THE LOWER AND MIDDLE PALEOLITHIC IN THE UPPER ZARQA/ KHIRBET SAMRA AREA OF NORTHERN JORDAN: 1982-83 SURVEY RESULTS

by
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Introduction

Two seasons of survey work were carried out in 1982 and 1983 by the R.C.P. 438 (now E.R.A. 1036) team of the C.N.R.S.,[1] in part of the Jordan catchment: the River Zarqa drainage basin north of Amman, as reported in a preliminary outline.[2] Our aim was to find sequences of fluviatile terraces containing Paleolithic artefacts, from which relative local chronologies could be set up. Using a combination of prehistoric and geomorphological studies of these terraces, we hoped to reconstruct the evolution of the Middle and Late Pleistocene in this part of northern Jordan.

We were interested in a certain kind of riverside terrain: banks of rounded, water-worn pebbles, gravels and soils perched as benches above the flood-plains of rivers and *awdiyah* (wadis); these have been recognised by geomorphologists as the remains of the cut and fill (erosion and accumulation) cycles of the Quaternary Glacial (or Pluvial) and Interglacial (or Interpluvial) phases.[3] Most often the terraces are invisible at the surface under layers of agricultural soil, but they can be seen in section at points where the river has truncated part of the terrace, or where road or rail cuttings have been made. A preliminary reconnaissance in Jordan to find a suitable area was carried out by J. Besançon, F. Hours and M. Muheisen in 1981. At the request of the Dominican fathers of the *Ecole Biblique* in Jerusalem, this included the area of Khirbet Samra, 15 km. north-west of the town of Zarqa, where, during the course of their excavations at this Classical site,[4] they had noted handaxes and other flint artefacts on the surface. Together with J. Sapin in 1982, they had collected these and generously turned the collections over to us for study. Although not strictly a fluviatile surface, the basalt bluff upon which Khirbet Samra was built was, however, surrounded by *awdiyah* (tributaries of the Dhulail), the banks of which consisted of Pleistocene terraces, and so this sector was included in the survey.

The areas surveyed form three broadly distinct zones (see map, Fig. 1):

1) The first is the valley of an important upper Zarqa tributary, the Wadi Dhulail, for about 15 km. upstream from its confluence with the River Zarqa; this zone includes the basalt bluffs of Khirbet Samra and the area drained by the Dhu-

[1] The team consisted of J. Besançon, J. Macaire and P. Sanlaville (geomorphologists, JB and JM from the Université Rabelais, Tours and PS from the Maison de l'Orient, Lyon) and L. Copeland and F. Hours (prehistorians, LC from the London Institute of Archaeology, FH from the Maison de l'Orient, Lyon). We had the valuable assistance of our Representative, mr. Mohammed Osman, and we are most grateful for the support given by Dr. Adnan Hadidi, Director-General of Antiquities, and all at the Department of Antiquities, Amman.

[2] J. Besançon and F. Hours, Prehistory and Geomorphology in Northern Jordan, *Studies in the History and Archaeology of Jordan,* vol. 2., (in press).

[3] J. Besançon, Chronologie du Pléistocène au Levant: synthèse; in J. Cauvin and P. Sanlaville (eds.), *Préhistoire du Levant,* Paris, 1981, p. 145-153.

[4] J. B. Humbert, Khirbet es-Samra, une ville du *limes arabicus* et sa commaunauté Araméene, in F. Villenueve (ed.), *Contrtibution Française a l'archéologie Jordanienne,* Dijon, 1984, p. 40-43.

lail's own tributaries, many of which arrive from the north (for example, Wadi Qara and Wadi Bellama). The Dhulail is not completely perennial (its bed was dry in September 1982 and 1983), and its water derives ultimately from the Jebel ed-Druze across the Hauran. According to Humbert the village of Khirbet Samra is at the limit of rain-fed agriculture today.[5] It commands a very ancient north-south route as well as the start of an eastward route to Azraq.[6] The area today consists of low plateaux and shallow steam valleys.

2) The second zone comprises the region of the confluence of the Dhulail with the Zarqa river. The Zarqa is a perennially flowing tributary of the Jordan which here begins to change the direction of its flow from northward to westward, below the basalt-covered Dauqara plateau. The relief is more pronounced here, and affluents (such as the Sayih-Saidah, a Dhulail tributary) enter the main valley between basalt-capped *mesas* (e.g., Jebel Bakiya). The river is constricted in the El-Hashimiya area, and has cut a narrow passage between the basalt and the limestone bedrock.

3) The third zone is the valley of the River Zarqa downstream of the confluence with the Dhulail for about 5 km. to El-Bire village (the stream flowing generally northwestwards) and then for another 5 km. to where it makes a turn at the Quneia "elbow" to flow southwestwards toward the Jordan Valley. Well-defined suites of gravel terraces occur here, and in many places they are being quarried for road-metal, cement, etc., or are being "landscaped" into broad agricultural terraces by earth-moving machinery; these often cut vertical sections which reveal the ancient terrace stratigraphy.

The above-mentioned three zones were chosen (in preference to areas in the Jordan valley proper) as suitable for research into the fluviatile sequence on several grounds. Firstly, in our experience of terraces in Lebanon and Syria[7] we had found that in tributary valleys, rather than in the valley of a large main river, the fluviatile deposits stood a better chance of surviving the forces of erosion and dismantling than did the main stream terraces. Secondly, we thought that the area was sufficiently upstream in the Jordan drainage system to have been largely unaffected by late base-level changes (in this area due to the rifting of the Jordan Valley) — at least in the recent past, with which we are concerned.[8] Thirdly, it was thought that the various basalts (fossil lava flows) in the area might contribute some radiometric dating and a chronology. Fourthly, it is a contact zone between the cereal-producing Fertile Crescent, and the desert steppe, and therefore had an influence on human occupation. Finally, the area was well supplied with paved roads, bridges and tracks, giving easy access to places where terraces had been eroded; as well as man-made sections such as were mentioned above, there were many natural sections cut by the streams themselves.

The Geomorphic Setting of the Paleolithic Sites

In the following account, the geomorphic data is based on a detailed report to be published separately.[9]

Samples of the basalts, obtained by J. J. Macaire have been dated by the *Bureau de Recherches Geologiques et Miniéres*

[5] The site is a station on the Hejaz railway to Medina. it was a stop on the *Viá Nova Traiana* linking Philadelphia to Bosra and Damascus (see Kennedy, 1982).

[6] A track goes east to Azraq Oasis via a line of *sabkhas* which, judging by the presence along it of Islamic hunting lodges, may mark an animal migration route between the desert steppe and the east bank highlands; it is also on the north-south bird migration route described at Azraq by Nelson (1973), and hence must have formed an area attractive to hunters.

[7] Besançon *et. al.*, 1978), and the Euphrates tributaries Sajour (see Besançon *et. al.*, 1982) and Balikh (see Besançon and Sanlaville, 1981), among others.

[8] For fuller discussion of the chronology of Jordan Valley tectonics in the Quaternary and how they affected the deposits in our area see Besançon *et. al.*, in preparation.

[9] J. Besancon, L. Copeland, F. Hours. J.J. Macaire and P. Sanlaville, Evolution de la valleé moyenne du Dhuleil et du Zarqa (Jordanie) au Néogène et au Quaternaire. *Revue de Géologie Dynamique et de Géographie physique,* in preparation.

(Orleans), using the Potassium/Argon process. They emanate from the volcanic area of the Jebel ed-Druze and the oldest basalts in our region (B1 and B2 on the map, Fig. 1) are dated to from 7 to 5 million years ago. As lava they twice flowed westwards to our area and spread out over what was then a wide basin, more or less following the course of the present Dhulail, which already belonged to the Jordan catchment. A thin fluviatile layer (named by the geomorphologists the Bakia Formation) is interspersed between the two flows. These older basalts were more resistant to erosion forces than were the surrounding limestones, and may be seen today in the form of *mesas* or tablelands perched above the valleys as far downstream to (but apparently no further than) Jebel Bakia. The date places them in the Miocene/Pliocene.

There then occurred a major downcutting phase, linked certainly to the deepening of the Ghôr, which brought about an intensification of the erosion. The Dhulail and Zarqa valleys became wider and deeper than they appear today, and two successive basalt flows (B3 and B4 on the map) spread along them from east to west, probably of a very fluid facies,since we can trace their flow down as far as the Quneia "elbow". They never reached the height of the older mesa basalts. The youngest basalt (B4) has two dates: 2.92 and 3.35 million years ago. The B4 overlies gravels, sterile of artefacts, which we call the Dhulail Formation. Thus our hopes that the basalt woud help to date absolutely the prehistoric artefacts were disappointed: they (and the gravels they cover) appear to be too old.[10]

From then onward the Zarqa and Dhulail Valleys went through alternating periods of erosion and accumulation associated mainly with severe climatic changes which occurred in the Middle and Late Pleistocene and Holocene as well as, at the start, with rifting in the Jordan Valley. These climatic changes in the Quaternary caused the build up of substantial pebble terraces during colder or drier periods while incision of the river bed occurred when temperature and precipitation led to a stabilisation of the valley sides by the vegetation. However, the subsidence of the Jordan rift tended to favour the forces of erosion.

At the end of the survey we were able to distinguish a succession of four, in some areas five, alluvial or colluvial fills (Formations), described hereafter using the following symbols: Q=Quaternary; f=fluviatile formation; Qf3=the third oldest (and here the highest) of the three Pleistocene terraces (before the Holocene) which we found, and which we call the Dauqara Formation; it overlies Basalt B4; Qf2 is the second oldest terrace, which we call the Bire Formation; Qf1 is related to the Last Glacial/Pluvial (*i.e.*, Late Pleistocene) and is called the Khirbet Samra Formation (allied to it but undated is the Qf2-1 or Bire-Samra Formation. Finally the Qfo is the Holocene terrace which we call the Sukhne Formation; it fills the flood plain of today.

Qf3, the Dauqara Formation or Complex

This is a high terrace formed when erosion in a Pleistocene climatic cycle, probably in several phases (and later than the last B4 basalt flow) at first incised the floor of the valley and then filled it to above the level of B4. Today it forms the broad *glacis,* easily seen on the left bank of the Zarqa *(e.g.,* sites 21-23, 30 etc.) perched sometimes 50.00-70.00 m. above the present valley floor, but occasionally visible even on the latter. The Formation comprises a cemented conglomerate of large pebbles, mainly of limestone, having a pink-coloured matrix, and covered by a substantial crust. No clear occurence was noted upstream above el-Hashimiya, where its deposits seem to be buried by later accumulations.

The only man-made implements we could find in Qf3 deposits were rare cores, flakes and one chopper (described below). Although there are many factors which could affect the dating of the Dauqara

[10] The matter would be put in a new light if the B4 dates are too old: it is curious that basalts which would correspond to the younger basalts in the Yarmouk Valley seem not to be present here.

Formation (such as Jordan Valley rifting, compensatory East Bank uplifting, perhaps-related lava emissions from the Jebel Druze area) it is considered to date to early in the Middle Pleistocene. If so, the Dauqara flakes would be contemporary with Middle Acheulean industries in the Levant, as will be discussed later.

Qf2, the Bire Formation

This occurs in the khirbet Samra sector but is more easily distinguished downstream of the confluence, due to the presence in it of numerous, considerably weathered, basalt blocks and pebbles, to the abundance of flint, and to the dark colour of the silty-clay matrix. There is some surface crust. It is usually found overlying the Dauqara Formation *(e.g.,* at Site 30b) against the valley sides, Upstream of Hashimiya the Qf2 deposits seem to be eroded and buried by Qf1 materials.

In the Zarqa valley a Late Acheulean assemblage of bifaces, cores and flakes was picked out of the sections of this Formation. They, too, are brown-patinated and heavily rolled and therefore cannot be younger than the time when the terrace was being built up. The Bire Formation is also Middle Pleistocene, and probably dates to around 200,000 years ago.

Qf1, the Khirbet Samra Formation(with Qf2-1, the Bire-Samra Formation)

Often more colluvial than alluvial, the "low" terrace contains an abundance of silty matrix and is not cemented or crusted over. It is sometimes found banked up against the foot of the Bire Formation and appears to represent the last Glacial/ Pluvial, the early Würm. What appears to be a different facies (called Bire-Samra by the geomorphologists) occurs upstream of el-Hashimiya, especially in the environs of Khirbet Samra village. As we shall see, it probably represents reworked deposits and contains both Middle and Lower Paleolithic artefacts.

Qfo, the Sukhne Formation

This Formation was preceded by a downcutting phase which also attacked the two earlier (Qf1 and Qf2) terraces. It is a low terrace resembling the early Würm one, from which it can be distinguished by its lower position and the presence in it of microliths, pottery and other artefacts of Epi-Paleolithic to Bronze Age date. It no doubt includes several phases, *e.g.*, Final Würm and Early Holocene, sometimes seen banked against the sectioned earlier terraces, and sometimes cut by the modern Zarqa, as at multi-period side 27; 27a is a Kebaran site overlain by 27b, a possibly Neolithic one.[11]

Surface sites

There are rich surface sites, not associated directly with the geomorphology, in three areas; the eastern part of the Dauqara glacis *(e.g.,* site 30), on top of the Jebel Bakia *mesa* (site 103), and on the volcanic plateau of Khirbet Samra.

Some of these surface sites have produced assemblages of a Late or Final Acheulean, unrolled, with grey patina; post-Paleolithic materials are present at other sites.

Conclusions on the geomorphology

In brief, it seems apparent that, perhaps because of the narrowness of the valley and the amount of energy coming from tributary streams (the northern tributaries come from a high rainfall zone;),[12] the Formations do not form a "staircase" suite of regular terraces, in contrast to what one sees in the Orontes or Euphrates valleys and their tributaries in Syria.[13] Here, in the Zarqa and Dhulail valleys, it is often difficult to distinguish the Qf1 and Qf2-1 from the Qfo, and the higher terraces can have various altitudes; it has a pronounced transversal slope, and if the alluvial and colluvial deposits are mainly of the Bire Formation, both more ancient (Dauqara) and more recent (Khirbet Sam-

[11] For fuller illustrations of this material see Besançon and Hours, in press, the artefacts have been given to A. Garrard and his team for analysis.

[12] National Water Master Plan vol. 2 (Atlas), 1977.

[13] Besançon (1981); Besançon and Sanlaville (1981).

ra) deposits can also occur. Distinction between the different Formations is especially difficult upstream from Hashimiya, *i.e.*, on the Dhulail. On the Zarqa on the other hand, where the forces of incision were more energetic, it is much easier to distinguish each formation.

Analysis of the Archaeological Material

In the two seasons of 1982 and 1983 a total of 4,500 flint artefacts were recovered in the Zarqa/Samra sector. The industries present included Lower and Middle Paleolithic, Epi-Paleolithic, post-Paleolithic, but no Upper Paleolithic. None of the assemblages were found archaeologically *in situ (i.e.*, in intact living-floors) but several were in geomorphological stratigraphy. Each assemblage, whatever its context, was classified; the collection has been devided between Yarmouk University and the Department of Antiquities in Amman. An inventory of the sites which we considered to contain Lower and Middle Paleolithic materials is presented in Table 1.

Methods

This consists initially of fieldwork: the careful, *i.e.* unbiased, collection of as many artefacts as possible from each site located by the geomorphologists. The collections are analysed in two stages, firstly a study of each artefact as part of an assemblage at each of these sites, and secondly an evaluation of the assemblages as chronological units or industries, based on the grouping of sites according to geomorphic context. The first stage includes a study of attributes, as expanded upon below.

