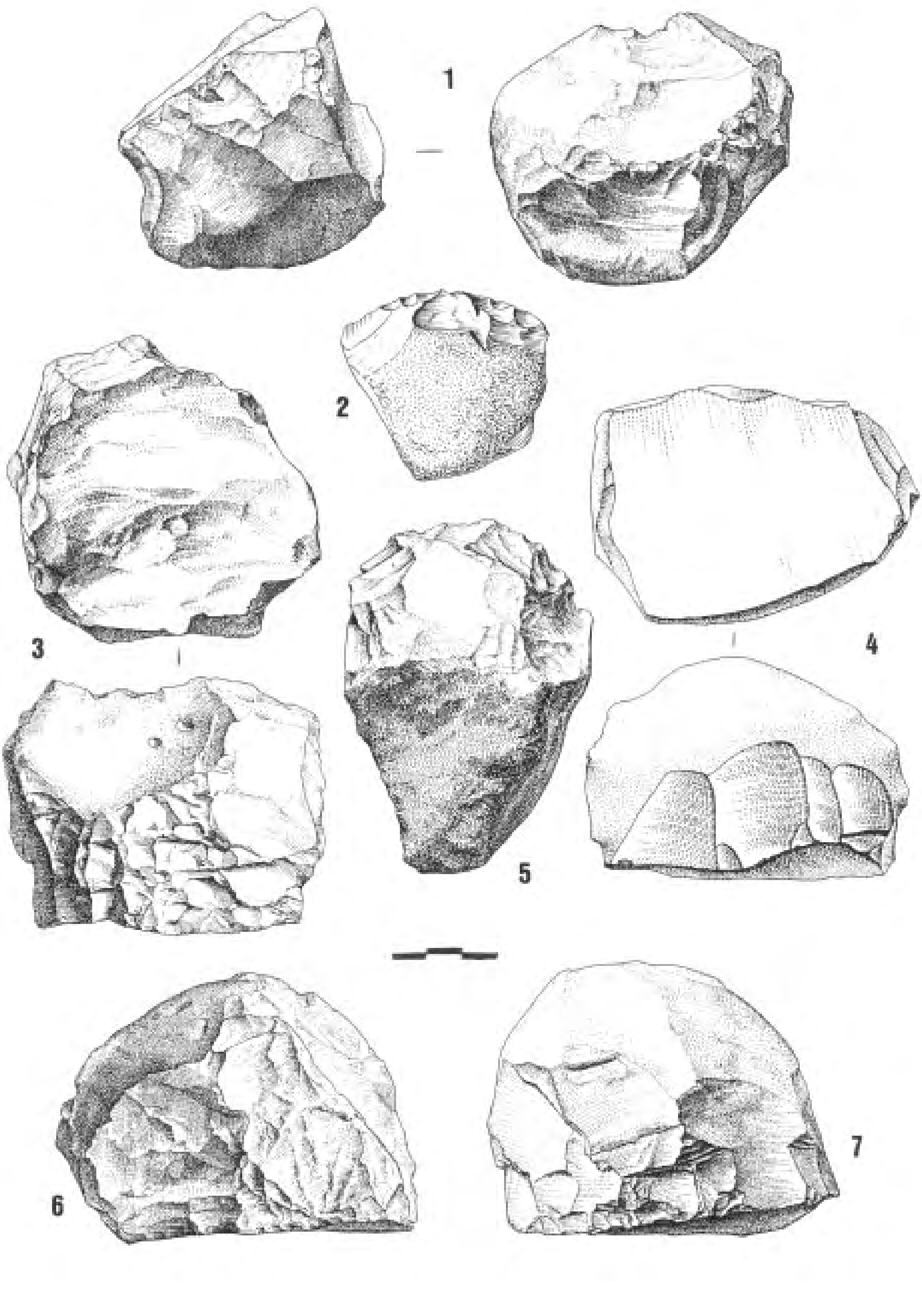

Fig. 26. Gombore I. Lithic industry from Level B. 1: unifacial truncated lateral chopper and rabot; 2, 5: heavy end-scrapers on pebble; 3, 4, 6, 7: rabots. Basalt. *Drawings by C. Chavaillon (1, 3, 5-7), J. Chavaillon (2) and J. Jaubert (4)*

Simple rabots	180
Double rabots	52
Triple rabots	8

Or from the functional aspect, 308 working edges for 240 tools.

Thus it is quite common to find double rabots (Figs. 25, *4*; 27, *6*) and even triple rabots that comprise 27% in sector 6 alone. Rabots, because of their repeated utilization, became blunted rather quickly and could not be re-sharpened easily. By creating a new working edge on the same tool, a replacement tool was made. It was an advantage to have a partially trimmed block as some removals for preparation of the first rabot were used in shaping the second. Was it to economise on raw material, or on work, or was there some other reason?

Raw material

Hard rocks are dominant and 71% of the rabots are of basalt. This indicates deliberate selection and a preference for hard rocks for this type of tool.

Morphology

Dimensions: Maximum length for 70% of the tools is between 80 and 110 mm and 35% are over 100 mm long. On the whole, rabots are larger than heavy scrapers. Nearly 80% of rabots have a maximum width between 60 and 100 mm. Finally, the maximum thickness for most tools is between 40 and 100 mm. One of the basalt triple rabots is 140 mm long, while an obsidian rabot is less than 60 mm.

Elongation: "Short" and "very short" tools are common, reaching 40%. Double or triple rabots frequently show this characteristic.

Flattening: "Thick" and "very thick" rabots are abundant (81%) while a few (1%) are "rather flat". Double and triple tools are mainly in the "very thick" rabots class (70%).

Shape: Pentagonal, hexagonal and polygonal outlines are dominant (70%).

Weight: Rabots are heavy tools: 70% weigh from 250 to 1000 g and 16% weigh over 1 kg. Double and triple rabots are mainly between 400 and 1000 g.

Shaping

The principle is the same as for heavy end-scrapers: a striking platform, natural or trimmed, serves as a base for the removal of a series of large adjacent flakes. In the case of double or triple rabots it can happen that certain flake removals were used to shape both rabots on the same tool. They are counted twice and both working ends of the tool are studied separately.

In fact, this shaping is a bit more elaborate than for heavy end-scrapers with 2 to 20 negative scars, but 75% of the rabots have from 3 to 8 removals.

Working edge

Like heavy end-scrapers, it is an abrupt edge that separates the platform from the face trimmed by vertical removals.

Ratio of active perimeter in relation to total perimeter, in the same plane: There is very clear resemblance to heavy end-scrapers and 40% of the rabots have an active perimeter which represents less than a third of the total perimeter.

Angle between basal platform and retouched edge: There is a narrow range for this angle and 94% are between 80° and 100°. As 60% are between 90° and 100° this is remarkably homogeneous and the rabot has an average angle of 90°. This is a technical and functional characteristic.