1. Analysis of the Attributes of the Artefacts

We study two kinds of attributes, one contributing archaeological, the other geomorphological, information: the first reflects selection and choice on the part of Paleolithic man and the degree of skill he attained in fashioning a mentally-conceived shape of stone tool or weapon; the second kind refers to the fate of the artefacts after they left the user's hands. By analysing and quantifying both sets of data, and comparing the results with those from known or dated assemblages elsewhere, an idea can be gained as to the stage of development of the knappers and the chronological age of the assemblages. We will examine eighteen attributes (out of a larger number which could be studied): raw material, blank type, flake type, core type, flake-butts, present condition, degree of patination, geomorphic context, and dimensions — length, width and thickness; for the bifaces, additional attributes are dealt with in a special section: tip type, base type, form of cutting edges, face retouch, present dimensions — length, width, thickness, and formal classification into the outline categories of F. Bordes.[14] The variables are defined, and their utility to prehistorians discussed, as we proceed:

1. Raw Material

This is the kind of rock available to, and utilised by, the makers of the artefacts. Flint and chert (abundantly available in the area) were used exclusively (no basalt artefacts were noted). The original colour of most flint or chert artefacts — seen on fresh break-surfaces — is pale, sometimes opaque, beige or greyish pink; near the cortex this can be darker grey or wine coloured. Both good and poor grades of flint and chert were used for artefact making; as many as 38% of the bifaces are made of a dense, rough chert or a mottled and banded chert resembling limestone (Table 13a).

2. Blank

This is the natural form of the rock as utilised by the knappers to make their implements. Originating in seams in the Cretaceous limestone bedrock, the raw material in our sector was available in primary context (as irregularly-shaped *nodules* or as flat-surfaced slabs of *tabular* flint or chert) direct from the bedrock, or in secondary context (the same materials rounded into river *pebbles,* found in the

[14] F. Bordes, *Typologie du Paléolithique Ancien et Moyen*, Bordeaux, 1961, p. 31.

stream beds or river terraces). Although rarely in our sector, *flakes* or *older artefacts* were sometimes reworked or made into new tools.

The blank form is distinguishable only when sufficient cortex has been left on the artefact; it is unrecognisable on, for example, completely-worked bifaces (Table 13b).

3. Condition

One of the most important attributes we study, this refers to the present state of the artefacts and indicates what has happened to them since they were dropped by their makers. It is also important to note the condition of the accompanying non-artefacts, since similar rolled condition can give a broad, relative chronological "fix" to an assemblage within a river terrace.[15] "Rolling" is caused by the transport of an artefact by the river whereby not only are its facet margins worn down so that new cortex forms on them, but also the peripheral edges (its most fragile areas) are battered and broken off.

It is normal to have varying degrees of rolling in an *in situ* assemblage whatever the age of the Formation, since it is by chance *(e.g.*, seasonal changes of course by the stream, etc.) that the final condition is determined; some artefacts can be rolled more than once, others hardly at all, and others differently on each face.

It was possible to study the degrees of rolling in more detail on the bifaces (Table 14a) than on the other pieces, so that for the former we have the following condition categories:

Heavily rolled the facets are almost obliterated and the piece is barely recognisable as an artefact (as in Fig. 5, 1); *Very rolled:* new cortex has formed on facet margins and the edges are blunted (as in Fig. 7, 1); *Rolled:* facet margins are damaged and edges are battered but all details of the working are visible. *Weathered:* the artefacts are largely undamaged but facet margins and edges are smooth to the touch, *i.e.*, slight dissolution or desilicification of the flint through chemical action has occurred. Such pieces are usually found buried in soils covering terraces remnants or encased in the crusts which sometimes form on top of terraces (in this case lumps of calcareous concretions adhere to the surfaces); due to recent ploughing, such pieces also occur on the surface, where they may have "podolithic retouch", plough-marks or thermal fractures. *Fresh:* this means undamaged but not, of course, mint fresh (when the edges will cut the fingers). Such pieces are found embedded in deposits or on recently exposed surfaces. We usually assume that the weathered and fresh artefacts have not been roled and, if found on a terrace surface, must date to a time later than the build-up of that terrace.

4. Patina

The *patina* is often a disappointing attribute to work with; the mechanisms which produce colour changes in flint through time are little understood and the variables (such as the composition and original colour of the flint) are numerous. Nevertheless, the reworking of a broken tip, as shown by differently patinated facets, can inform on man's actions, and differing patinas on each face can indicate the position of an artefact in relation to its context. Patina colours also suggest which pieces "belong together' in a surface assemblage. Sometimes it is necessary to chip a piece slightly in order to determine the patina colour, or succession of colours.

In general, in our sector, the oldest patinas are brown and yellow-brown (47.18%), the grey being slightly younger (46.05%), though older than pale grey or wine (6.74%). The sequence of patination seems to be that flint becomes cloudy o dotted with whitish grey, eventually be

[15] It is considered that (leaving aside the unlikely possibility of lakeside or seashore rolling, the only natural agency which could have caused the rolled condition of the artefacts was a stream flowing in a stony bed (presumably during a glacial or pluvial). Today, this stream having long since abandoned that level during the next phase of incision, h left traces of its bed, fossilised as the raised terrace. The rolling cannot have taken place la than the accumulation of the terrace, but artefa in it could be older, having been derived from earlier formation.

coming uniformly grey or white; this gradually darkens to yellow brown and finally to a deep brown. No black flint or black patinas were seen.

5. Geomorphic Context

It is fundamental to our method to establish the relationship of the artefacts of an assemblage (whether *in situ* or on the surface) with the context of the findspot. Clearly, the most valuable context is *geologically in situ*, that is to say the artefacts were picked out of a terrace section, the spot to which the river had transported them. If rolled, they cannot be younger than the terrace, but could of course, be older, as explained in Note.[15] Even if unrolled, but embedded (accompanied by equally unrolled flint fragments) in a conglomerate, artefacts could also be contemporary with the deposit which contained them.

As to surface material, it is also sometimes possible to assign a relative date to a site, taking certain topographical factors into account. An example is site 30, where localities "a" and "b" were on truncated surfaces of the Dauqara Formation and locality "c" was on the surface of the Bire Formation; since the material on all three is so similar typologically and similarly unrolled, we are able to give virtually all of it a post-Bire date. It is also to be noted that not all terrace surfaces contain artefacts; these occur in concentrations, especially in strategic spots such as at confluences of streams on bluffs with a commanding view, as at site 30 and the *Site Eponyme* of the Dominicans, which we call site 135.

As stressed above, the context of our assemblages, even some of those on the surface, is the basis on which we group them according to age.

2. Grouping of Sites by Geomorphic Context

Having analysed each artefact of each site, a task done at the end of the field season, assemblages are sorted into "age-groups" based on the relative geomorphic position of the findspot. The *in situ* sites of the Dauqara Formation form one group, those of the Bire Formation another, and those of the Bire-Samra and Khirbet Samra Formations a third (Tables 2, 4 and 6 respectively). Given that, although transported, the artefacts occur in definite localities within a terrace rather than at random, and that the samples for each site are small, we feel justified in lumping (for purposes of discussion) materials in similar context.

Each of the surface sites is dealt with separately, on its merits, as alluded to above; some collections had to be abandoned as useless, those retained for this study being listed in Table 1. We retain site 135 because of its typological value even though we do not know the context of the findspots (those marked on the bifaces are: Khirbet Samra; Site Est; Site Centre: Site Ouest; Sp. 3; Sp. III 13 Nord; p. 7; p. 2; 2.81.10; and Sp. III 01) except for "Gare", which is at Khirbet Samra railway station. The few artefacts from this spot have been included in our site 5b.

The Artefacts of the Dauqara Formation

In sections cut into the Dauqara Formation downstream from el-Hashimiya, we recovered forty-two artefacts *in situ* from eight distinct localities: sites 19, 21, 22al, 22b, 31b, 110, 119a, and 124. This is a somewhat meagre sample, but it does serve to certify the Pleistocene (rather than Pliocene) age of the formation. The details of the assemblages are shown in Tables 2 and 3 and the dimensions of the measurable flakes are plotted in Fig. 3.

There are six cores; three are polyhedric, two are for the production of flat flakes and the last, with orthogonal platform, for flakes or blades. There are no blades, and five of the flakes are transverse, the rest being mainly squarish cortex flakes (57%) with large, plain butt (45%); all but one are more than a centimetre thick. The only tool is a bifacial lateral chopper which has a sinuous cutting edge formed by two removals on each side meeting at an angle of 77° (this is fairly evolved for a chopper).

The patina of 80% of the artefacts is yellow-brown or brown; two of the others

are only slightly patinated, the rest are patinated as shown in Fig. 9. As to their condition, 72.2% pieces are rolled to some extent, 34.3% slightly rolled, 22.5% moderately rolled, 15% heavily rolled.

The relative position of the Qf3 (Dauqara Formation) as against that of the other formations in the Zarqa and Dhulail valleys places it in parallel with other terrace systems, *e.g.,* in Syria; the Latamne Formation on the Orontes (Besançon *et. al.,* 1978 a and b), the Berzine Formation on the Syrian Nahr el-Kebir, where the artefact assemblages are more abundant and more characteristic and, so far as Berzine is concerned, the geomorphic position is clearer.[16] On the Euphrates, the Chnine Formation is also comparable geomorphically; it contained only flakes.[17] All these formations are regarded as Middle Pleistocene,[18] and we have placed the Dauqara deposits in the same period. Our forty-two artefacts would not contradict this attribution, given the absence of Levallois debitage, the absence of faceted butts, and the number of yellow and brown patinas. As at Chnine, there were no bifaces, and this trait seems to be characteristic of inland Levant areas, even though the smallness of the samples reduces the validity of this observation. Nevertheless, we are able to compare them with samples from younger formations in the area.

The Artefacts of the Bire Formation

Younger than the Dauqara Formation, and partly embedded in its terrace, the Bire Formation is particularly distinct downstream from el-Hashimiya on the Dhulail and along the Zarqa below the confluence. We have recovered 114 artefacts *in situ* (including eight bifaces) in nine sites: 22a2, 24, 29a, 106, 116, 118, 119b, 130a and 134; this indicates a somewhat increased intensity of occupation compared to that in Dauqara times, as is usual in sites younger than the early Middle Pleistocene. The composition of the assemblages and the technical details are analysed in Tables 4 and 5 and Fig. 4, while some of the artefacts are illustrated on Figs. 5 to 8.

There are sixteen cores; four have traces of orthogonal preparation (Fig. 6, 1), eight gave rise to flat debitage (which we can see as a technical improvement, especially since one has two opposed platforms: Fig. 5, 2); one is amorphous and there are two exhausted discs. If this latter form represents an ultimate stage in the reduction of radially prepared cores, it would mark the earliest manifestation of such technology in this region, since there are no other Levallois pieces in Bire assemblages.

The flakes do not differ greatly in shape or technique of production from those of the Dauqara assemblages, except that fewer (47%) are cortex flakes, while slightly more have cortex butts (27% as against 20%). As Table 5 shows, most (32%) have plain butts (usually with wide angle between butt and ventral surface) with almost as many (27%) having cortex butts. This probably indicates a slight advance in core-preparation techniques though there are no Levallois flakes. Transverse flakes are relatively numerous, as in the Dauqara assemblages. There are also six pieces which could be regarded as blades (Fig. 4, left). The thicknesses (Fig. 4, right) seem to cluster more closely than those seen on Fig. 3, right, but this may be due to the small samples involved. Two typical part-cortex préparation flakes are shown on Fig. 6, 2 and 3.

The tools consist of eight bifaces (two ovate, six amygdaloid) which will be described in details below, as well as two choppers and two racloirs. Both of the choppers are bifacial distal types, made on river pebbles. The racloirs are made on heavy cortex flakes.

The patinas are almost equally divided

[16] P. Sanlavillie. ed., *Quaternaire et Préhistorie du Nahr el-Kebir Septentrional,* Paris, 1979.

[17] J. Besançon and P. Sanlaville, Apercu géomorphologique sur la vallée de l'Euphrate Syrien, *Paléorient,* 7:2 (1981) p. 5-18.

[18] J. Besançon, L. Copeland, F. Hours, S. Muhesen and P. Sanlaville, Le Paléolithique d'el-Kowm: rapport préliminaire, *Paléorient,* 7:1 (1981) p. 39-45.

into yellow-brown or brown (47.18%) and white-grey-beige (46.05%), with a slight element of wine-grey (6.74%).

The reduced number of brown patinas, compared to that for the Dauqara assemblages, is what would be expected in a younger formation, where lighter patinas are more common (Fig. 9). The condition of the artefacts differs a little from that of Dauqara assemblages: all are rolled, 15.7% slightly, 58.4% moderately and 25.8% heavily.

The relative position of the Bire Formation in the Zarqa-Dhulail basin is that of the second oldest fluviatile formation before the Holocene, marked as Qf2 on the map. It would therefore correspond to the Jraibiyate Formation (the second oldest before the Holocene on the Orontes), the Abu Jama's Formation on the Euphrates and the Jinderiyeh Formation on the Nahr el-Kebir.[19] All these Qf2 deposits contain Acheulean assemblages characterised by somewhat fewer brown patinas than in the oldest formations, by a very small Levallois element, by the presence of numerous evolved bifaces and by a relatively increased element of tools (on cores or on flakes) than were evident in the preceding formations. For us, this is the Late Acheulean of the Levant, but in the literature, terms such as Middle Acheulean or Middle-Late Acheulean have sometimes been employed[20] and it must be noted that the battered and rolled condition of the bifaces conceals the degree of technical skill attained by their makers. Yet, the absence of Levallois debitage can be regarded as significant on a total of eighty-seven flakes. Taking all this into account, as well as the stratigraphic position of the Bire deposits, an age at the end of the Middle Pleistocene seems fairly certain.

The Artefacts of the Bire-Samra and Khirbet Samra Formations

As mentioned earlier, upstream from the narrow passage through the basalt at el-Hashimiya, the relief is flatter and the formations are less visible; the Dauqara does not seem to be present and the Bire is not clearly distinct. In certain places the latter seems to have been planed off, together with deposits of a younger formation which is quite prominent in the area of Khirbet-Samra. This has led the geomorphologists to distinguish two ensembles: the Khirbet Samra Formation (Qf1) proper, at sites 5b, 13, 26b, 107, 109, 115a, 115b, 129a and 132, and the combined Bire-Samra (Qf2-1) material, at sites 7a, 9a, 10, 11 and 12. In the first-named we collected 158 artefacts (including eleven bifaces) at nine distinct sites and in the second, 66 artefacts (one biface) at five sites. Table 6 and 7 give an inventory of the artefacts by type and by site and Table 8 shows the butt and flake types. Artefacts from the Khirbet Samra Formation are shown in Figs. 10 and 11.

Since the samples at each site are small, the prehistorians can do no more than give cautious answers to the geomorphological problems raised. One such problem is that the two formations Qf2-1 and Qf1, while relatively substantial above el-Hashimiya are not in evidence downstream, where the Holocene (Sukhne Formation, Qfo) lies immediately at the foot of the Bire Formation; in contrast, the Dauqara and Bire deposits are not clearly present upstream of the same point (the el-Hashimiya passage). However, archaeologically speaking, the difference between the two areas is of some importance: downstream is a Late Acheulean, evolved even though without Levallois debitage, while upstream in the Bire-Samra and Khirbet Samra Formations the Levallois is relatively important and the assemblages contain material reminiscent of the Middle Palaeolithic. A possible explanation could be that regressive erosion occurred, connected to the rifting of the Jordan Valley, at the end of the Upper Pleistocene; this evacuated the Wurmian deposits in the valley up to as far as

[19] Besançon and Sanlaville, *op. cit.*

[20] F. Hours, Le Paléolithique inférieur de la Syrie et du Liban, Le point en question en 1980, in J. Cauvin and P. Sanlaville (eds.), *Préhistoire du Levant*, Paris, 1981, p. 165-184.

el-Hashimiya, but the erosion did not reach the area upstream.

However this may be, we also have to ask if two different ensembles are really present in the upstream area, and in this case the archaeology can give some indications. We may note the presence, in both formations (Qf2-1 and Qf1) the same types of evolved bifaces and Levallois debitage; we see that the Levallois is the same style (the flakes are mainly thick and the cores very well made (Fig. 11, 3), some being bipolar "Nubian" point cores, and that the Levallois Index in each is very similar (26.3 in the Bire-Samra and 21.6 in the Khirbet Samra). The proportion of the patinas is also much the same: in comparison with the patinas in Bire assemblages one can see a decrease in numbers of older patinas, many pieces being virtually unpatinated, and many being wine or grey patinated (Fig. 9). The condition proportions are also similar: unrolled "fresh" pieces number 25.4% in Qf1 and 23.6% in Qf2-1 assemblages; by far the most numerous condition is "weathered" or "slightly rolled" (59.5% in Qf2-1 and 52.5% in Qf1 assemblages). Rolled pieces are slightly more numerous in the Qf2-1 (22%) while in the Qf1 they number 16.79%.

While maintaining separate inventories in Table 6a and Table 6b we conclude that, as regards the artefacts, either one industry or the same mix of industries is involved. To choose between these possibilities we would have to ask: what do the assemblages represent, and what is the date of the formations in which they occur? We can reply very easily to the last question; the stratigraphic position of the deposits, immediately above the Holocene terrace and anterior to it, places them in the Last Glacial/Pluvial.

Having been dated to Qf1, *i.e.*, as the youngest Pleistocene formation in the Zarqa-Dhulail basin and last before the Holocene, the Khirbet Samra Formation can take its place within the chronostraphic sequence of the Middle East. Some of the same traits occur in equivalent Qf1 formations in Syria: Ech-Chir (Nahr el-Kebir), Saroute (Orontes) and Abu Chahri (Euphrates), held to be of Last Glacial date.[21] Indeed, fluviatile formations in the Levant interior often contain assemblages analagous to those of the Khirbet Samra Formation in Jordan, while *in situ* industries dating from the same Last Glacial are exclusively flake facies of Levallois debitage, without bifaces; examples are the coastal caves, the Judean caves or the Palmyrene caves. Moreover, the rare Acheulean assemblages which have Levallois debitage,[22] evince use of techniques far less advanced. It would appear, therefore, that what we have at these fourteen sites of the Bire-Samra and Khirbet-Samra Formations are the remains of Acheulean surface sites occupied between the Qf2 and Qf1, mixed in with a Middle Paleolithic (still not very evolved) which could date either from the interpluvial or from the Würm itself.

The Artefacts of the Surface Sites

Both Lower and Middle Paleolithic material (1,100 artefacts) was recovered from surface sites 3, 4, 5a, 7b, 14, 25b, 30a, 30b, 128, 129b, 130b and 130c, the artefacts of which are inventoried on Table 9. The value of these assemblages is variable in two respects: first, the number of artefacts in the sample and second the number of tools (Table 11). The latter amount to 190 (excluding Levallois pieces) of which 115 are bifaces. The most interest-

[21] Besançon, Chronologie, *op. cit.*

[22] Although many instances of bifaces with Levallois flakes are known in the Middle East, these are usually on the surface (Joubata; Goren, 1979) or derived (Kissufim; Ronen *et. al.*, 1982) or on river terraces such as at Abu Shahri and Halouandji (Besançon *et. al.*, 1982). In stratigraphy, only rare cases of Acheulean with Levallois debitage have been reported: Birket Ram (Goren, 1982), Wadi Qdeir C at El-Kowm (Besançon *et. al.*, 1981) and Yabrud I. levels 12, 17 and 23 (Bordes, 1955). Most stratified Late Acheulean assemblages are of non-Levallois debitage. Examples are Nadawiyeh I (Hours *et. al.*, 1983), Lion Spring level 5d at Azraq (Kirkbride and Copeland, in preparation) and from within Qf2 river terraces, such as at Abu Jema'a or Hammam Kebir on the Euphrates (Besançon *et. al.*, 1980). One could say that Wurmian (Qf1) terraces without a rolled, older, handaxe element are rare, except perhaps in the Negev (Rosh Ain Mor, for example; Marks and Crew, 1972).

ing sites are 4, 30a, 30b, 30c, and site 135 (the *Site Eponyme,)* clearly mainly Acheulean, and 3, 5a, 7b, which are mainly Middle Paleolithic. Table 10 shows the types of butts at each site excluding flakes of site 135; some of the artefacts are illustrated in Figs. 13-22, and the dimensions of the flakes at sites 3 and 4 are compared on Figs. 15 and 16.

It is considered that the surface assemblages represent (as do those of Qf1) mixtures. In theory, certain of them could be quite old, for example the assemblage of site 135, mainly collected from the lava bluff B1 which is 4 or more million years old. In fact, the typology and technology of the bifaces (see below), as well as the proportions of Levallois debitage, is uniform in all these stations and is equivalent to that found in the last fluviatile formations. The IL of the total artefacts on Table 9 is 17.51. In contrast, the proportions of bifaces is higher than in the assemblages found in the fluviatile formations: 10.18% on surface sites, as against 6.96% in the Samra Formation sites. If the collections are representative, and if the hypothesis as to the mixture of industries is correct, it could mean that the surface sites were not often occupied in the Middle Paleolithic, but were formed mainly during the Last Interglacial.

The later terraces, such as the Sukhne Formation (containing Epi-Paleolithic or even pottery) are clearly Holocene and do not concern us here.

Having studied the artefacts and their position in the Zarqa-Dhulail basin, we are able to make some general observations: 1) The succession of industries in Jordan follows the same course as that which occurs along the inland rivers (Orontes; Litani; Euphrates), testifying to a relatively abundant population of Late Acheuleans, probably lasting into the Last Interglacial. 2) There is a certain "cultural lag" between the apparent evolutionary stage of the industries and the age of the formations, at least as regards the assemblages contained in (respectively) the Qf1 and Qf2 Formations. The artefacts are more archaic than those in other areas which are attributable to the same periods but found archaeologically *in situ.* In the Qf1 of the Last Pluvial in our sector we have bifaces and Levallois debitage, but none of the levels of the cave Levalloiso-Mousterian contain contemporary bifaces. Again, the handaxes of the Bire Formation (Qf2, Penultimate Pluvial) are less evolved than those of the late Acheulean found in caves in the same chronological position (Qatafa; Tabun). The data from the Dhulail-Zarqa valley provide, we think, clear indications that the assemblages contained in the formations are partly older than the formations themselves, which is logical, Hence, it is necessary to maintain the distinction (already observed on the Orontes) between an Acheulean which, although "Late" according to geomorphic position, is not highly evolved from a typological point of view, and another Acheulean which we call "Late Evolved", like that of Gharmachi Ib in Syria.

Many of the data upon which we base these conclusions are contributed by the bifaces (handaxes) of our sector; a detailed study of these follows.

Attribute Analysis of the Bifaces

In our experience, patterns emerge from attribute analysis of bifaces when a large sample can be examined. For that reason the following account deals only with bifaces, cleavers and picks found in 1982-3, a total of 152 pieces (Table 12). Besides giving further details as to context, raw material, condition blank and patina, an additional set of attributes is studied: formal classification, tip, base and edge types, dimensions and type of face-retouch.

Context

Effectively, this means the context of the sites where bifaces were found, in relation to Quaternary deposits, and this has already been discussed above. The bifaces are accordingly divided into three groups: In Group 1, the eight bifaces of the Bire Formation; in Group 2, the eight bifaces of the Khirbet Samra Formation (including one from the Bire-Samra group of sites); Group 3 consists of the surface

material, which can be subdivided into: fifty pieces from site 30a, b, c, and site 130b (which we believe to be fairly pure); thirty-seven bifaces from the Dominican's collection, exact context unknown (our site 135); and fifty bifaces from all other sites mentioned on Table 12.

Raw Material

As Table 13a shows, on a sample of 127 specimens, an opaque, good-quality flint in pale beige tones was the most popular raw material; together with a few grey-blue or grey-wine tones; this forms 61.4% of the total. Another 38.5% of the bifaces were made of an often very rough, dense grey chert which graded into a material resembling limestone. Nevertheless, twelve of the bifaces were made from it, predominantly at site 30; some were very well made.

Blank

A third of the bifaces (34.5%) have had all the cortex removed, making it impossible to determine the kind of blank selected for biface-making. Moreover, many other specimens have only small patches of cortex remaining, so that the division (in Table 13b) into those made on a slab or on an irregular nodule is somewhat subjective; however, twenty-one bifaces were clearly made on rounded river pebbles, some having globular cortex bases. Even the slab or nodule blanks could have been picked up in the form of pebbles, rather than taken directly from bedrock seams, as most show old natural-fracture planes, with traces of battering. Flakes were only rarely used.

Condition

As Table 14a shows, all eight of the Group 1 bifaces picked out of the El-Bire Formation (Qf2) are rolled, indicating that they have been transported by the river of Middle Pleistocene date. One would have expected the pieces of Group 2 (Qf1) to be more heavily rolled than they are, if they really of Qf2 age and have been transported twice.

The presence of five rolled, among the predominantly unrolled, bifaces at surface sites 30a and 130b needs explaining; since they are large and rough, it is conceivable that the two from 30a (Fig. 14) are older than their merely "weathered" companions; they could be contemporary with the Dauqara Formation on the surface of which they were found. (There *are* artefacts [flakes] in the *in situ* sections of the Dauqara Formation, but not at site 30a). As Table 14a shows, the other site 30 pieces are predominantly weathered or even fresh so that they cannot have been rolled in the river of Dauqara times. Many specimens at 30c are encrusted with calcareous concretions and seem to derive from the crust covering part of the terrace. The other rolled bifaces at surface sites are assumed to have been eroded from their original terraces. When the physical condition of a biface is ambiguous, as on some surface sites, it is not included in the sample, which amounts in Table 14a to 133.

Patina

As mentioned earlier, it is normal to have a variety of patinas in *in situ* assemblages, given the number of variables involved, *e.g.*, the composition of the flint, but there is usually a dominating tone, as shown in Fig. 9.

The biface patinas are shown in Table 14b; all are patinated to some extent and a number of surface pieces had two stages of patination. Three of the Bire (Group 1) bifaces are unique in having a deep chestnut patina, similar to that seen in Syrian Middle and Late Acheulean fluviatile contexts, such as at Latamne or Jraibiyate[23] and at Azraq (Lion Spring level 5d) [24] In contrast the Qf1 bifaces have patinas similar to those seen in surface sites, where a large majority of pieces are patinated to grey/beige (this most often corresponds to 10YR 6/2 [light brownish grey] on the

[23] J. Besançon, L. Copeland, F. Hours and P. Sanlaville, The Paleolithic sequence in Quaternary Formations of the Orontes River Valley, Northern Syria, *Bulletin of the Institute of Archaeology*, 15 (1978) p. 149-170.

[24] D. Kirkbride and L. Copeland, Results of a sounding at Lion Spring, Azraq (Jordan) in 1956, (in preparation).

Munsell soil colour chart). As to the whitish patinas, it is thought that these originate on certain flint types upon exposure at the surface, and they occur in small numbers in all the groups on Table 14b.

Formal Classification

We use the outline categories (and system of determining these) of Bordes, with slight alterations to suit the material of the Zarqa-Samra sector, as in Table 12. This exercise is done partly to render an assemblage comparable to others classified the same way, and partly because — although the forms were deliberately sought and follow detectable patterns, — we do not yet know why Man chose certain shapes in which to form his artefacts.

Two new categories have been added, both of which have already been noted from Central Levant sites such as Tabun and Azraq:[25] one is "D-shaped biface"; examples of these look at first glance like the basal parts of bifaces with tip broken off; but they recur often enough to justify regarding them as a type, the "base" being the rounded tip, the "break" being the base (Fig. 18, 3; Fig. 22, 1). The other category is "bifacial cleaver"; these have either a straight distal edge (sometimes oblique to the axis as in Fig. 18, 2 or a slightly convex transverse edge as in Fig. 21, 1. They are made on nodules rather than on flakes as are African cleavers. An *hacherau biface* according to Bordes, this type corresponds to *biface à bout carré* of other French authors.

Partially flaked pieces are counted according to their outline shape rather than in a separate category of Partials (Fig. 12, 1). Backed bifaces have one lateral cutting edge opposed to hand-hold on the other side. The categories are grouped into three classes, one consisting of discoids and ovates (widest at the centre), the other of amygdaloids and lanceolates (widest at the base), with all the other categories, which usually have small totals, forming a third class. A number of "pointed ovates" occur; this form has been noted in Middle East assemblages, and is not common in Europe, where it is often considered as an amygdaloid even though widest at the centre.

When amalgamated, the Zarqa/Samra sector bifaces show a predominance (40%) of ovate shapes (the first seven categories of Table 12). This is largely due to the inclusion of the D-shaped pieces and the bifacial cleavers, which are most often oval. The thirty-six amygdaloid and lanceolate shapes (categories 8-14) are also important. Cordiform bifaces are relatively rare in the assemblages (Fig. 12, 3); the sub-cordiform category includes specimens made on naturally-thin raw material, *i.e.*, with cortex on both faces, as well as partially decorticated pieces. The Short Amygdaloids (Fig. 20, 1) are those where the L is less than 1.5 of the W and includes some almost minute specimens (Fig. 22, 2). Bifacial cleavers are also relatively rare, but occur more frequently here than they usually do at Syrian Acheulean sites.

Although the sample is small, the Group 1 bifaces show a 5-to-2 preference for amygdaloid shapes, but these often verge on the ovate form (Figs. 5-8).

Only one piece with a trihedric section was found, slightly rolled on the surface of the Site Eponyme. There is bifacial retouch on each of the three faces at the tip. Four picks (Fig. 22, 4) show no consistent pattern, and are unlike the picks known from certain Euphrates sites such as Maadan and Hamadine.[26]

Tip

Although tip shapes are partly subsumed by the formal classification (cleavers are straight-tipped, lanceolates are pointed, *e.g.,)* a closer look reveals that some tip shapes cross-cut the usual outline categories (pointed ovates, and accuminates, *e.g.)*. In short, we assume that the various shapes were designed to perform different tasks, about which we can only speculate; their relationship with outline categories remains just as unclear.

Unfortunately, as can be seen on

[25] G. Rollefson, The Late Acheulean site at Fjaje, wadi el-Bustan, Southern Jordan, *Paléorient,* 7:1 (1981) p. 9.

[26] Hours, *op. cit.*

Table 15a, 24% of the bifaces have no tips; occasionally the break is fresh, but usually signs of reworking of broken tips can be seen, *(e.g.,* on Fig. 17, 2); the reworking most often results in a straight edge.

Of the 104 bifaces with tips, pointed tips (27.8%) slightly outnumber those with rounded (25.9%) or ogival (13.4%) tips. The straight or broad convex tips are seen on the bifacial cleavers (Fig. 22, 1), the narrow accuminate ones on amygdaloids, cordiforms and lanceolates (Fig. 21, 3). Undamaged tips are thin and relatively sharp.

the tranchet method of forming the tip was seen on only two pieces (Fig. 21, 1); one had this feature (where the tip is made by a transverse blow) on each face at the tip.