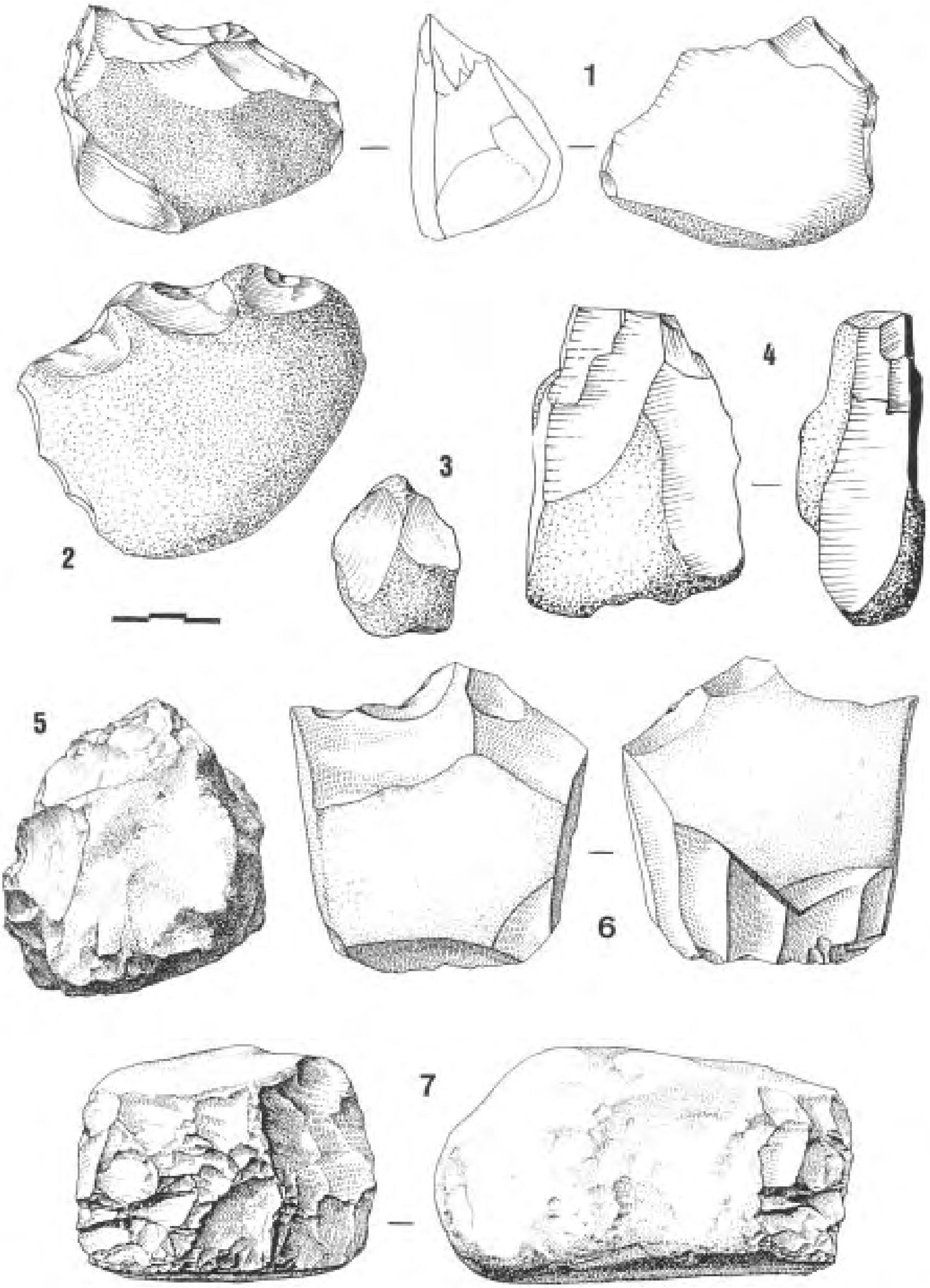

Fig. 27. Gombore I. Lithic industry from Level B. 1: heavy end-scraper on pebble and borer; 2, 5: denticulates on pebble; 3: casually trimmed chopper; 4: burin on pebble; 6: bifacial distal chopper and rabot; 7: rabot. 1, 2, 4-7: basalt; 3: trachyte. *Drawings by J. Chavaillon (1-4), C. Chavaillon (5, 7) and J. Jaubert (6)*

Working end of rabot: The ratio of the height h in relation to length l of the working edge (h x 100 / l) allows one to say whether the working end is low (heavy end-scraper) or high (rabot). Although some rabots have a working edge of average height, 60% are clearly high. On 3% of rabots the height is twice the length of the working edge.

Basal platform: This is used for shaping the working edge and flake removals start here to create the end-scraper working end. Moreover the edge of the platform on the retouched surface is the active part of the rabot. The platform is usually a fracture made at the start of shaping (72%). It is seldom formed by the removal of a few flakes and 22% of the tools have a natural platform (cortex or prior fracture).

The platform is generally flat or concave (more often slightly concave).

The active part of the rabot is the partial outline of the platform on a plane perpendicular to the working end. It can be:

Active part	**N**	**%**
Very convex	42	13.63
Convex	149	48.38
Straight	39	12.66
Concave	6	1.95
Angular (form of beak)	66	21.43
Irregular (denticulate)	6	1.95

The convex characteristic dominates with 62%, but the angular outline or a beak-shape represents 21%.

Utilization marks: There are utilization traces on the retouched edge of all but three tools. On the other hand, only 33% have marks on the retouched edge and platform surfaces at the same time and the marks are always clearer and more abundant on the retouched edge than on the platform surface. Most of the utilization marks were made by scaling but crushing also occurs. The two characteristics are complementary.

Of final importance here is an unusual characteristic for heavy scrapers, namely gloss on the working edge that gives a shiny and slightly blunted appearance to 19% of the rabots. Some zones have more of these tools than others and there are 36% in zone B and 26% in zone D. This gloss is probably linked to utilization. Was it from scraping skin, vegetable bark or large bones? These tools perhaps served the different activities equally, but tool dimensions certainly played a part in the function.

Special characteristics

Two tools from sector 1 have a similar appearance. They are formed like an elongated and slightly cylindrical pebble with one end truncated obliquely and shaped and retouched as a rabot. The manual handling is excellent.

In addition to the working end, a tool from sector 5 has two symmetrical fractures, one natural and the other intentional, that make it easy to hold.

Some rabots have a front and a working end reminiscent of a nosed/end-scraper in outline with clear lateral constrictions isolating the active part.

Multiple tools

The association of a rabot with another tool raises some questions concerning their order of utilization. The progression from core to rabot rests on the preparation of these tools. It was the same for choppers: first the core, then the tool, chopper or rabot. The functional order follows the technical order and they cannot be disassociated: the core precedes the tool. On the other hand, when it is an association of two tools such as chopper (Fig. 26, *1*), polyhedron or rabot, the functional order is not always the same:

whether one precedes or follows the other is neither evident, nor necessary to determine. Some shaping or utilization marks can occasionally suggest an order.

Spatial distribution

Zone B has few tools on pebble but numerous rabots: 16 on two neighbouring squares, Z / 24-25. These squares are also well provided with heavy end-scrapers, but zones A and C also yielded numerous rabots as the southern part of zone D.

Comparisons and conclusions

If the function of heavy end-scrapers and rabots is similar and their preparation is closely related, these two typological categories nevertheless have their own special characteristics. Most important for rabots, their high working end gives them a rather different function from that of heavy end-scrapers. The comparison of these two types allows a better understanding of their respective functions.

Raw material

Heavy end-scrapers, like rabots, are made of particularly hard rock, basalt, which accounts for 50% of end-scrapers and 71% of rabots. Obsidian is present for 8% of heavy end-scrapers. The choice of this vitreous but brittle rock implies a precise activity.

Morphology

Dimensions: The maximum lengths of rabots are higher than those of heavy end-scrapers. Thus, 35% of the rabots have a maximum length of over 100 mm, while only 16% of the end-scrapers fall into this length category. This contrast also applies to width. Finally, rabots have a much higher maximum thickness: for 57% it is over 63 mm, while this is the case for only 8% of end-scrapers.

Elongation: Rabots and end-scrapers are mainly “short” and “very short”. But “long” or “rather long” tools are better represented among heavy end-scrapers (34%) than in rabots (21.5%).

Flattening: This index points out some differences. Among rabots, 81% are “thick” and “very thick”. “Flat” and “rather flat” tools account for 1% among rabots and 29% among end-scrapers.

Shape: There is little difference in shape between these two tool types. Heavy end-scrapers often show an irregular outline, while rabots are usually hexagonal or polygonal.

Weight: As in the dimensions, weight is also higher for rabots. Thus, 12% of heavy end-scrapers but only 1% of rabots weigh less than 100 g and 16% of rabots and 2% of heavy end-scrapers weigh over 1 kg.

Shaping

Preparation is the same for rabots and heavy end-scrapers. A series of more or less regular removals were made from one platform that could be natural (cortical) or obtained by a kind of truncation. The removals are often long and adjacent, and they shape an abrupt and vertical edge for the rabot, but an inclined one for the end-scraper.

Number of removals: Double or triple end-scrapers are of course registered two or three times so there is a higher number of “functional” tools than objects. The number of flake removals ranges from 2 to more than 20. Thus, 40% of rabots and 53% of heavy end-scrapers are in the tool class with 2 to 5 removals. On the whole, rabots have more complex shaping.

Ratio of length of working edge in relation to total perimeter is similar in these two categories. The working edge occupies less than a third of the total perimeter in nearly 50% of both heavy end-scrapers and rabots.

Working edge

Working end of heavy end-scrapers: The ratio of the height *h* of the working end and of the length l (of the worked edge) was calculated as *h / l*. For 93% of heavy end-scrapers the height of the working end is clearly less than the length of the worked edge and 60% of rabots have a height that is greater than the length of the worked edge.

Basal platform: There are differences between end-scrapers and rabots. Nearly 40% of heavy end-scrapers have a natural platform that is cortical or on a prior fracture while only 22% of rabot platforms are in this category. A recent fracture is usually the origin of the platform (i.e., it is contemporaneous with tool manufacture) or may be trimmed by some removals. This is the case in 78% of the rabots and 60% of the heavy end-scrapers.

The angle between basal platform and working end of the end-scraper varies also: the most frequent angle is between 50° and 80° for 81% of heavy end-scrapers, while for 94% of rabots it is between 80 and 100°, with two thirds between 90° and 100°.

Thus these differences characterise two variants of a tool type that probably had rather similar functions.

Angle value	**Heavy end-scrapers**		**Rabots**	
	N	%	N	%
< 50°				
50° - 79°	75	80.65		
80° - 99°	18	19.35	289	93.83
> 100°			19	6.17
Number of cutting edges	**93**		**308**	

Angles of the platform / retouched edge for rabots and heavy end-scrapers.

Utilization marks

Utilization traces	**Heavy end-scrapers**		**Rabots**	
	N	%	N	%
Retouched edge +platform	15	18.07	84	33.20
Retouched edge only	68	81.93	166	65.62
Platform only		3	1.18	
Blunt	5	5.38	48	18.97
Scaling	65	78.31	222	87.75
Crushing	49	59.04	158	62.45
Total tools	**83**		**253**	

Characteristics of utilization marks on the working edge of rabots and heavy end-scrapers.

This study concerns 89% of the heavy end-scrapers and 82% of the rabots. The proportion of tools with utilization marks is similar from one typological category to another: about 9 tools out of 10 are well marked. These utilization traces affect the working edge either on the platform side or on the retouched surface (the working end of the end-scraper). Thus, the retouched surface nearly always has utilization marks. On the contrary, the same edge, platform side, is less frequently marked. This is the case for 18%

of the heavy end-scrapers and of 33% of the rabots. In fact, the action of scraping does seem to be the same, but mainly affects the working end of the end-scraper.

Unlike choppers, marks are mainly scaling rather than crushing, although both can be observed on the same tool.