Base

Like the tip, base shape was evidently chosen by man, but for what reasons we cannot yet say; if the base was worked to an edge the artefact would seem to be a more useful tool than one with pebble cortex base, although the latter may represent a hand-hold.

When present (Table 15b) the basal edging is well done and typically Late Acheulean (Fig. 22, 5), although only two "perfect semi-circle bases" were seen.

Many bifaces (for example the D-shaped pieces) resemble cores at the base, with either zig-zag edge formed by alternate removals, or perpendicular, core-platform-like form ("stand-up bases"). Sites 30a, b, c and 130b, where such types predominate, may be factories since some pieces were roughouts, though other specimens, which had been repaired at these places, suggest the sites were also used as habitation areas. Group 1 (Qf3) bifaces are the most evolved, 4 having what appear to be basal edges, and 3 others having a worked base.

The S-twist feature is rare, but present at most sites with good samples. In spite of the apparently rough impression (due to coarse raw material) given by the 30a bifaces, their edges show just as many "evolved" traits as are seen at the other sites. Meplats are quite common.

Surprisingly for a Late Acheulean group of bifaces, of 117 recognisable bases, 52.9% are without an edge at the base (Fig. 19, 1 and 2), and thus slightly outnumber those with the cutting-edge continuing all around the base (44 pieces; 47%). However, eleven other pieces (Fig. 21, 1) have part of the base edged, and the two categories together form 39.8% of the bases — quite a respectable index of refinement when compared to older (Middle Acheulean) bifaces, where the number of edged bases does not rise above about 20% *(e.g.,* at Joubb Jannine)[27]

Cutting-edges

The lateral edges of bifaces also represent deliberate action by *man.* We can only assume that edges which are made straight in profile are more efficient for cutting and slicing (and possibly for hafting) than are those with sinuous cutting edges; we further assume that the makers of the former shape were the more skillful knappers. On Table 16a, the first six categories refer to bifaces with two edges, one each side; one-edged bifaces are those with a "back" or hand-hold opposed to an edge, sometimes called "bifacial knives"; three-edged pieces are trihedrals, where all three edges are worked rather than where two edges are worked and the third one represents converging facet-margins.

Amalgamated, 30% of the bifaces (including those of Qf2 sites) show typically "evolved" edges, 39 pieces having both edges straight in profile *(e.g.,* Fig. 21, 1); together with seventy-eight pieces with at least one straight cutting-edge (one-edged included) this gives an Edge Refinement Index of 60. This figure may be contrasted with that of twenty-nine at the older, Middle Acheulean, site of Joubb Jannine, where 71% of the bifaces had sinuous edges.

[27] J. Besançon L. Copeland and F. Hours, L'Acheuléen Moyen de Joubb Jannine (Liban), *Paléorient,* 8:1 (1982), p. 11-36.

Face Retouch

Fine, scalar retouch on one face, both faces or parts of one or both faces, of a biface is an indication of advanced knapping skill, and represents a secondary or finishing stage such as, was not carried out in earlier Acheulean phases; it may be contrasted with the more primitive stone-hammer or primary flaking methods of the Early and Middle Acheuleans, who did not "finish" their bifaces. Hence, the greater the amount of fine flaking present, the more evolved the biface is thought to be. In practice, it has been difficult to reduce the variables to just six categories as in Table 16b, and many variations are subsumed in these (deliberately vague) categories. The situation is made more complicated in our sector because of the availability of thin tabular flint slabs; there would often have been no need to remove the cortex of the blank in order to obtain a desired thickness. Thus, the presence of cortex over much of the surface of the piece does not necessarily denote lack of knapping skill.

Amalgamated, the 122 recognisable bifaces show that all but fourteen completely rough pieces have some fine flaking, and that fine or mainly fine pieces, totalling fifty-four pieces, amount to 44.2%. Fewer rough pieces might have been expected. This result may be due to the presence of a number of rough-outs (Fig. 18, 1) and *divers* bifaces, probably denoting factory waste. On the other hand virtually the same proportions occur in the *in situ* Group 1 sites. At each site with a fair sample, both well-made, typical and poorly-made atypical pieces occur together, which is normal in the Lower Paleolithic.

Dimensions: Length and Width

Length and width distributions of all measurable Zarqa-Samra sector bifaces are shown on Figure 23. In rolled assemblages, such as occur in our sector, bifaces have usually lost their tips, but the length can sometimes be reconstructed, following the curve of the edges. The original size of rolled bifaces can only be approximated, as they may have lost up to 1 cm. all around their edges.

The length is measured on the axis and symmetry of the upper (tip) half, even when the piece is asymmetric at the base. The width is taken at the widest point at right-angles to the axis. When necessary, further measurements are made to determine if a piece is discoid, ovate, amygdaloid or cordiform, according to the Bordian system.[28] "Minute" bifaces are those less than 7 cm. long.

The L/W values on the measurable Group 1 bifaces on Figure 23 form a compact triangle in the midst of the other L/W values, but of course their edges have been reduced (often by 1-2 cm. all around) by rolling and each was originally larger. Virtually all the other values stay within the L=W and L=2W lines, mainly at the centre; exceptions are some of the D-shaped pieces which are short and wide, and the lanceolate and trihedric pieces which are long and narrow. Large bifaces are rare (only two exceeding 17 cm.) but small pieces are quite common, fourteen not exceeding 8 cm. in length. With some lengths reconstructed, the mean length for the surface bifaces is 10.84 cm., and for the *in situ* Qf2 pieces; 11.4 cm. The longest mean length is that for Site 30a: 13.25 cm.; it is between 10 and 9 cm. in Qf1 sites and this lends some support to the observations of D. Gilead,[29] that the dimensions of bifaces decrease through time.

Dimensions: Thickness/Width

The thickness is taken at the thickest point perpendicular to the axis.

As Figure 24 shows, the thickness values are massed along the W=2Th line between 5 and 11 cm., the Group I bifaces staying close to the line. The thickness was deliberately formed on about half the pieces (by removing cortex), and the rest, with cortex remaining on each face, are not noticeably thicker, *i.e.*, tabular pieces of a certain thickness range were chosen. Exceptions are two larger pieces with globular cortex butts, rought-outs from Sites 30a

[28] Bordes, *op. cit.*, p. 49-53.

[29] D. Gilead, Handaxe Industries in Israel and the Near East, *World Archaeology*, 2 (1970) p. 1-11.

and b. There seems, therefore, to be a certain thickness/width preference, within certain limits, shown by the Zarqa/Samra knappers, to which different raw materials and blanks, such as thin tabular slabs, were made to conform.

Summary of the Biface Attribute Analysis and Tentative Chronology

We mentioned above the possibility that two of the largest and most rolled bifaces of Site 30a, found on the surface of the Dauqara Formation, might be as old as the Formation; one (Fig. 14) is a large, thick ovate (16.0 x 11.6 x 8.4 cm.), the other a broken lanceolate made on a thin pebble and either would fit well typologically with Middle Acheulean assemblages in Syria.[30] The presence of a combination of "evolved" traits, such as straight cutting-edges, fine flaking, edged bases, symmetric tips and moderate size confirms the Late Acheulean character of the Zarqa-Samra bifaces, over and above the typlogy, which suggests the same thing. The Group 1 bifaces (which are securely dated to the period of the Qf2 terrace, around 200,000 years ago) form a typical assemblage of ovates and amygdaloids comparable, although the sample is small, to what can be found in a contemporary terrace on the Orontes (Jraibiyate)[31] and on the Euphrates at Hammam Kebir and Abou Jama'a,[32] as well as to some nearer assemblages (see below).

For the rest, for reasons already discussed above, we are persuaded that the Qf1 (and Qf2-1) bifaces are derived Acheulean, probably of the same date as those at the large surface sites such as 135 and 30a, b and c. The latter, most of which are in 'weathered' condition, present certain anomalies in their attributes; the knappers were capable of producing "good" bifaces but did not always do so. Some of the roughly based specimens had carefully re-worked tips and so were not rough-outs (Fig. 12, 2). Moreover, some of the attributes (presence of some minute or very small specimens, presence of bifacial cleavers and D-shaped types, disregard for the basal part of the biface etc.) are seen in Final Acheulean (Tabun F) and later Yabrudian (Tabun E, Bezez C) industries,[33] to name only two of many other instances. Provisionally, therefore, most of the surface bifaces of sites 30 and and 130b might be assigned to a post-Bire date and called "Final Acheulean". Since it is hard to believe that they were made during the Würm, they are more likely to refer to riverside occupations (well above the flood-plain) at the end of the Riss or start of the Last Interglacial/-pluvial, say about 120,000 years ago; although left intact downstream *(e.g.,* at site 30), the upstream Dauqara and Bire deposits were evidently dismantled during the Würm and scattered over a wide area around Khirbet Samra. This interpretation is based on some striking parallels in context and typology with the site of Gharmashi Ib, where an evolved Late Acheulean also occupied an earlier, Qf3 terrace surface overlooking the River Orontes.[34]

Concluding Remarks on the Zarqa-Samra Paleolithic

The chronology proposed above on the basis of the bifaces is supported by the character of the rest of the assemblages, described earlier. In sum, in the Zarqa-Samra sector we have traces of the presence of Man in the Middle Pleistocene — very faint in the third oldest Quaternary (Dauqara) Formation but quite distinct as a Late Acheulean in the succeeding (second oldest) Bire Formation, which probably was built up during the Penultimate Glacial/Pluvial.[35]

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[30] Besançon, L'Acheuléen, *op. cit.*
[31] Besançon, The Paleolithic *op. cit.*
[32] Besançon, *op. cit.*
[33] L. Copeland, The Paleolithic Stone Industries, in D. Roe (ed.) *Adlun in the Stone Age: The excavations of D. M. A. Garrod in the Lebanon, 1958-1963, British Archaeological Reports,* 1983.
[34] F. Hours, 1980; S. Muhesen, 1981. The industry was *in situ* in a soil overlying the Latamne Formation (Middle Pleistocene, Qf3) and the industry is clearly delineated due to a large sample of artefacts.
[35] No trace of a fourth oldest Quaternary formation was found, such as does exist in the Orontes Valley (the Khattab Formation; Besançon *et. al.,* 1978).

Since it is found, unrolled, overlying Dauqara and Bire surfaces, a later (?Final) Acheulean (with or without Levallois debitage?) seems to have occupied strategic riverside positions, perhaps during the start of the Last Interglacial. Some time later, traces of a Middle Paleolithic suggest the presence of Neanderthal man in the valley; this could refer to the end of the Last Interglacial or to the start of the Würm.

In passing we have mentioned material which is comparable to that in our sector, often (because more familiar to us) at some distance from the Zarqa-Samra sector. However, the Late Acheulean and succeeding facies are very widely distributed in Jordan itself. The nearest published site is that of Abu Sawan at Jerash, a surface assemblage with ovate and amygdaloid biface types closely comparable to ours.[36] To the north there is a large site at Ma'ayan Barukh, where some 6,000 bifaces were collected[37] and another site at Dera'a[38] while to the east, surface material is reported in the Azraq drainage basin,[39] sometimes in fluviatile terraces which are only relatively-dated as yet.[40] We know that cave sites were occupied, for example Umm Qatafa.[41] There are, however, three stratified open air sites of great interest, relevant to our work in the Zarqa-Samra sector.

The first is that of L. Villiers at Abu al-Khas in the Jordan Valley near Pella. Here, test trenches were dug into a cemented conglomerate overlooking the Ghôr, from which large flakes and pebble tools, rolled and white-patinated, were recovered; on the surface at the same spot some bifaces (described as crude) were found.[42] It is tempting to relate the conglomerate with the Dauqara Formation, but we must await further details.

The second site is Lion Spring at Azraq, where D. Kirkbride made a sounding in 1957, finding *in situ* two phases of a Late Acheulean; we have been able to examine these assemblages, which resembles our Zarqa-Samra Late Acheulean typologically and technologically, in having no Levallois technique, few flake tools, but having several bifacial cleavers and D-shaped and other bifaces.[43]

Finally, at the site of Birket Ram, a lake in a volcanic cone in the Golan Heights, an artefact-bearing horizon was located, embedded between basalt flows; the artefacts occurred in and on basalt pebbles and boulders overlain by a red clay of volcanic tuff origin, and the industry consists of small bifaces, many and varied flake tools and cores, while the debitage is said to be Levallois.[44] We await with interest the dating of the basalts, but meanwhile it would seem that the industry differs from any facies found in our sector, resembling more the Final Acheulean of Levallois facies at El-Kowm in site 23c, W. Qdeir.[45]

From all this it appears that Late Acheulean times in Jordan were just as complex culturally (with industrial variations which are only now coming to light) as they are already known to be in the rest of the Middle East and as we know they were in the Last Interglacial.[46]

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[36] D. Kirkbride, Notes on a Survey of Pre-Roman Archaeological sites near Jerash, *Bulletin of the Institute of Archaeology,* 1-3 (1958-62).

[37] A. Ronen, M. Ohel, M. Lamdan and A. Assaf, Acheulean artefacts from two trenches at Ma'ayan Barukh, *IEJ,* 30 (1980) p. 17-33.

[38] H. Field, ed., *North Arabian Desert Archaeological Survey, 1925-1950,* Papers of the Peabody Museum, Harvard, 45:2 (1960).

[39] A. Garrard and N. Stanley Price, A Survey of Prehistoric Sites in the Azraq Basin, Eastern Jordan, *Paléorient,* 3 (1977) p. 109-126.

[40] Besançon and Hours, *op. cit.*

[41] R. Neuville and R. Vaufrey, L'Acheuléen supérieur de la grotte d'Oumm Qatafa, *L'Anthropologie,* 41 (1931) p. 263-299.

[42] L. Villiers, First Report on Paleolithic Sampling at Abu el-Khas, Pella, *ADAJ,* XXIV (1980) p. 163-167.

[43] Kirkbride and Copeland, *op. cit.*

[44] N. Goren, The Acheulean site of Brekhat Ram, in A. Ronen, ed., *The Transition from Lower to Middle Paleolithic and the Origin of Modern Man, British Archaeological Reports,* 1982, p. 117-119.

[45] Besançon, Le Paléolithique, *op. cit.*

[46] Gilead, *op. cit.:* Hours, *op. cit.*
The extraordinary variety of facies, with and without Levallois debitage, with or without bifaces, and presumed to be at least of Last Interglacial date, has been discussed by Copeland and Hours, 1981; see their Fig. 3, p. 234.

Our work in the Zarqa-Dhulail basin is far from complete, and many problems, both archaeological and geomorphological, remain to be solved.[47] We hope that our data, when put together with that obtained from similar research, will contribute to our knowledge of the prehistory of the Middle East as a whole.

J. Besançon
L. Copeland
F. Hours
J. Macaire
P. Sanlaville

[47] We would like to find larger samples for the Bire Formation and the Middle Paleolithic, to have more dates for the basalts, particularly for B4, and to find the "missing" Qf4, for example.