Finally, some tools show some kind of blunting and gloss on the working edge in 5% of heavy end-scrapers, but in 19% of rabots. This gloss could possibly imply an action on vegetable matter such as grass.

Spatial distribution

It is not surprising that these two functionally similar tool categories are found in the same activity areas and same squares.

However, one particular sector, sector 4, zone B, was especially popular for activities using heavy end-scrapers and both end-scrapers and rabots are abundant there. For example, squares Z / 24 and Z / 25 have 20 heavy end-scrapers and rabots, and neighbouring squares C-Z / 24-27 have 67. This density of heavy end-scrapers is significant.

Conclusions

Heavy end-scrapers, well represented at Gombore I B, clearly show the characteristic of a technology and the manufacture and use of tools that was particularly well established in the Oldowan. Together with the knife and the hammer, the end-scraper was one the major tools of this Paleolithic industry.

Heavy end-scrapers and rabots are more characteristic of this period once the flake industry including end-scrapers was particularly well established. But, with the advent of the Acheulian and even more recent stages, the heavy end-scrapers progressively give way to end-scrapers on flakes. On the other hand, the rabot technique survives and improves. At Melka Kunture, the Upper Acheulian of Garba I yielded very fine rabots, in particular double or triple ones.

Diverse tools on pebble

The category of *diverse tools on pebble* is a kind of rag-bag, but it is necessary and interesting.

Category	1	2	3	4	5	6	7	Total N	Total %
Beaks	6	7	6+1	2		8	1	**30+1**	9.12
Burins	3	3	1		1	1		**9**	2.73
Notches	6	6+1	5	2		7	1	**27+1**	8.21
Denticulates	3	7	6	7	1	8	1	**33**	10.03
Side-scrapers	3	1	1	1				**6**	1.82
Truncated pebbles	3	1	2	2	1	2	3	**14**	4.26
Unifacials	1				6	1	1	**9**	2.73
Trihedral tools		5						**5**	1.52
Casually trimmed pebbles	22	27	43	22	7	37	25	**183**	55.63
Various tools	1		2	1				**4**	1.22
Broken tools	1	2	1		1	2	2	**9**	2.73
Archaic handaxes	3	1	3	2	1	3		**13**	
Tools with abrupt fracture	9	11	8	4	4	5	3	**44**	
Waste	33	8	9		8	2	10	70	

Spatial distribution of diverse tools on pebble, archaic handaxes, tools with abrupt fractures and fragments, for the 7 sectors.

Obviously they are not the classic categories of choppers, polyhedrons or scrapers, but, in this chapter, various categories of tools on pebble which could have been used as tools, are grouped together. There are also beak-shaped, truncated and unifacial pebbles. Curious objects that were perhaps not tools, such as archaic handaxes and tools with abrupt fractures, as well as waste or debris, were studied separately.

Casually trimmed pebbles, i.e. pebbles which have as few individual characteristics as those in the "retouched flake" typological category, represent 55%. Among the remainder, beaked pebbles, notches and denticulated pebbles will be analysed.

Beaked pebbles

This term is used for tools that, instead of a point, have a kind of beak that is obtained by creating a concave notch with lateral removals. They are the pebble equivalent of beaked flakes (Fig. 28, *4-9*). At Gombore I, these tools are rare (30 specimens). They represent only 1.57% of the 1909 tools on pebble (waste excluded).

Raw material

Trachyte and basalt are used most often. However, there is also a high proportion of obsidian with 23.3% but volcanic tuff and welded ignimbrite are absent.

Morphology

Dimensions: All the tools with extreme dimensions come from zone A. The maximum length ranges from 25 to 126 mm and 23% are between 70 and 80 mm long. The average width is between 50 and 70 mm. Maximum thickness is between 40 and 60 mm. It is interesting to note that the smallest tools are morphologically close to beaked flakes.

Elongation: There is some homogeneity. "Short" tools dominate, but there is a high proportion of long tools in this typological category.

Flattening: 80% of these tools are "thick" or "rather thick".

Shape and outlines: Nearly half of the tools have an irregular outline. Only 20% are pentagonal which is explained by the cutting of the beak which, when pronounced, creates an irregular outline.

Weight: The markedly heterogeneous weights include extreme values. There is no real selection of a particular dimension or weight, except where the use varied.

Shaping and utilization

The working, or rather the useful edge is reminiscent of that of heavy end-scrapers, but they are closer to heavy end-scrapers than rabots.

The angle between the basal platform and retouched edge ranges from 80° to 100° for 78.5% of beaked pebbles (with 46% between 80° and 90°). There are, however, 20% with an angle under 80°. Their use as scrapers was probably different from that of the pebble scraper class which has a higher angle.

The useful part, the working end of the beaked scraper, occupies 20 to 45% of the total periphery. It seems therefore that the beak was not used alone, but with both adjacent retouched edges as well.

The basal platform can be either cortical, on a fracture, or trimmed by several removals. It is usually flat: 67%.

The angle of the beak in the length/width plane ranges from 50° to 100° with 38% under 70°, which creates a rather sharp point, but 33% have an angle between 80° and 90°. These beaks are quite pointed although they are not classified as points or awls. The extremity is sometimes broken, which could indicate that the point was valued. Finally, some beaks resemble the working end of the nosed-scraper.

The shaping of the beak could be done by two notches (52% of the cases) or by a fracture and two removals, or by several abrupt removals.

Special cases: Two tools have a trihedral section at the point that makes the beak look like an awl (Fig. 28, *7*).

Utilization marks affect the notches, beaks and points differently. The ventral surface is only slightly marked by scaling but also crushing. Finally 10% of the tools retain a slight gloss on the extremity.

In sector 3 (zone A) four tools have a straight bevel by way of a beak, besides being very thin (Fig. 28, *9*).

On the whole, these beaks seem to have been used to scrape rather than pierce, but they are a more precise tool than the heavy scraper.

Spatial distribution

Beaked pebbles are mainly distributed in zone A: 63%.

Pebble burins

"Pebble burins" are tools manufactured on pebble fragments and which show a straight bevel obtained by a fracture or a removal. M D. Leakey reported such tools at Olduvai Gorge (Leakey 1971) but they are controversial. They are also found here, mainly in zone A, with only 9 tools, or 0.47% of total tools on pebble (Figs. 27, *4*; 28, *10*).

Raw material

Basalts dominate with 67%.

Morphology

Dimensions: With one exception, lengths are between 37 and 88 mm, and the average is about 60 mm. They are rather small, rather thin and mostly flat tools.

Elongation: The index shows that 45% of the burins are "short" and "rather short", and 34% are "long" and "rather long" tools.

Flattening: There is a majority of "rather thick" burins. What is left is distributed between "thick" and "rather flat" tools.

Shape: For the most part, the pebble burins are quadrilateral and 22% have a hexagonal outline. The shapes are often related to function. It may be recalled that quadrilateral shapes are rare among choppers and polyhedrons.

Weight: With the exception of one tool, they weigh between 35 and 250 g. These are light tools.

Shaping

These tools on pebble mainly resembe angle burins. The thin bevel was obtained by a fracture in the plane of the thickness of the pebble and by one or two vertical removals from this fracture. Sometimes, a prior fracture was used. One tool from zone C shows four removals with two crossed planes determining the active angle. It varies from 72° to 100° and the bevel length varies between 10 and 15 mm.

Utilization marks

All these tools show marks due to utilization on the thin bevel. There is crushing but also scaling.