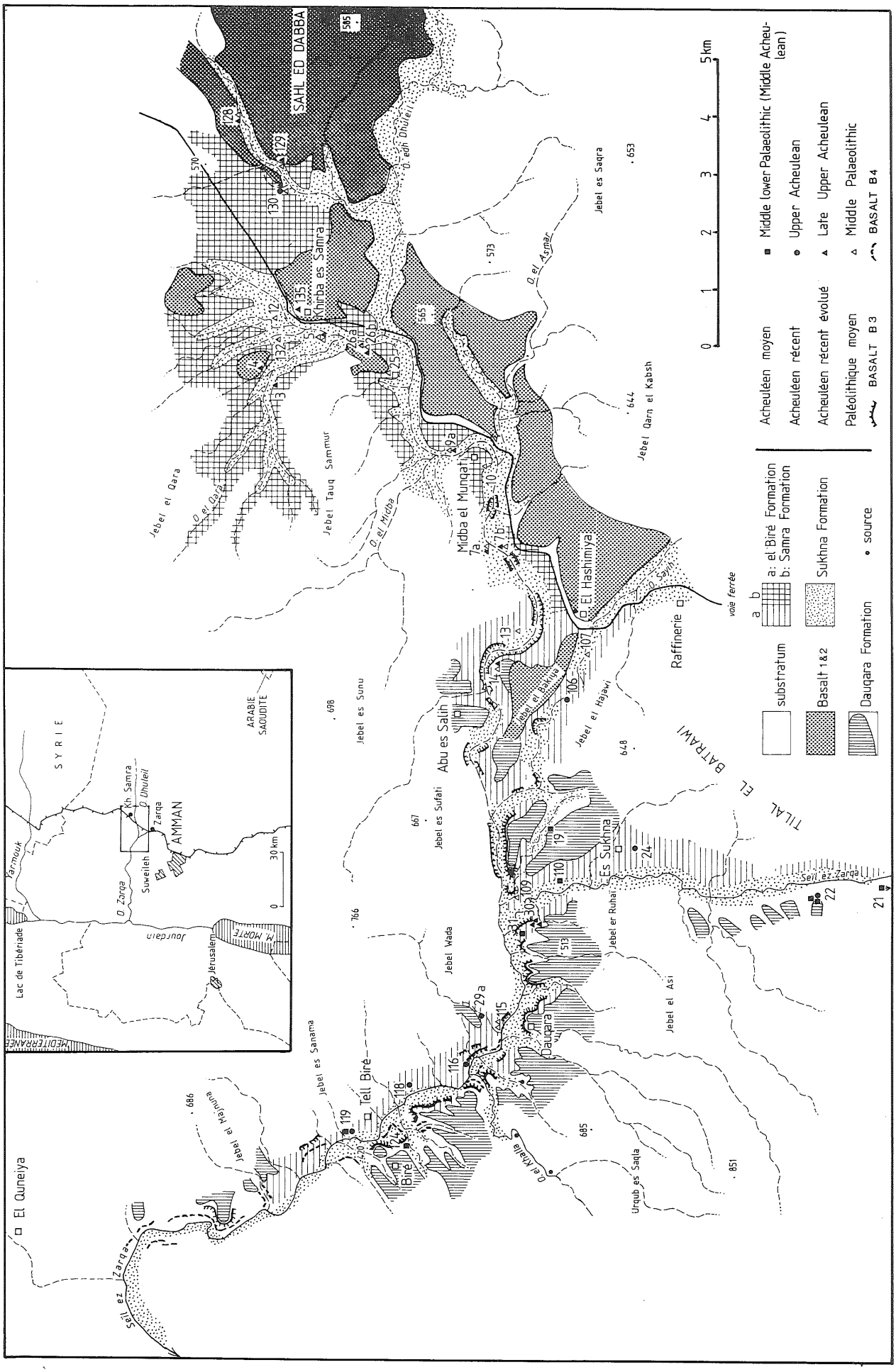

Fig. 1: Map of the Zarqa-Samra sector.

Fig. 2: Location of sites in the Zarqa-Samra sector, 1982-1983.

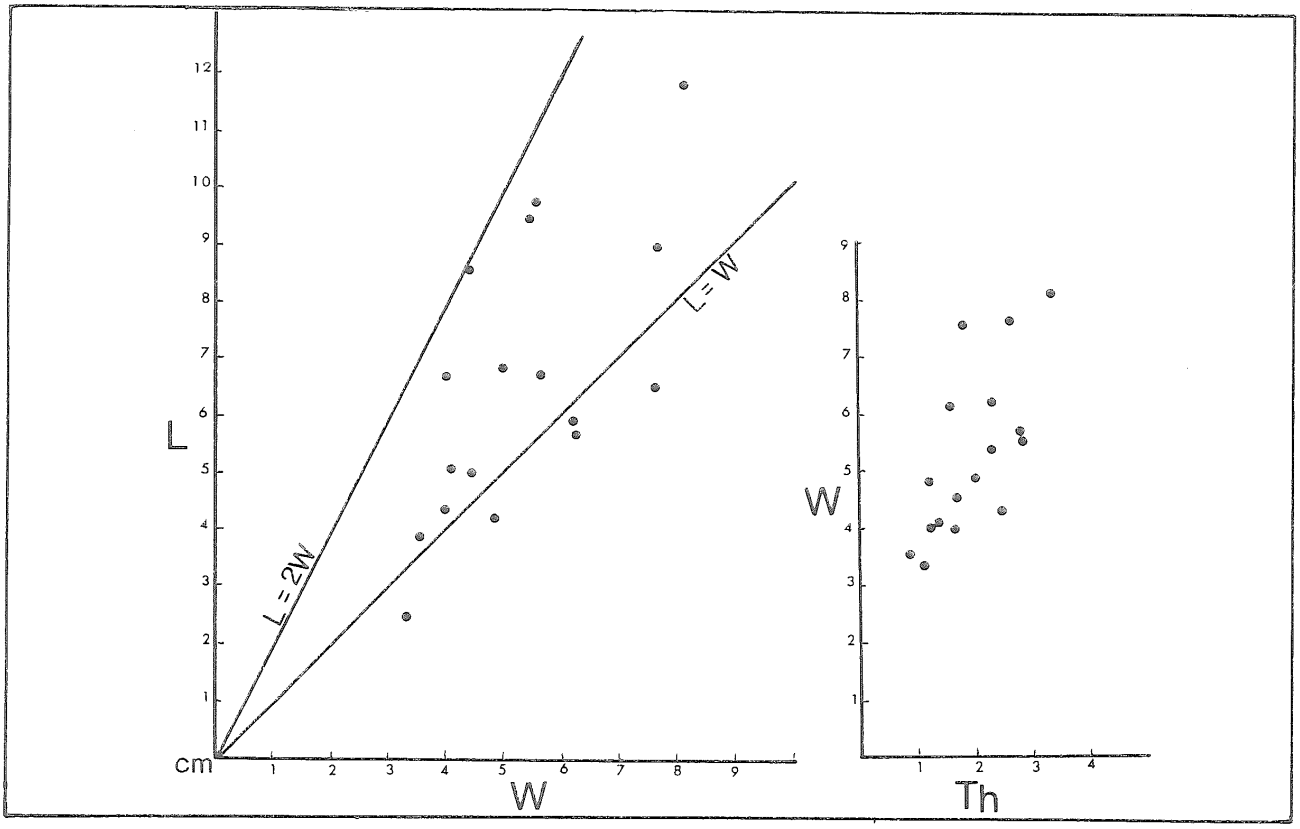

Fig. 3: Length/width and width/thickness of 17 flakes from Dauqara Formation.

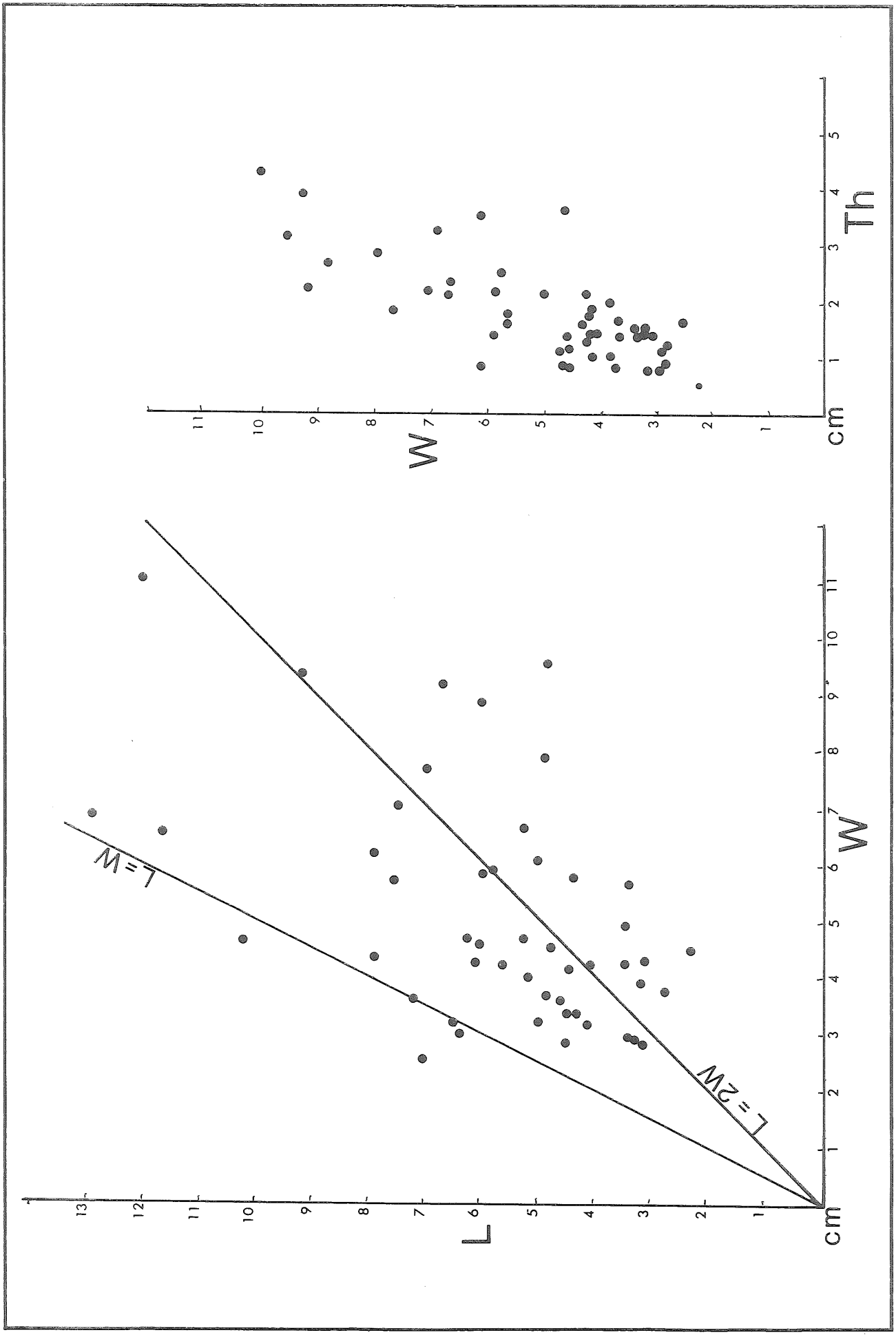

Fig. 4: Length/width and width/thickness of 48 flakes in Biré Formation sites.

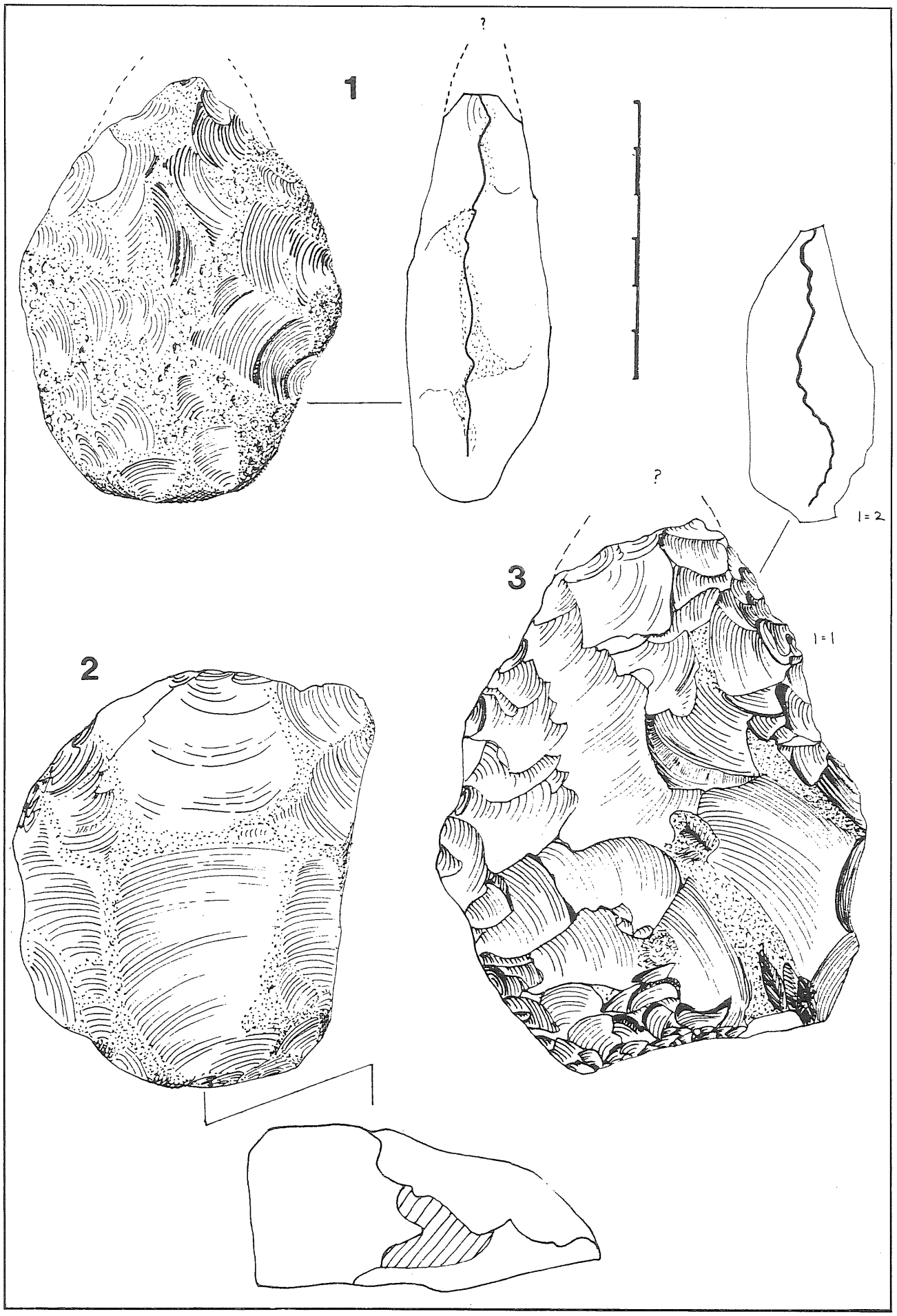

Fig. 5: Artefacts of site 119b (Bire Formation); 1, Extremely rolled, ovate biface; 2, Very rolled unipolar core; 3, Atypical amygdaloid biface rolled, with broken tip.