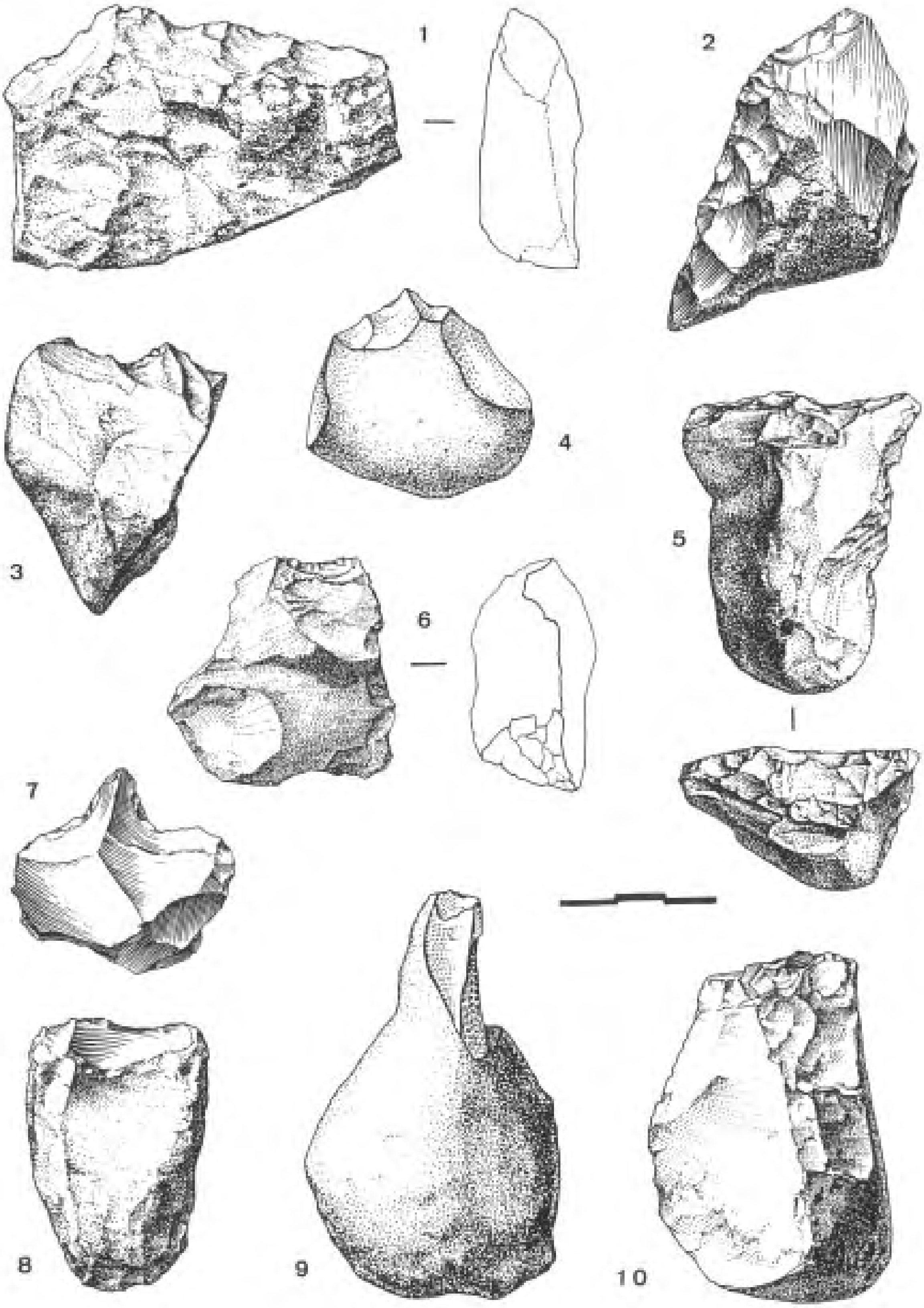

Fig. 28. Gombore I. Lithic industry from Level B. 1, 2: side-scrapers on pebble; 3, 6: notches on pebble; 4, 9: perforators on pebble; 5, 8: truncated pebbles; 7: borer on pebble; 10: burin on pebble. 1, 3, 5, 6, 10: basalt; 2: various volcanic rock; 4, 9: trachyte; 7, 8: obsidian. *Drawings by C. Chavaillon (1-3, 5-8, 10) and J. Jaubert (4, 9)*

Spatial distribution

All pebble burins come from the western part of the excavation and 78% of these tools were found in zone A.

Notched pebbles

As early as Oldowan times, notches and denticulates are quite common either on pebbles or on flakes. It is not surprising then, that 60 tools of this category were found in the excavation. These tools represent 3.14% of the total class.

Tools called "notched pebbles" are characterised by a notch which is usually both large and markedly concave (Fig. 28, *3-6*). Typologically and probably functionally, these tools resemble tools on flake, as well as those sometimes termed "hollow scrapers".

"Notched pebbles" are rare with 27, or 1.41% of the total tools on pebble.

Raw material

Curiously, it is not basalt (26%), but trachyte that is the most frequently used rock (52%). This contrasts with what is generally observed in other typological categories. Is it because the rock is softer? The notch could then perhaps be used as a rasp.

Morphology

Dimensions: The average arithmetical length is about 85 mm, but 26% have a length between 100 and 150 mm, surprising for a notched tool generally made on small blanks. Finally, the thickness, under 40 mm for 63%, indicates flatter tools than choppers.

Elongation: Compared with other tools on pebble, there is an exceptional proportion of "long" or "rather long" notches: 45%.

Flattening: "Rather flat" and "rather thick" tools reach 85%. This percentage indicates that the "flat" characteristic was quite sought after for this type of tool.

Shape: The irregular form dominates with 40%, but 25% are pentagonal which is low, but to be expected because of the concave notch.

Weight: Weights are very heterogeneous as indicated by extreme values (10 to 1442 g). Some 30% of the tools are light (10 to 40 g), and 50% weigh between 250 and 630 g.

Characteristic of the notch

Including one tool with two notches located on lateral and opposite edges, there are 28 notches.

Technically they started as clactonian notches of which some (21%) were trimmed by 2 to 3 removals.

1. Length of the notch varies from 12 to 55 mm, so:

Length (mm)	N
< 14 mm	1
15 - 19	7
20 - 29	8
30 - 39	8
40 - 49	3
> 50	1

2. Depth of the notch in 86% of the class is under 10 mm.

Depth (mm)	N
1 - 4	13
5 - 9	11
10 - 15	4

3. Index of concavity is an index obtained by multiplying the depth by 100 and dividing by the length (chord of the notch). The index is distributed as follows:

Index		N
< 10	very slightly marked	1
10 - 14	slightly marked	7
15 - 24	rather marked	13
25 - 39	marked	6
> 40	heavily marked	1

46% of the tools are “rather marked”.

4. Angle of the notch, formed by the meeting of the basal platform and the retouch of the notch concavity, varies from 70° to 100° but with a majority between 80° and 90°.
5. Base of the notch: most notches have a flat cortical surface as a base.
6. Utilization marks on notches, with one exception, are clear and often numerous. They are small scaling and crushing marks localized on the notch itself, but not on the cortical surface.

Spatial distribution

Notched pebbles are distributed in the north-west of the excavation. Zone A is preferred with 70% of these tools.

Denticulated pebbles

Tools called “Denticulated pebbles” have two or more adjacent notches roughly resembling “denticulated flakes” of the Middle Stone Age. Their use might be different, but the fact that they are pre-Acheulian or post-Acheulian hardly modifies the function. On the other hand, this type is closer to a tool with a series of notches than to a denticulated scraper. Its function seems linked to scraping (Fig. 27, *2-5*).

There are 33 tools, but 34 denticulated edges: one of the tools has two series of non-adjacent indentations. The class is small and represents 1.73% of all tools on pebble.

Raw material

Less common than in notched pebbles, trachyte is again used in preference to hard rocks such as basalt.

Morphology

Dimensions: These tools are rather large: 36% have a maximum length over 100 mm. The width is between 50 and 100 mm. The thickness ranges from 30 to 60 mm.

Elongation: Denticulates are both “very short” and “long”. However, more than a third is in the “rather short” category.

Flattening: Even more clearly than for the notches, the choice of “flat” or “rather flat” tools here exceeds 54%. The use of rather flat pebbles was undoubtedly preferred for making this type of end-scraper with deep denticulations.

Shape: Even if hexagonal shapes are common, irregular shapes dominate. The presence of adjacent notches, with an often well-marked concavity, creates a serrated outline which characterises the denticulated pebble class.

Weight: Extreme values range between 48 and 2760 g, but 30% of the denticulated pebbles weight between 250 and 400 g.

Retouched edge

From the functional point of view, there are 34 denticulates, one of which, a tool from zone D, has two series of indentations. The retouched edge with the indentations can occupy from 15 to 30% of the total perimeter.

1. Number of indentations: This class has between 2 and 5 indentations:

Indentations	**N**
2	11
3	13
4	6
5	4

2. The angle of the indentations varies from 50° to 95°. The dominant angle is 80° to 95° for 70% of the tools (88% for notched pebbles).
3. The lower surface, base or platform, can be cortical, but there is often a prior or recent fracture trimmed by other removals. This lower surface is flat or sometimes slightly concave.
4. Dimensions and concavity: the length of indentations is less than that of notched pebbles and ranges from 10 to 35 mm. Their depth varies by a few millimetres, but the concavity can be "marked".
5. Utilization or crush marks are not seen on all the indentations of these tools. They generally affect the retouched surface, but one tool out of three also has utilization marks on the lower surface that differentiates them from "notched pebbles".

Spatial distribution

The distribution is uneven but they are mainly found in zones A and C. B-26/27, A-27, Z-27, Y-26 yielded 7 tools of this type.

Pebble side-scrapers

These are side-scrapers made on a pebble blank, not a flake. They are closer to Acheulian than Middle Stone Age side-scrapers. They are exceptionally rare (Fig. 28, *1-2*) with only six specimens accounting for 0.31% of all tools on pebble. The established percentages are only indicative.

Raw material

Trachyte and basalt are the dominant rocks.

Morphology

Dimensions: These are small tools with a maximum length of about 60 mm. The thickness varies from 30 to 40 mm.

Elongation: Pebble side-scrapers are "rather long" and "long" (68%).

Flattening: Two thirds of the tools are “rather thick”. As a whole they are clearly made on flatter pebbles than the average tools on pebble.

Shape: A third of the side-scrapers have a triangular form, which is rare among tools on pebble.

Weight: These are light tools that weigh from 48 to 256 g.

Retouched edge

These tools have little retouch. The removals were obtained from a flat surface, either cortical (1 tool), an old fracture (2 tools) or a fracture created during manufacture (3 tools). The number of adjacent retouch flakes ranges from 2 to 6. Two thirds were retouched 3 to 4 times. The angle between the retouch and the lower surface ranges from 55° to 77°. Five of these side-scrapers have unifacial retouch, except for one tool from zone B which has bifacial retouch.

The length of the retouched edge in relation to the total perimeter ranges from 8 to 40%.

Like denticulated pebbles, there is a remote similarity between these side-scrapers and Stone Age tools on flake.

Spatial distribution

The distribution is selective: 5 side-scrapers are in zone A with 2 in squares F/G-27.

Truncated pebbles

These are pebbles with a generally transverse fracture that has been reworked by some removals or retouch. They can be compared to their equivalents “truncated flakes”. There are only 14 and they represent 0.73% of all tools on pebble (Figs. 28, *5-8*; 29, *2*).