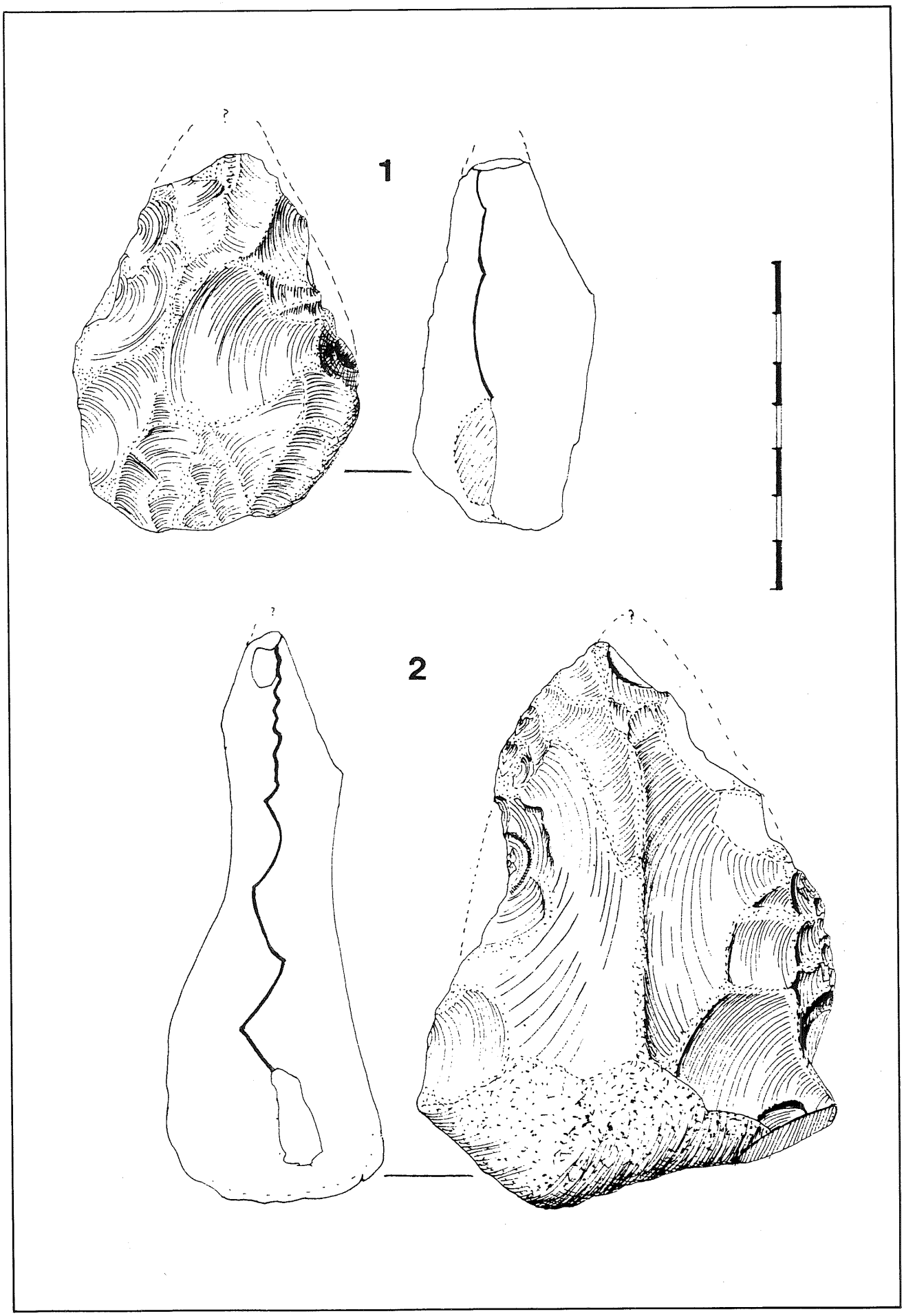

Fig. 8: Artefacts of site 134 (Biré Formation); 1, a typical amygdaloid biface; 2, Broken amygdaloid biface.

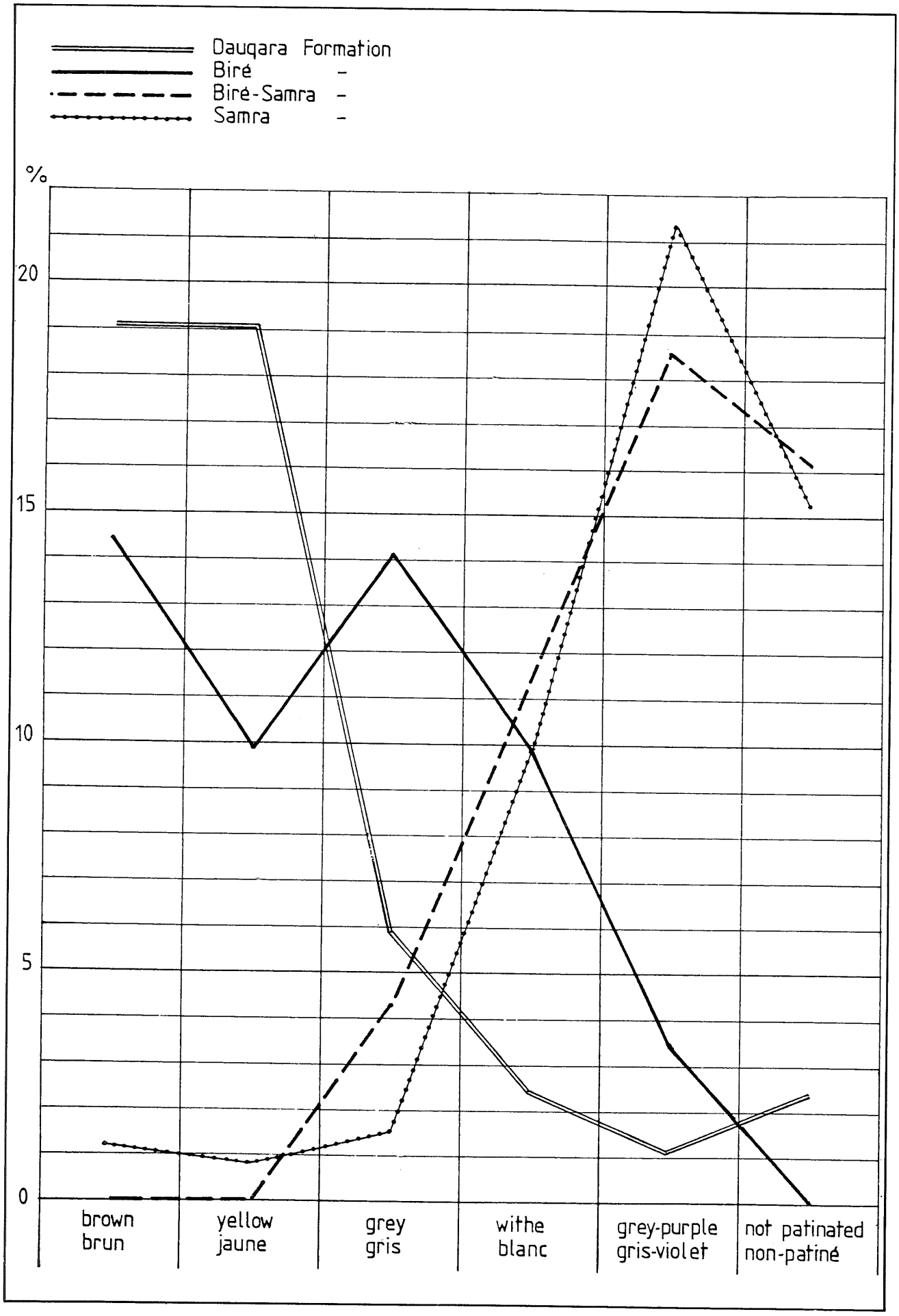

Fig. 9: Patina proportions of the artefacts in four Formations.

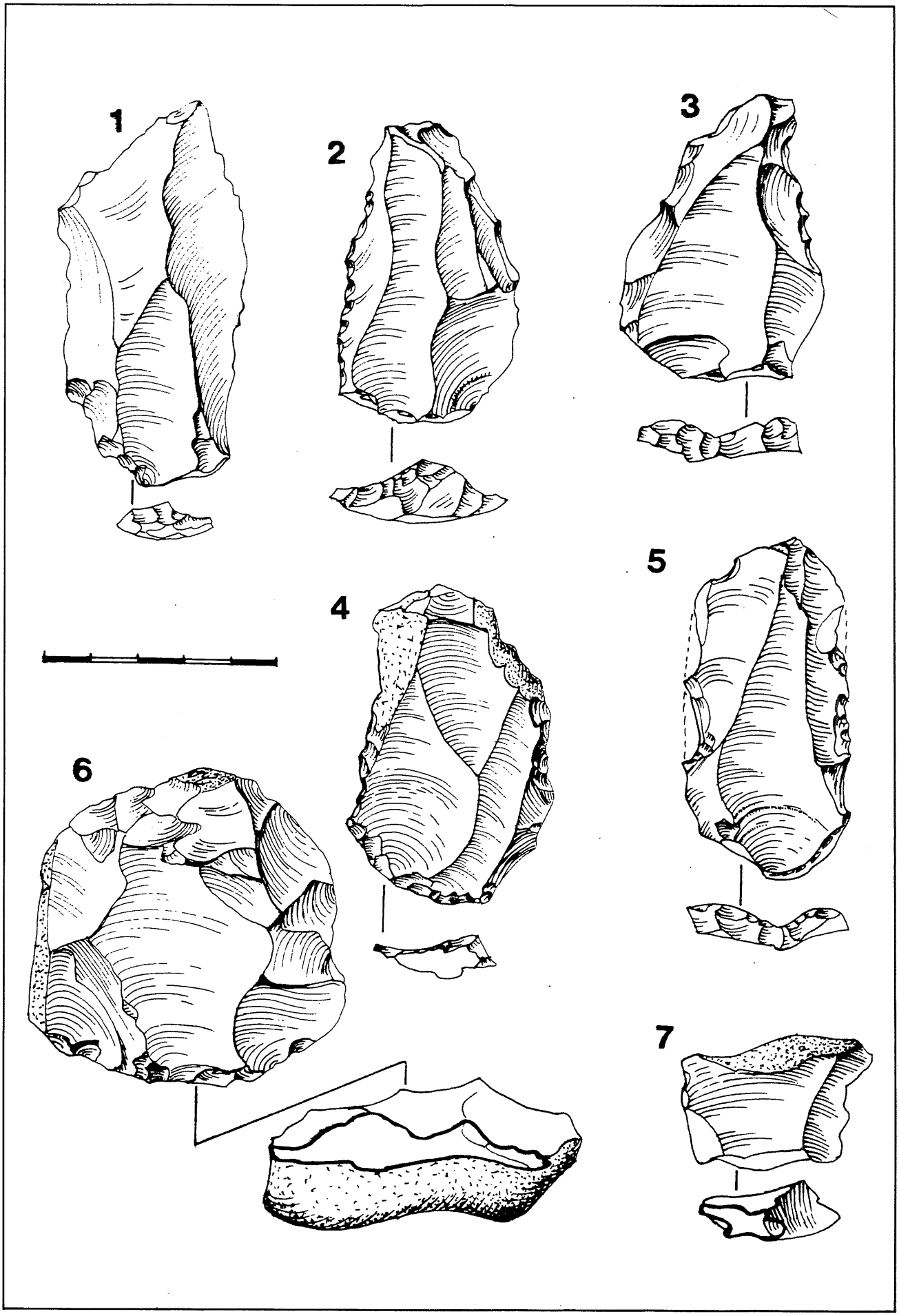

Fig. 10: Artefacts from the Khirbet Samra Formation: 1-2 from site 26b, 3-7 from site 13. 1-3 & 5, Levallois flakes; 4, Atypical Levallois flake; 6, Levallois core; 7, Non-Levallois preparation-flake.

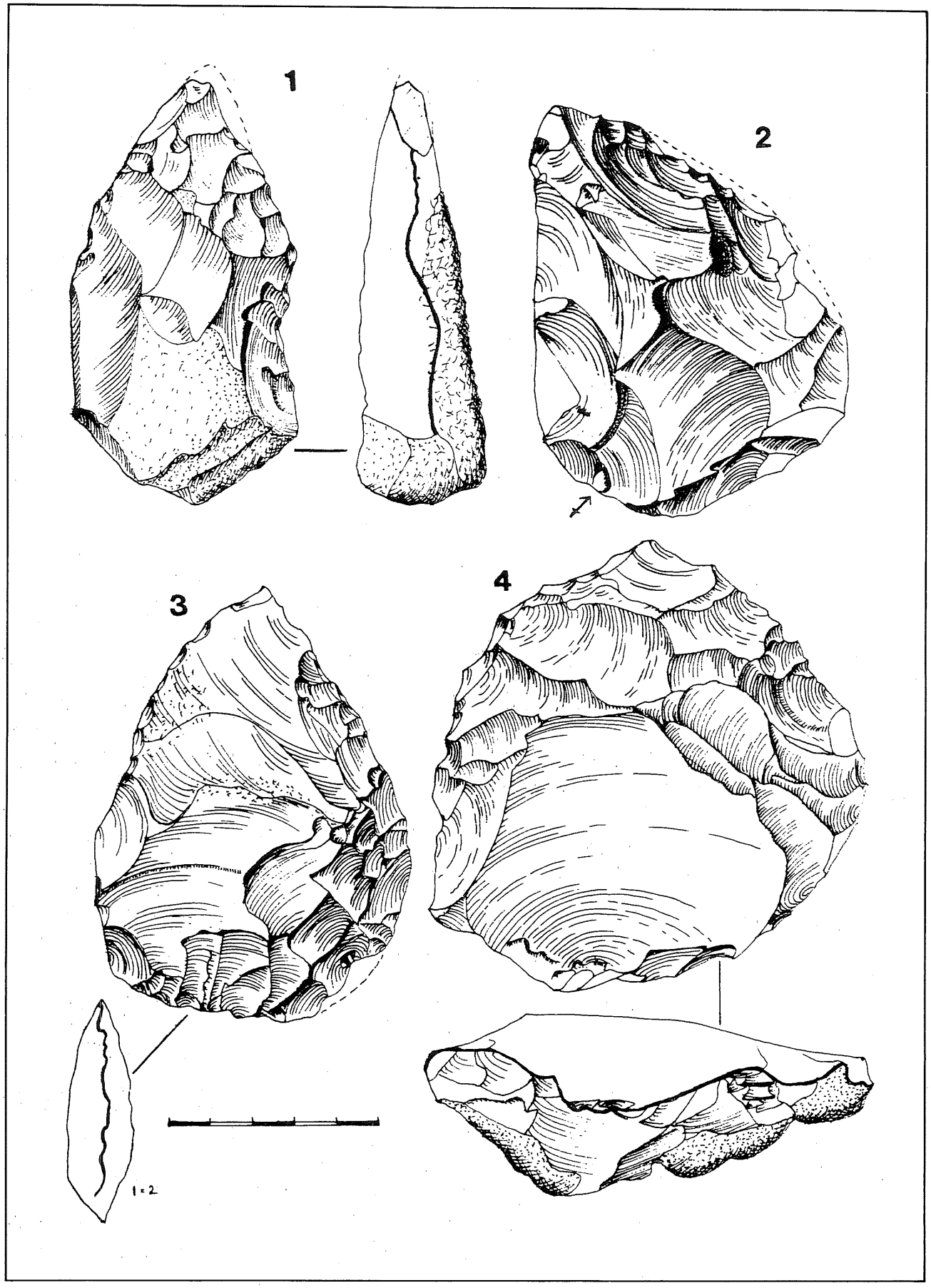

Fig. 11: Artefacts from site 5b, Khirbet Samra Formation; 1, Partial subovate pointed biface, tending to a lanceolate; 2, Bifacial racloir on a flake; 3, Cordiform biface, profile drawn half-size; 4, Classic Levallois core with radial preparation.