Raw material

There is a clear predominance of basalt which accounts for 57%.

Morphology

Dimensions: These are quite large tools with 28% longer than 100 mm. The width is between 60 and 100 mm in 71%. Finally, the thickness ranges from 60 to 100 mm (57%).

Elongation: “Short” and “rather short” tools predominate, which is logical for this tool category. However, 21% of truncated pebbles are “rather long”.

Flattening: About 78% of these transversely truncated pebbles are “very thick” and “thick”.

Shape: The dominant shape is the broken ellipse.

Weight: Four tools out of 14 weigh over 1 kg, but 6 tools weigh between 400 and 630 g.

The truncation

In 13 tools the truncation is a fracture that has been reworked by two or more removals. One specimen has direct shaping on the cortical surface. The fracture is usually transverse (in the width/thickness plane), except for one tool in which the fracture is longitudinal in the length/width plane. Finally, one pebble has two transverse truncations which brings the total to 15. Most truncations were trimmed by 3 to 5 removals (73%).

The angle between the truncated surface and the edge of the pebble ranges from 85° to 105°.

There are numerous percussion marks (utilization) on the truncation edge as a result of some kind of hammering. These tools could have been used as linear hammerstones.

Removals	Tools
2	2
3	5
4	2
5	4
7	2

Spatial distribution

Truncated pebbles are present in all zones but most were found in the centre of the excavation, with 3 tools in D-25 and C-25/26.

Unifacially shaped tools

These rare tools (9) represent 0.47% of total tools on pebble. They are pebbles with one face (length/width plane) either broken and then retouched, or directly trimmed by flat convergent removals, giving a more or less flat surface. This preparation resembles that of Acheulian unifacial tools. Three tools out of nine keep a cortical area on the upper face.

Raw material

Basalts are not represented but "welded ignimbrites", that are rare or absent in other typological categories, comprise 45%.

Morphology

Dimensions: These tools are of average dimensions, 60 to 100 mm long.

Flattening: Unifacial tools are distributed between "thick", "rather thick" and "rather flat" categories.

Shape: The most frequent are the ellipse and polygon.

Weight: Minimum and maximum are 74 and 1067 g, but the majority lies between 250 and 400 g.

Shaping

In the case of 55% of these tools, they are only trimmed on one face that has been made flat or slightly convex by 5 removals. Sometimes 12 peripheral and convergent removals were necessary (Fig. 24, *1*). Two tools also have oblique removals that are the start of bifacial preparation. Seven tools are whole pebbles and two have old fractures that served as a striking platform for the shaping.

The angles formed by the removals and cortical edge (working or retouched edge) vary from 78° to 105° although the facets always create angles over 140°.

The use of these tools is uncertain. Utilization marks are rare and unconvincing. In fact it is reminiscent of the preparation of some Acheulian cores.

Spatial distribution

These unifacials are clustered in the centre of the excavation, in zone C (78%), where two thirds of the class are located in squares B/F-13/18.

Trihedral tools

These tools are similar to broken pebbles. They can on no account be compared to Acheulian trihedral picks. There are very few: only 5 tools, all coming from sector 2 (zone A).

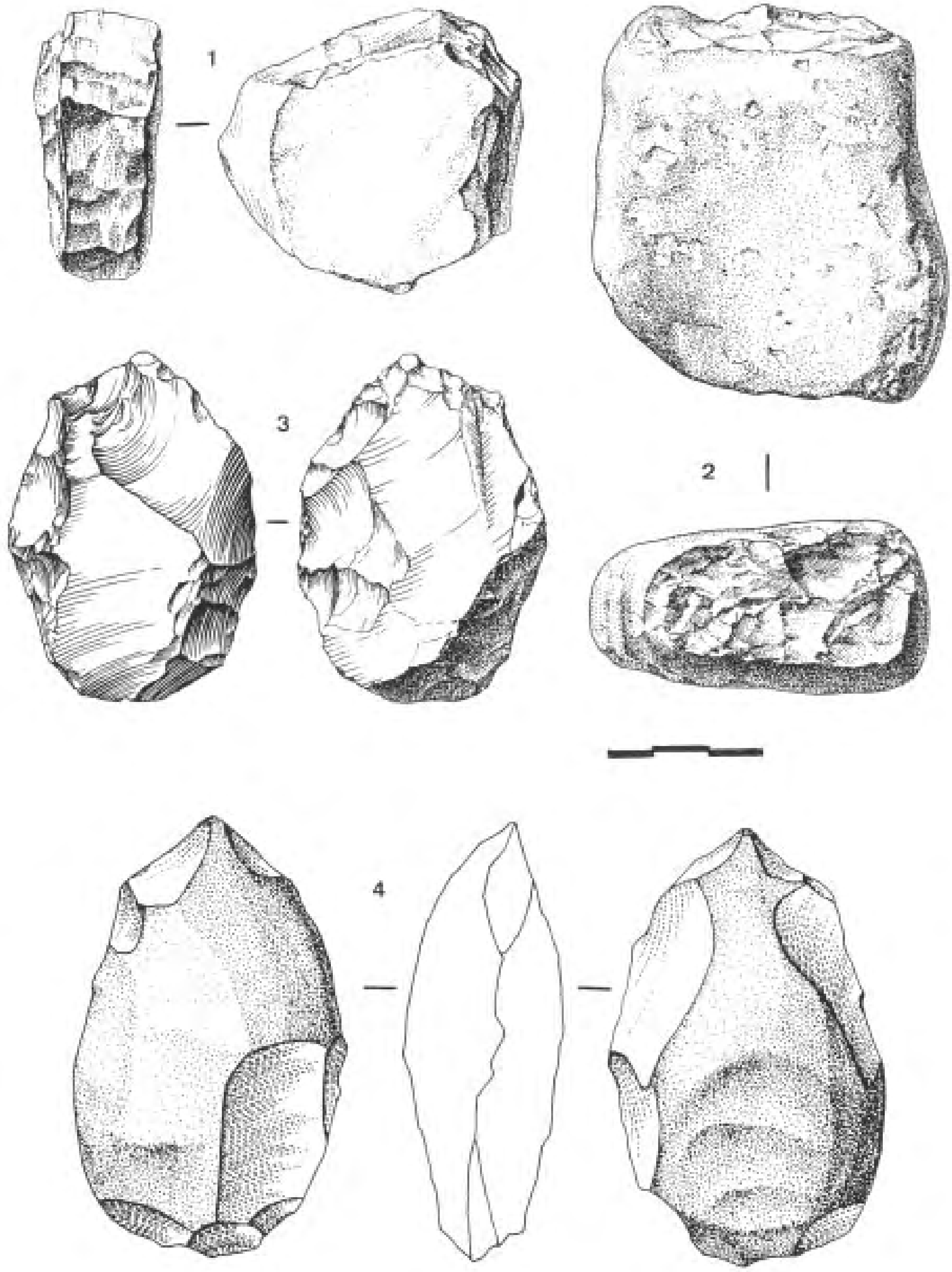

Fig. 29. Gombore I. Lithic industry from Level B. 1: tool with abrupt fractures; 2: truncated pebble; 3, 4: archaic handaxes. 1, 4: trachyte; 2: basalt; 3: obsidian. *Drawings by C. Chavaillon (1-3) and J. Jaubert (4)*

Raw material

Four tools out of five are of obsidian.

Morphology

Dimensions: Two tools are between 140 and 150 mm long. Extreme values are:

Length:	73 to 148 mm
Width:	39 to 95 mm
Thickness:	37 to 63 mm

Elongation: The index varies from "rather long" to "very long".

Flattening: Four fifth of the tools are "rather thick".

Shaping

Four tools have fractures on three faces. Three tools have a more or less pointed extremity of which one is broken. The best trimmed have from 6 to 14 removals. Edge angles are sometimes acute, sometimes right.

Utilization

As they are made of obsidian they are too fragile to have been used as picks, but the pointed end of trihedrals may have been used.

Casually trimmed pebbles

"Casually trimmed pebbles" are usually not classified, but show signs of probably intentional removals. They have sometimes been utilized and could be unfinished or unsuccessful tools. They are numerous, but have little significance. They perhaps represent mistakes, apprenticeship or lack of skill. With 183 specimens, this typological category, even if secondary, cannot be neglected (Fig. 27, *3*). These casually trimmed tools represent half of the diverse tools on pebble and 9.59% of total tools on pebble.

Raw material

Trachyte and basalt reach 73% while obsidian is very scarce (2%).

Morphology

Dimensions: Tools from zone A have extreme values; for example, length ranges from 32 to 195 mm. The mean for lengths is about 90 mm but 38% are over 100 mm long.

Elongation: 45% of the tools are "long" and "rather long".

Flattening: Casually trimmed pebbles are mostly "thick" and "rather thick" (87%).

Shape: Half of the class is pentagonal and hexagonal.

Weight: It is heterogeneous and ranges from 24 to 2500 g, with an average about 300 g.

Shaping

The shaping is basic, but there are some interesting characteristics.

The number of removals ranges from 1 to 7; most tools have 2 to 5 removal negatives.

The relationship between retouch or removals is as follows:

Adjacent	71.45%
Adjacent and not adjacent	18.85%

Not adjacent 9.70%

In other words 90% of these tools have adjacent retouch.