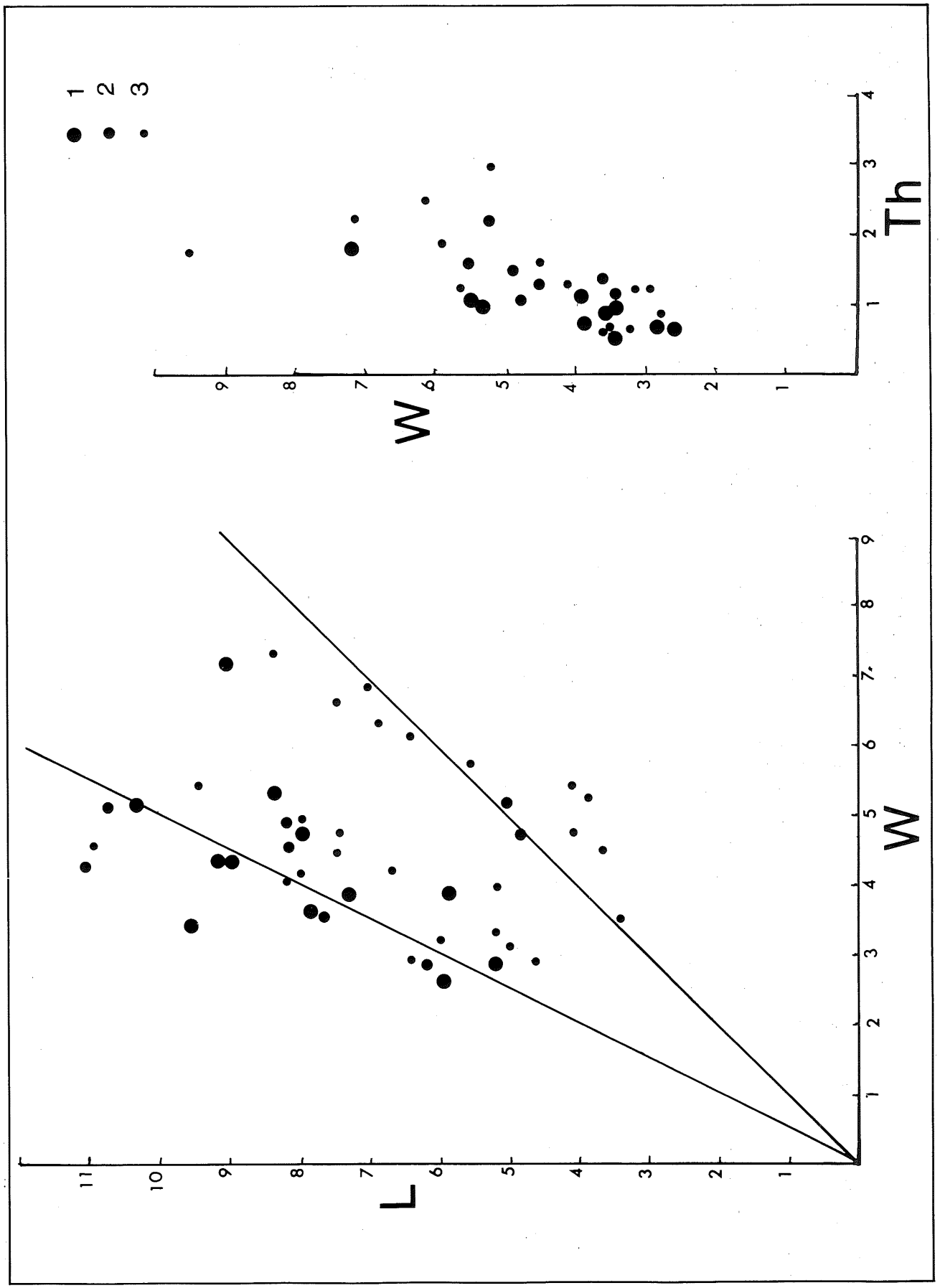

Fig. 12: Length/width of 31 flakes and blades of surface site 7b (Middle Paleolithic): 1=Levallois debitage; 2=Non-Levallois debitage; 3=Cortex and secondary preparation-flakes.

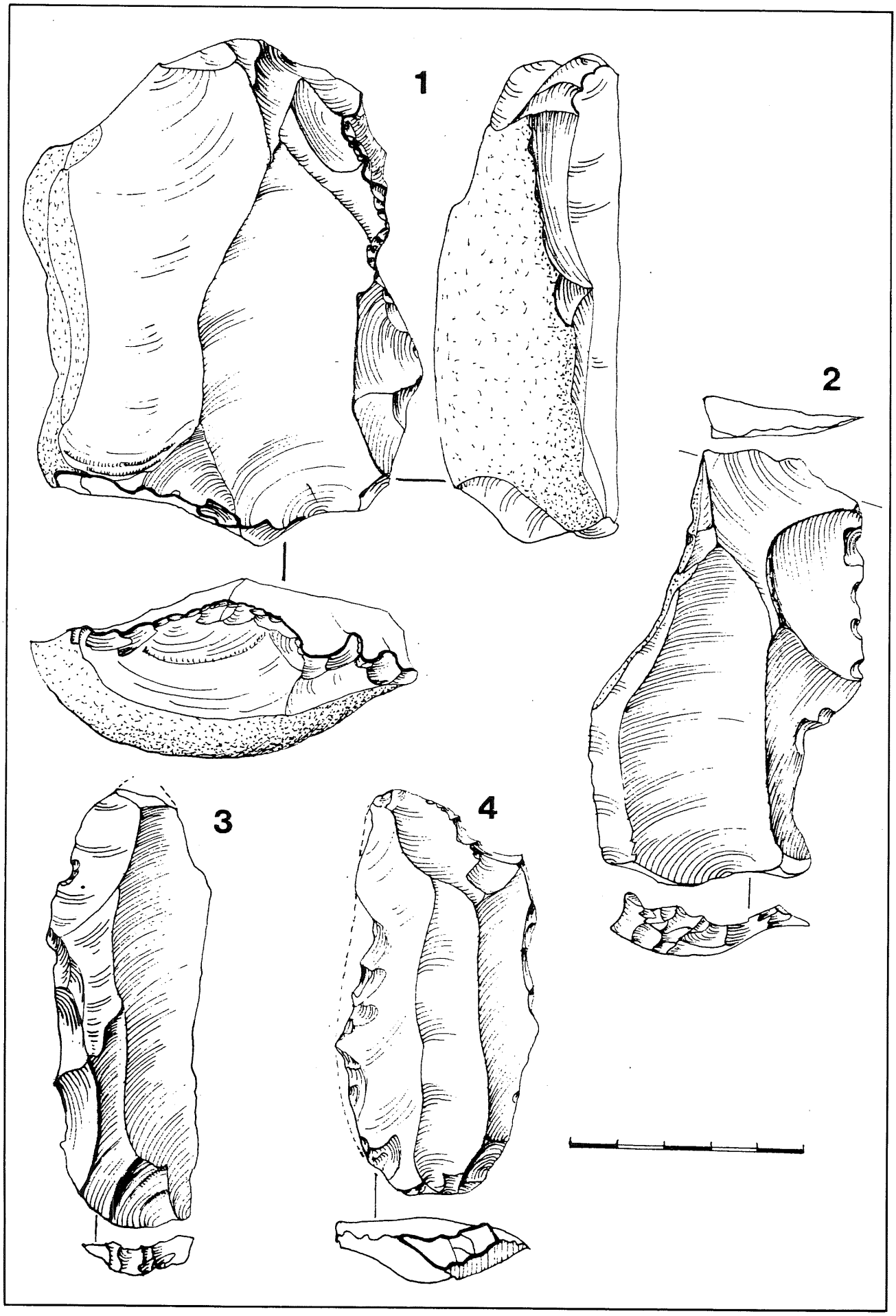

Fig. 13: Artefacts from surface site 7b; 1, Bipolar Levallois blade-core; 2, Atypical Levallois flakes, 3 & 4, Levallois blades from bipolar cores.

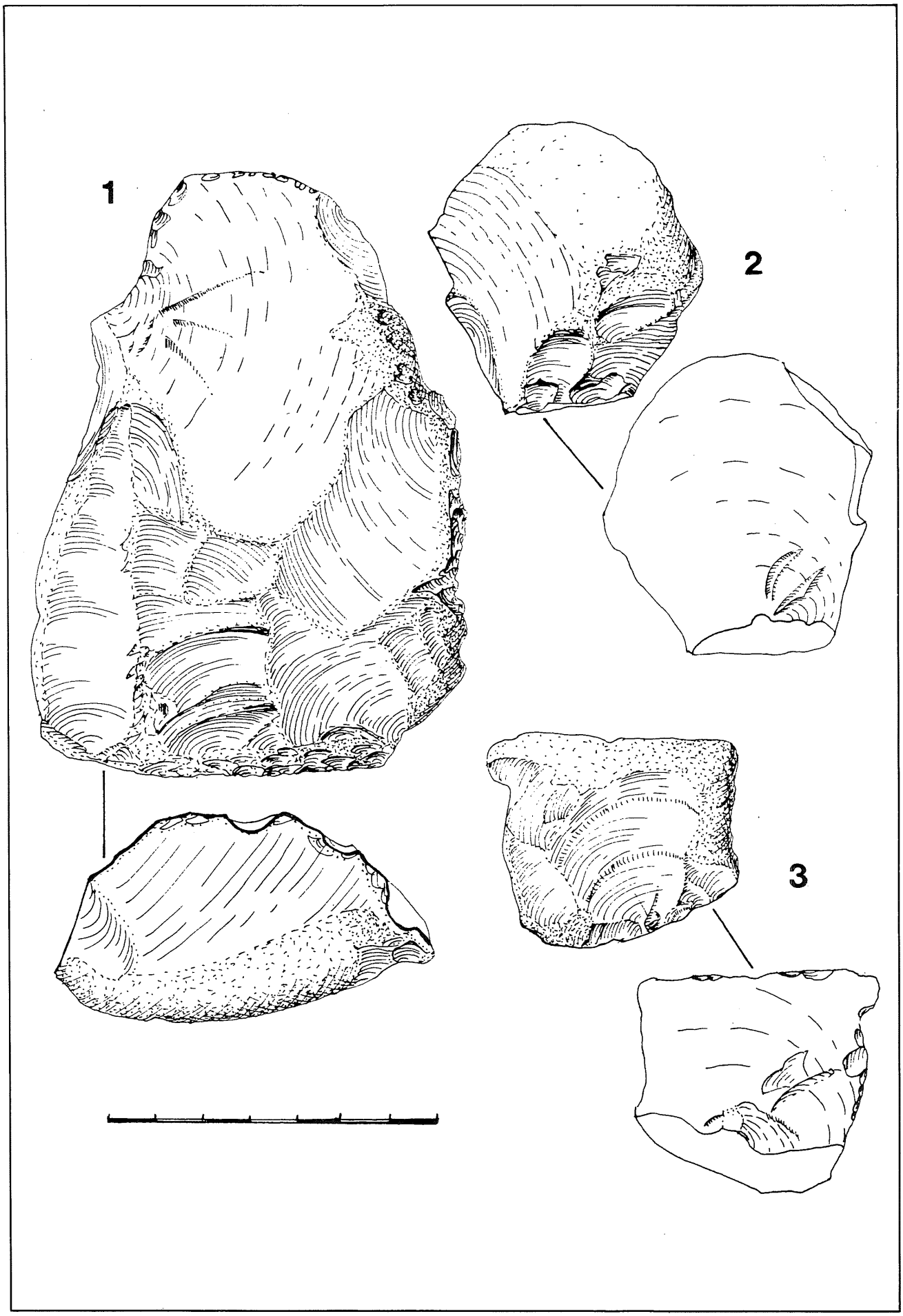

Fig. 6: Artefacts of site 119b (Biré Formation); 1, Unipolar core; 2 & 3, Cortex flakes.

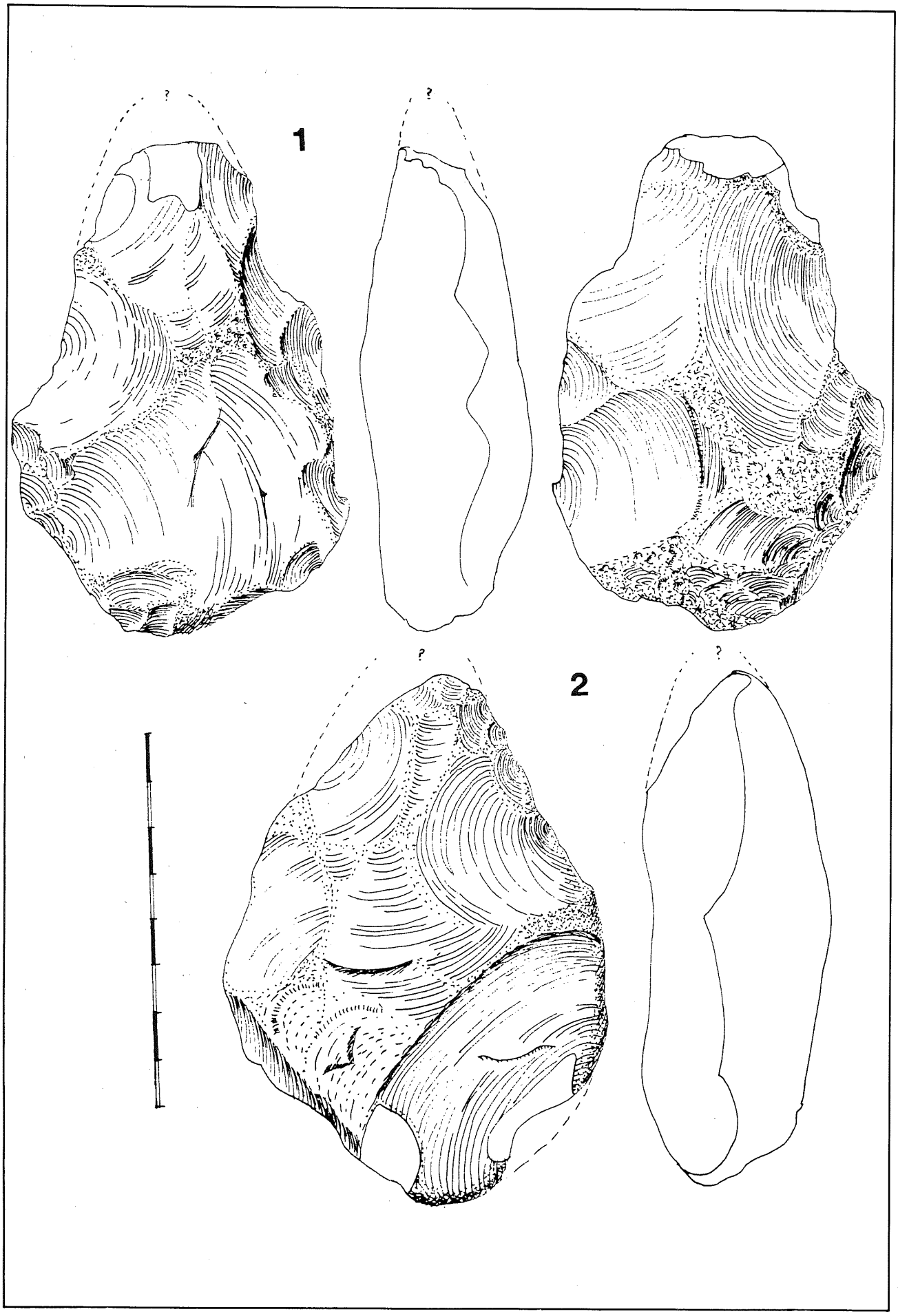

Fig. 7: Artefacts of the Biré Formation; 1, Amygdaloid biface (site 116); 2, Atypical amygdaloid biface (site 134).