Removals	Tools
1	7
2	40
3	55
4	48
5	27
6	4
7	2

Removal or retouch location is:

On the same edge 47.40%

On opposite edges 52.60%

Nearly 38% of the retouch was from the same plane and 62% from different planes. All the removals and retouch have clear impact marks, except when it is a fracture. Then the impact is not always clear.

Utilization

Even when the sharp retouched edge was utilized, the traces left are slight and are present in only 31%. This scarcity of utilization marks can be linked to the condition of these tools. It is a heterogeneous group.

What were these casually trimmed pebbles? Were they:

- tools abandoned during shaping?
- rough tools or pebbles used as hammerstones?
- tools in which retouch, however casual and basic, was sufficient to create a working edge?
- the clumsy tools of a beginner?

In fact, these tools are reminiscent of well-known tool types such as hammerstones, cores, lateral choppers, distal choppers and rabots.

Spatial distribution

There is a concentration of 30 tools in four squares: A/B-25/26, with 15 tools in B-25 alone. It is effectively a stone flaking sector. There is also a less important concentration of about twenty tools in F/G-22/23.

Diverse tools on pebble

There are 4 of these tools that do not fit into any other category.

1 - Tools with abrupt retouch (2)

These two tools are not “tools with abrupt fractures”. Retouch forms an abrupt edge of 80°-88°. The retouched edge has impact marks with crushing and scaling. They are small tools that are 35 and 63 mm long. One of them is of trachyte, the other of basalt.

2 - Tools with retouch on a fracture (1)

This is a small broken pebble with a fracture which has 5 peripheral low-angled removals, and is therefore equivalent to a flake with retouch on the ventral surface.

3 - Tool with grooves (1)

Of volcanic tuff (ignimbrite), this oblong pebble 100 mm long, has two grooves on one face. They start at opposite ends but do not join. This tool is reminiscent of some manual polishers from the last few thousand years. This curious tool is undoubtedly *in situ* in the Oldowan level.

Broken tools on pebble

These 9 tools were trimmed on pebbles. Then, they were broken during manufacture or use. Sometimes, the original typological character can be recognised.

Raw material

Most of the raw material blanks are of basalt.

Morphology

These measures are only an indication as the tools are broken.

Dimensions: The nine specimens show a great variety in size, ranging from 40 to 120 mm in length.

Other measures: Two thirds are "rather thick". The present outline is pentagonal or polygonal.

Weight: 25 to 100 g.

The fracture

In eight of them, the fracture is simple and only one has two fractures. Once broken, these tools were trimmed by a series of removals. On the fragments there are traces of 4 to 7 removals, some of which are chipped again by the fracture. Four of the tools are not classifiable, but 5 can be related to:

Choppers	1 tool
Polyhedrons	3 tools
Choppers or cores	1 tool

Most of these broken tools do not seem to have been used after their fracture. Only one shows some marks (retouch, scaling?) on the fracture ridge.

Spatial distribution

Broken tools on pebble are scattered throughout the excavation.

Archaic handaxes

Archaic handaxes

The archaic handaxes were shaped on blocks or pebbles. "The protohandaxe is, morphologically and technically, an intermediary tool between the chopper and the handaxe" (Berthelet and Chavaillon, in Leroi-Gourhan 1988, p. 904). It shows one or two sinuous edges as well as a rough axial symmetry. Mary D. Leakey notes it in Upper Bed I as well as in the base of Bed II at Olduvai in Units 1, 2, 4 FLK North and 3, 4, 5 HWK East (Leakey 1971).

At Gombore I B there are 13 such tools that represent only 0.68% of all tools on pebble. Nine archaic handaxes are reproduced (Figs. 29, *4*; 30; 31). However, some are archaic handaxes (Fig. 30, *1-3*), while others are true handaxes (Figs. 29, *3*; 31, *1-3*). Seven tools out of thirteen were found in zone A. This study was carried out according to the method established for African handaxes by J. Chavaillon and A. Berthelet (Berthelet 1999, 2002; Chavaillon 1979a).

Raw material

These handaxes are distributed as follows:

Trachyte	2

Basalt	1
Tuff	4
Obsidian	6

Obsidian is the most sought-after rock for this type of tool with 45% (Figs. 29, *3*; 30, *1*, *2*, *4*; 31, *2*, *3*). During the Acheulian at Melka Kunture obsidian was often preferred for the manufacture of handaxes, for example at the site of Gombore II, *localities 1* and *5*.

Morphology

Dimensions: For 61%, the maximum length is in the 70-90 mm range, with exceptionally large and small tools (extreme values: 50 to 126 mm). The maximum width for nearly half of the class is in the 50-60 mm range. Finally, the mean thickness for 38% is in the 30-40 mm range.

Elongation: The length/width index is distributed as follows:

L/w		Tools
1.15 - 1.29	rather short handaxes	4
1.30 - 1.59	rather long handaxes	7
1.60 - 2.19	long handaxes	2

The elongation index ranges from 1.21 to 1.75.

Flattening: According to the ratio length + width divided by twice the thickness (see Methodology in this volume), handaxes are distributed as follows:

Index		N
1.25 - 1.49	thick handaxes	1
1.50 - 1.99	rather thick handaxes	7
2.00 - 2.99	rather flat handaxes	5

The F. Bordes flattening index (maximum width divided by the thickness) indicates that all the handaxes fall within the “thick” handaxes category, that is to say handaxes for which the index is less than 2.35 (Bordes 1961).

The position of the maximum width or thickness in relation to the length of the tool, i.e., situation of width and maximum thickness in the proximal, medial or distal parts of the handaxe (see “Methodology” in this volume), is summarised below:

Part of the handaxe	Width	Thickness
Distal sector		
Mesio-distal sector	1	1
Mesial sector	8	9
Mesio proximal sector	3	4
Proximal sector	1	

There is thus a certain symmetry with maximum width and thickness placed mostly in the medial sector with a fairly pronounced tendency towards the medio-proximal sector. This tallies well with the following handaxe characteristics:

Shape: We note a certain variety:

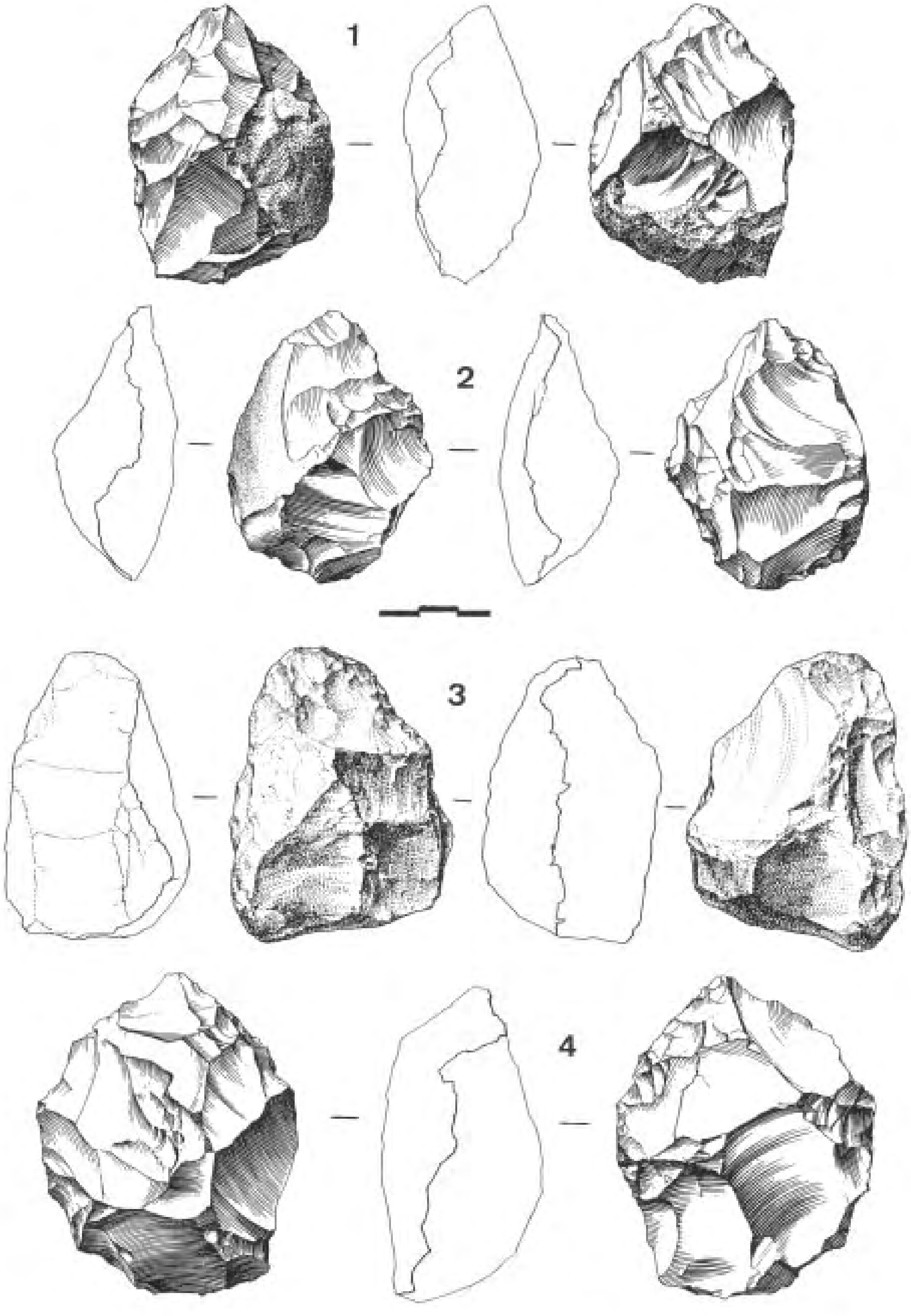

Fig. 30. Gombore I. Lithic industry from Level B. 1-4: archaic handaxes. 1, 2, 4: obsidian, 3: tuff.
Drawings by C. Chavaillon

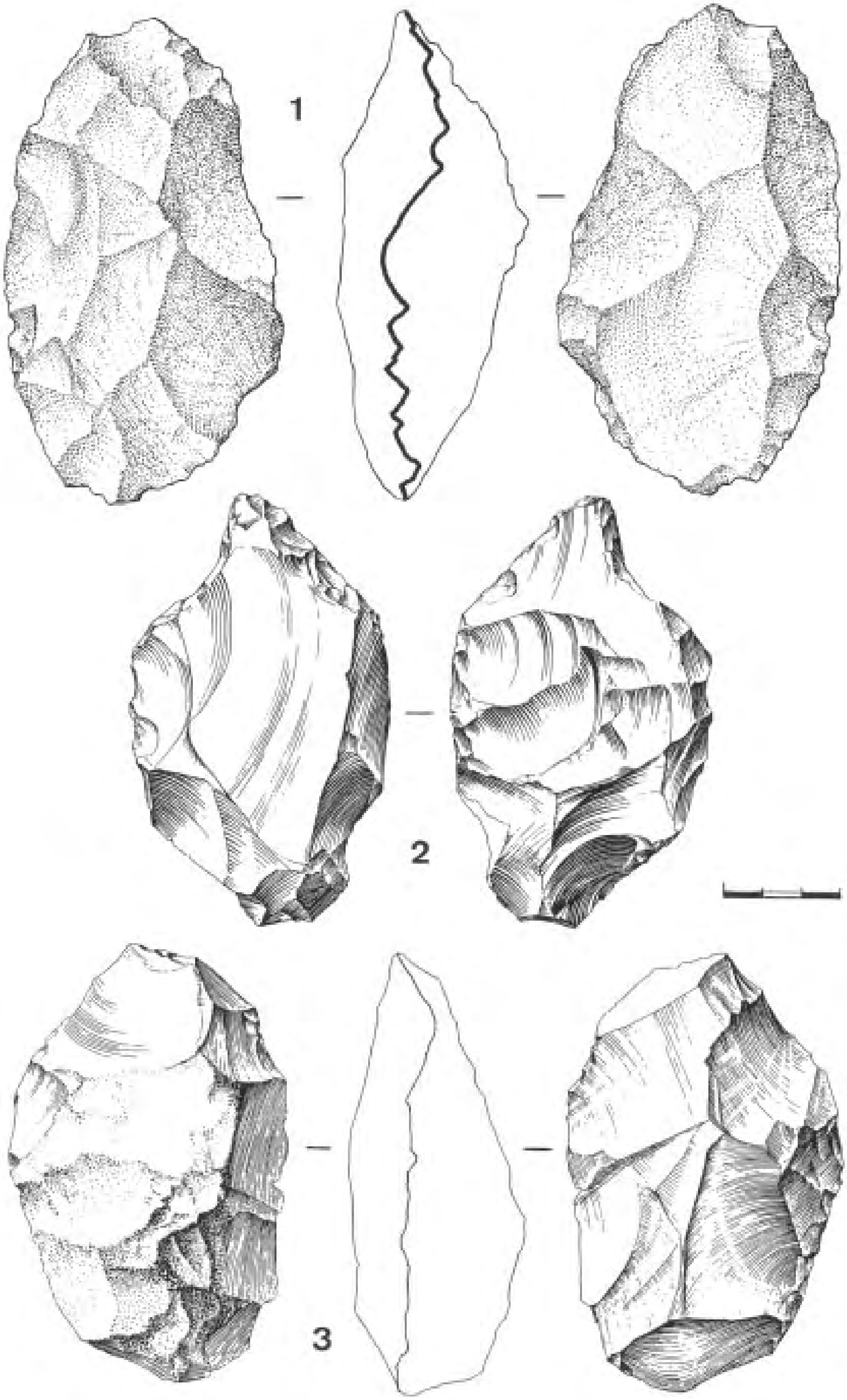

Fig. 31. Gombore I. Lithic industry from Level B. 1, 2, 3: archaic handaxes. 1: basalt; 2, 3: obsidian. *Drawings by J. Jaubert (1) and C. Chavaillon (2, 3)*

Shape	N
Circular	2
Cordiform	3
Ovate	2
Elliptical	1
Pelecyform	1
Irregular	4

The “elliptical handaxe” is what Fr. Bordes calls a “limande handaxe”, that is to say a very elongated ovate handaxe. In fact, apart from this particular tool with its elliptical outline and thickness, regular outlines and true symmetry hardly exist.

Form of the distal extremity:

Pointed	5
Ogival	3
Angular	2
Semi-circular	3

8 tools out of 13 have a pointed or ogival extremity, that is to say rather sharp.

Form of the proximal extremity:

Straight	5
Angular	6
Semi-circular	1
Irregular	1

Unlike numerous Acheulian handaxes which have a semi-circular base, 11 tools out of 13 (85%) have a thin or angular base.

The thickness of the base is also significant. Archaic handaxes of the French Lower Acheulian often show a globular and thick base. Conversely, European or African Upper Acheulian handaxes often have a very thin and sharp base.

Very thick base	6
Thick base	7
Thin base	0

Even if the maximum thickness is often in the medial part, the base always remains very thick. It is, not surprisingly, an archaic characteristic.

Weight: The weight of handaxes is classified according to a semi-logarithmic progression (as with other tools). It ranges from 35 to 420 g:

Weight (g)	N
25 - 39	1
40 - 62	0
63 - 99	3
100 - 159	4
160 - 249	2
250 - 399	2
400 - 630	1

They are, on the whole, rather light tools and more than half of them weigh from 60 to 160 g. One of the heaviest is a true handaxe (Fig. 31, *1*) which belongs to the F. Bordes “Abbevillian type”.

Shaping

Blocks and pebbles were used systematically. There are two stages of preparation that can be recognised from primary removal negatives and, for ten tools out of thirteen, by secondary removal negatives, that indicate a reasonable stage of development. Only four tools were retouched three times.

There are never more than five primary removals and secondary removals do not exceed eight. In fact, except for some more elaborate and typical tools that can be termed handaxes, the other tools are definitely in the category of archaic handaxes, which are close to choppers with a peripheral working edge.

Number of removals	Primary Upper face	Primary Ventral face	Secondary Upper face	Secondary Ventral face
1		2 handaxes		2 handaxes
2	1 handaxe	2 handaxes	2 handaxes	1 handaxe
3	4 handaxes	3 handaxes	3 handaxes	1 handaxe
4	6 handaxes	5 handaxes	2 handaxes	2 handaxes
5	2 handaxes	3 handaxes	2 handaxes	2 handaxes
6				1 handaxe
7				
8			1 handaxe	

Primary and secondary removals observed on faces A and B of each handaxe.

All these removals seem to have been made with a hard hammerstone, that is to say a rock, as in the preparation of choppers.

The shaping of the surfaces has sometimes changed its original aspect. The present surface can be flat, convex or angular:

Aspect of the surface	Upper face	Ventral face
Flat		1 handaxe
Convex	3 handaxes	2 handaxes
Angular	10 handaxes	10 handaxes

The “angular” shape dominates with 77%, which indicates a rather roughly worked face with a median ridge that is often at a very obtuse angle.

This characteristic is reinforced by the cross-section of the distal extremity that can be triangular (1), plano-convex (1) and especially lozenge-shaped (11).

Various characteristics

Patina is distributed in three stages with an added stage 0 for tools without patina. All handaxes have a heavy patina (stage 2); however, on two of them there is a lighter patina on one of the surfaces (stage 1).

The “blunted” characteristic of ridges and surfaces was studied on only 9 tools and there are four stages from 0 to 3:

Blunted stage	Upper face	Ventral face	Edges
Stage 0	6 handaxes	2 handaxes	5 handaxes
Stage 1	1 handaxe	6 handaxes	1 handaxe
Stage 2	3 handaxes	3 handaxes	2 handaxes
Stage 3	2 handaxes	1 handaxe	4 handaxes

A feature that is often observed is that edges are less blunted than surfaces and there is little difference between the lower and upper surfaces. In fact, one third are not blunted and half are only at the lowest stage.

There are four categories of tools according to the absence or partial presence of cortex on 12 tools that were studied: 0 = Absence; L = Slightly marked; M = Marked; V = Heavily marked:

Cortex	Upper face	Ventral face	Base
Stage 0	6 handaxes	2 handaxes	5 handaxes
Stage L	1 handaxe	6 handaxes	1 handaxe
Stage M	3 handaxes	3 handaxes	2 handaxes
Stage V	2 handaxes	1 handaxe	4 handaxes

The presence of cortex is quite well marked but is variable. On the whole, tools have been quite carefully trimmed, as proved by the relatively large number of facets. Even the base is often without cortex, which indicates rather elaborate preparation.

Function and retouched parts of the handaxe

Outline: In the length/width plane of the upper face, edges can have various outlines.

While 58% of the edges are convex or very convex, 31% are irregular. This last characteristic is uncommon among Acheulian handaxes.

Outline	Left edge	Right edge	Total
Straight	1	1	**2**
Convex	5	3	**8**
Very convex	4	3	**7**
Concave		1	**1**
Irregular	3	5	**8**

Sinuous edges in the length/thickness plane: Using the sinuosity index, 20 edges out of 26 have been measured. The distribution is as follows:

Curved edge	1
Slightly sinuous edge	3
Sinuous edge	12
Very sinuous edge	4

On 80%, edges are sinuous or very sinuous. This archaic characteristic is well represented among the first handaxes. One of the edges has a very elongated curve or S-twist. However, handaxes with twisted edges in the Middle Acheulian at Gombore II or at Langano have little in common with this tool.

Both edges may show identical curves but sometimes one is more sinuous than the other.

Active and passive areas: The total perimeter (PC), usable perimeter, or retouched edge (PU) and the perimeter that seems to have been used (PUT), were measured.

The ratio of the usable perimeter (which could have been used) multiplied by 100 and divided by the total perimeter (PC) documents the technique and function. Thus 25% or 50% of the tool could have been used. For ten handaxes:

Possible utilization	40 - 49%	2
	50 - 74%	4
	75 - 90%	4

The ratio of the used perimeter (which has utilization marks) to total perimeter indicates a length that does not exceed 70% of the total perimeter of the handaxe.

The ratios between usable and actually used perimeters indicate that a third of the archaic handaxe edges have been used at only 50% of their potential. It may be surprising to note that edges which had the potential for 90% use, were always under-utilized. A few handaxes similar to choppers with peripheral retouched edges do indicate, however, some technical and functional evolution.

Angle of the edges (ratio between two faces): this angle was measured on 18 edges:

Angle	Edge
40° - 55°	1
55° - 70°	3
70° - 85°	8
85° - 95°	6

These values are not the same as those of Acheulian handaxes, but they do fall within the range of the dominant angle of choppers: 70° to 100°, or here 82%.

Utilization marks are distributed in four stages: 0 = Absent; L = Slightly marked; M = Marked; V= Heavily marked:

Stage	Upper face		Total	Ventral face		Total
	Right edge	Left edge	edges	Right edge	Left edge	edges
O	2 handaxes		2 handaxes	1 handaxe	4 handaxes	5 handaxes
L	3 handaxes	4 handaxes	7 handaxes		3 handaxes	10 handaxes
M	3 handaxes	3 handaxes	6 handaxes		1 handaxe	1 handaxe
V		1 handaxe	1 handaxe			

This table shows that 44% have utilization marks along the edges of the upper surface, while these same edges on the lower surface are less clearly marked (6%). This could indicate that the retouched edge was not used vertically as an axe, but obliquely as a scraper.

The two surfaces along the same edge always differ: for example O and L or L and M. There is a certain symmetry between the right and left edges (37%) but sometimes the right edge is clearly marked on the upper face and not on the lower and conversely for the left edge. This alternation is often seen in the Acheulian handaxes at Melka Kunture. The tool could have been used successively on one edge and then the other.

Although they are small, some of these tools may have been picks and others look like knives, which are all uses attributed to handaxes. But the archaic handaxe – was it something else?

Spatial distribution

Handaxes are found all over the site, but groups are clustered in sectors of principal activity. For example there are 2 tools in Z/26, 2 tools in G-H/26, and 3 tools in H/14, H/16 and G/15.

Conclusions

From the raw material point of view, 46% of the tools are of obsidian. The dominant length is between 70 and 80 mm. These tools are rather short or rather long, rather thick or rather flat. But according to F. Bordes' index, all these handaxes belong to the category of thick handaxes. In outline they are cordiform, circular, and irregular. The distal extremity is pointed or ogival, while the proximal end is straight or angular. Finally, the base is always thick.

The shaping was made with a hard hammerstone. There are few, if any, primary and secondary removals. The section is usually lozenge-shaped.

Light in weight, these tools have little patina, are slighlty blunted or not at all, retain areas of cortex and occasionally have none. Edges are convex or irregular and when seen in profile they are sinuous and even very sinuous.

Surprisingly, the retouched edge can occupy 90% of the perimeter, but the part that has actually been used does not exceed 70% of the total perimeter, which is notable. On the other hand, the angle formed by the meeting of the two faces is close to that of choppers (80°-90°).

Regarding utilization marks, some edges are marked while others have no traces. It seems that they had different uses, such as knives, picks, etc. Unusual tools, sometimes in groups of two or three, these archaic handaxes still lack a clearly defined function.

Artefacts with abrupt fractures

Artefacts with abrupt fractures

These are pebbles or fragments of pebbles which often have two more or less flat parallel surfaces. Partly peripheral and abrupt fractures (Fig. 28, *1*) originate from these surfaces. There are 44 such pieces that represent 2.22% of the total lithic material on pebbles (waste included).

Raw material

Obsidian and vuggular lava are not represented, whereas welded ignimbrites, elsewhere very rare, are common with 18.2%. Finally, half the group is of trachyte.

Morphology

Dimensions: The arithmetic average of the maximum lengths is around 70 mm; only 11% are over 100 mm. Thickness is under 40 mm (75%).

Elongation: About 70% of these tools fit into the "very short", "short" and "rather short" categories, even though 30% are "long" or "rather long".

Flattening: These are "rather thick", "rather flat" and "flat" tools, which is in harmony with their tablet-like appearance.

Shape: These tools often have an irregular outline (32%), but hexagonal and pentagonal shapes are also common.

Weight: Weights are rather low and 73% of the tools weigh between 40 and 250 g.

Fractures

The number of fractures or removals ranges from 2 to 10:

Fractures	Tools
2	2
3	9
4	11
5	10
6	7
7	3
9	1
10	1

Most (84%) of the tools have from 3 to 6 fractures. All have adjacent fractures but a quarter of the class also have non-adjacent fractures.

The angle of the fracture varies from one fracture to another:

Angle	%
70° - 79°	5
80° - 89°	33
90° - 99°	45
> to 100°	17

The impacts that created the fractures could have come from one or both faces. These tools nearly always have two flat parallel surfaces from which the impacts originated, mostly from one cortical surface. The impact is always clear.

Surface obtained by fracture	18.20%
Cortical surface and face obtained by fracture	2.25%
Surface showing a prior fracture	6.80%
Cortical face	72.75%

The fractures can be straight, convex or concave. They are mostly concave or very concave, but they can also be straight. One tool shows alternation from one face to the other and another tool shows bipolar removals.

Utilization

Out of 44 tools, only 8 (18%) have marks attributable to utilization, either crushing or scaling. These marks can be accidental. In fact, nothing proves that they are tools, although they are not due to chance. The following hypothesis can then be made:

- These small tablets or blocks of average size (70 mm) could have been the base, or the intermediate blank, of the tool they wanted to shape. For example, the extremity of a tool (stone, wood, bone) that was to be flaked, broken or scraped was put onto this tablet. A hammerstone was then applied if a block of stone was to be shaped, or crushers would be used on bones or wood, or a scraper might be used on bark, branches or bone. But whatever had to be worked on could be placed on a stone tablet or block. The effect on the latter could be flaking, but mostly fractures. What is found on these objects could be those accidental fractures. They would probably be discarded after use.
- They also could be testing stones for a hammerstone: for example, before striking on the good quality material, it was better to try on another stone. This would explain the relatively small size of these objects, although of course they might have been larger before receiving from 2 to 7 fractures.

Spatial distribution

A high proportion (63%) of these tools are in zone A and are sometimes clustered: for example, there were six specimens in G / 26-27 and F / 27, as well as in B / 26-27 and A / 26.

Fragments or debris

Fragments or debris

Waste or debris includes rejected blocks or fragments of indeterminate tools. There are 70 pieces that represent 3.54% of the material on pebbles.

J. Chavaillon

The difference between waste and debris is difficult to appreciate. At Gombore I, waste includes tools that lost their technological qualification and became unusable. Debris is what remains after utilization or after a technical accident. It is also a fragment of a tool, but at a more advanced stage than “broken tools”. They are quite easily distinguished from broken pebbles with several fractures, because waste and debris have removal scars from preparation or shaping. Most of the time they are products of exhaustion.

Raw material

Obsidian is exceptionally common (77%) and basalts represent only 15%. For the sake of economy, the rock was flaked and used to the utmost. This can explain the abundance of obsidian, which was very sought-after.

Morphology

Dimensions: The maximum length is low with 60% between 20 and 40 mm long and 51% have a maximum thickness between 10 and 20 mm.

Elongation: The class of debris considered as “long” is well represented with 64%, mainly in the “rather long” category.

Flattening: Nearly half are “rather thick tools” and 26% are “rather flat tools”.

Shape: Waste products with pentagonal or hexagonal outline dominate (60%).

Weight: Extreme values go from 4 to 165 g, but 63% of the tools weigh under 25 g.

Special characteristics of waste

Even if the term “shaping” is not exact, the number of removals nevertheless ranges from 4 to 13. Most of the objects have negative scars of 6 to 8 removals.

With so many removals, it is surprising that there are still one or two areas of cortex on nearly half of the class.

The angle between facets ranges from 55° to 135°, with most between 70° and 90°.

Finally, utilization marks are really exceptional. Two tools out of 70 were probably used before becoming waste. However, doubtful marks were found on 12 of them.

Spatial distribution

There is a considerable quantity of these tools in zone A, for example in F-G-H / 25-26-27 where 20 out of 70 are located.