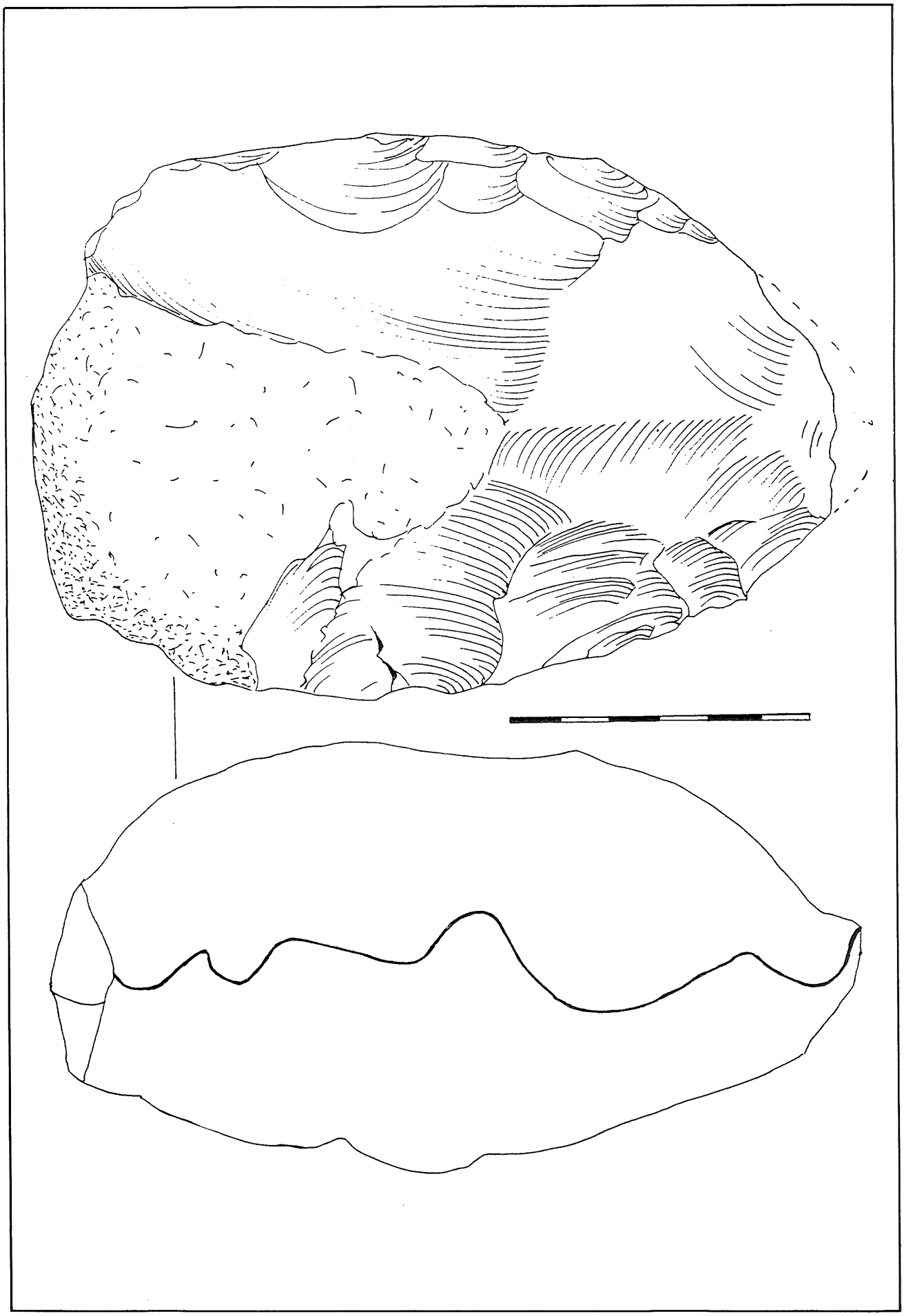

Fig. 14: Large, rolled ovate biface from site 30a.

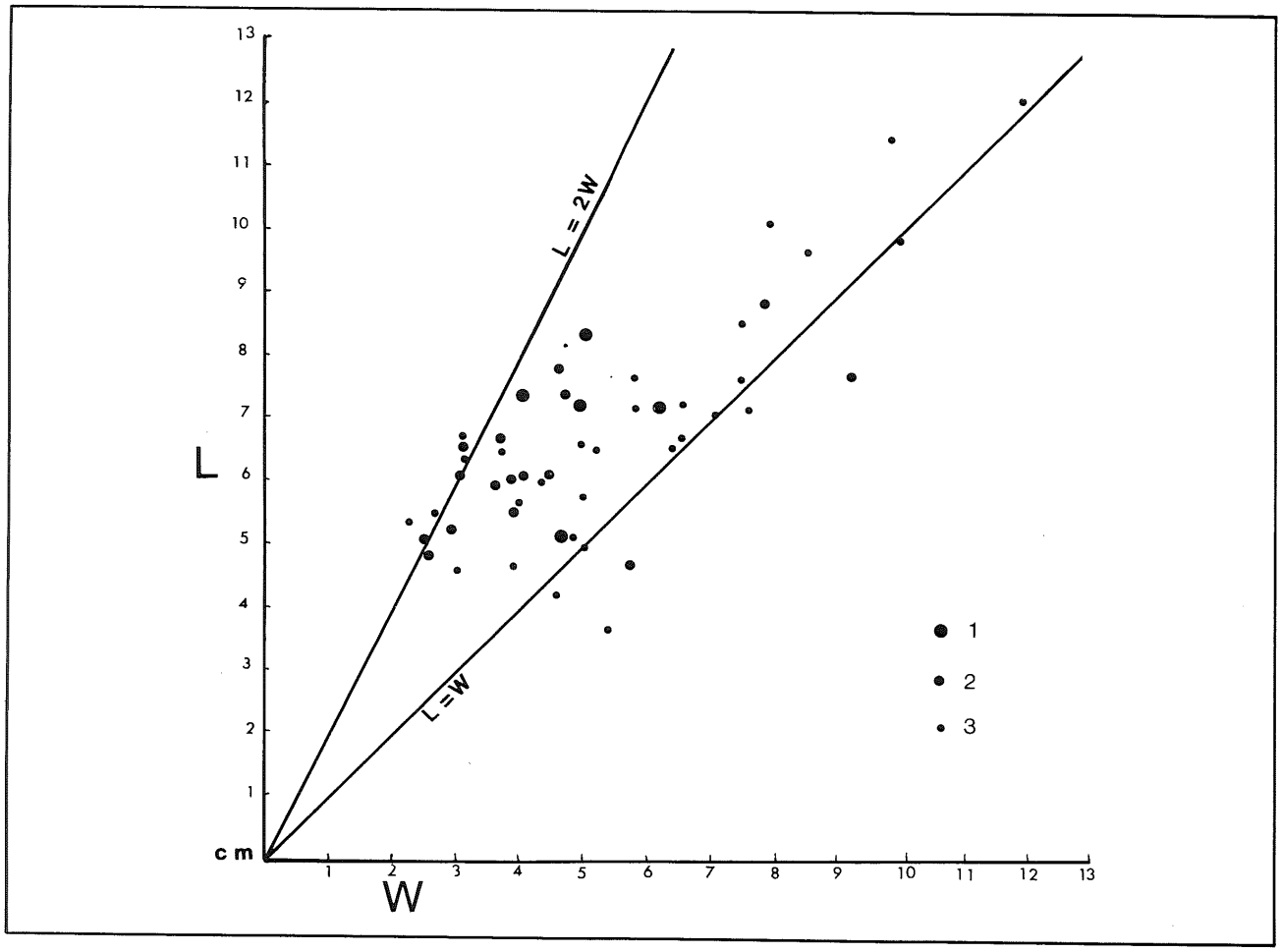

Fig. 15: Khirbet Samra site 4 (Lower Paleolithic). Length/Width of 49 flakes and blades: 1=Levallois debitage; 2: Non-Levallois (flat or orthogonal) debitage; 3: Cortex and secondary preparation-flakes.

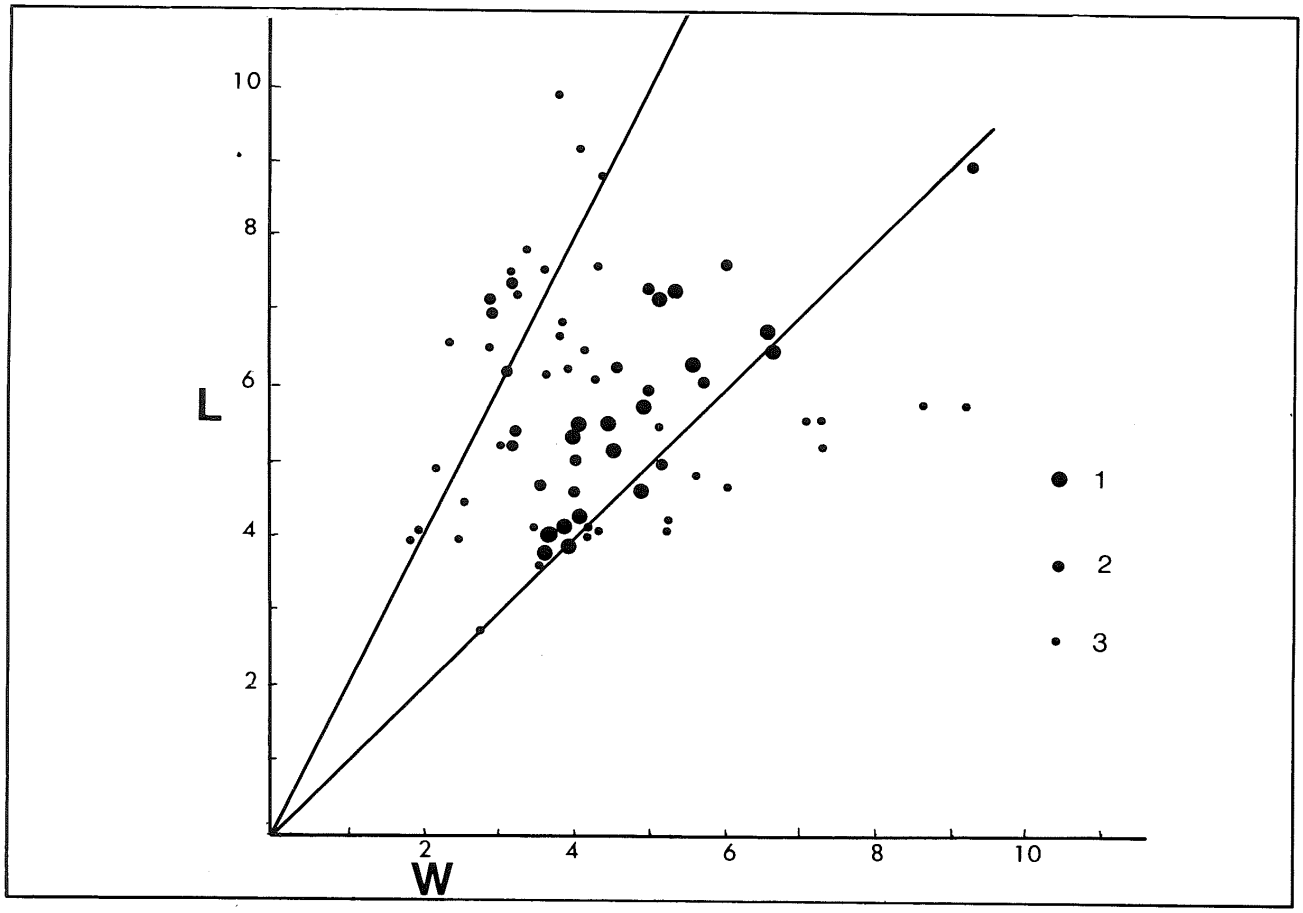

Fig. 16: Khirbet Samra site 3 (Middle Paleolithic). Length/width of 68 flakes and blades: Key as in Fig. 15.

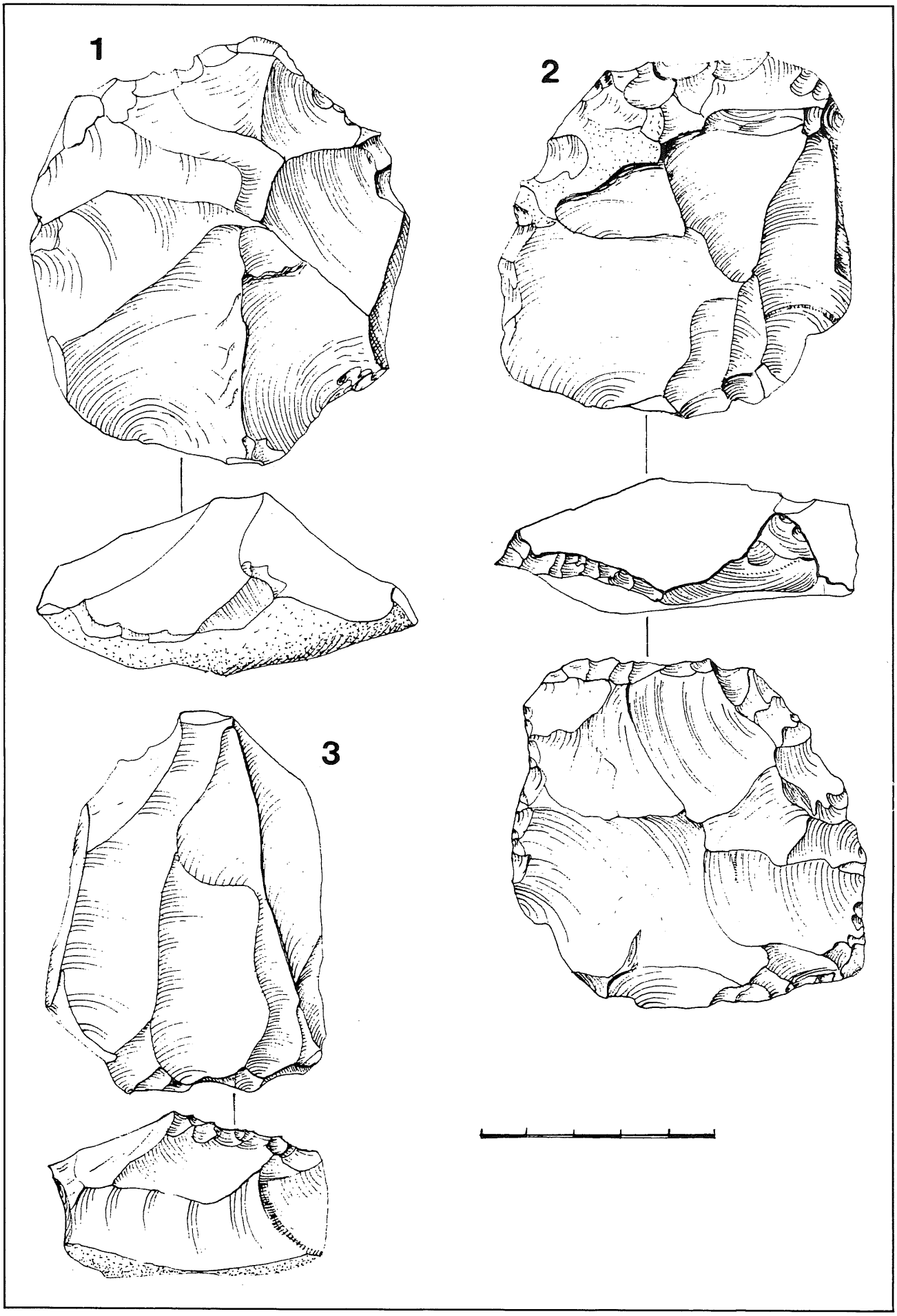

Fig. 19: Artefacts from surface site 30c; 1, Discoid core; 2, Flat debitage core Proto-Levallois; 3, Unipolar core for orthogonal debitage.

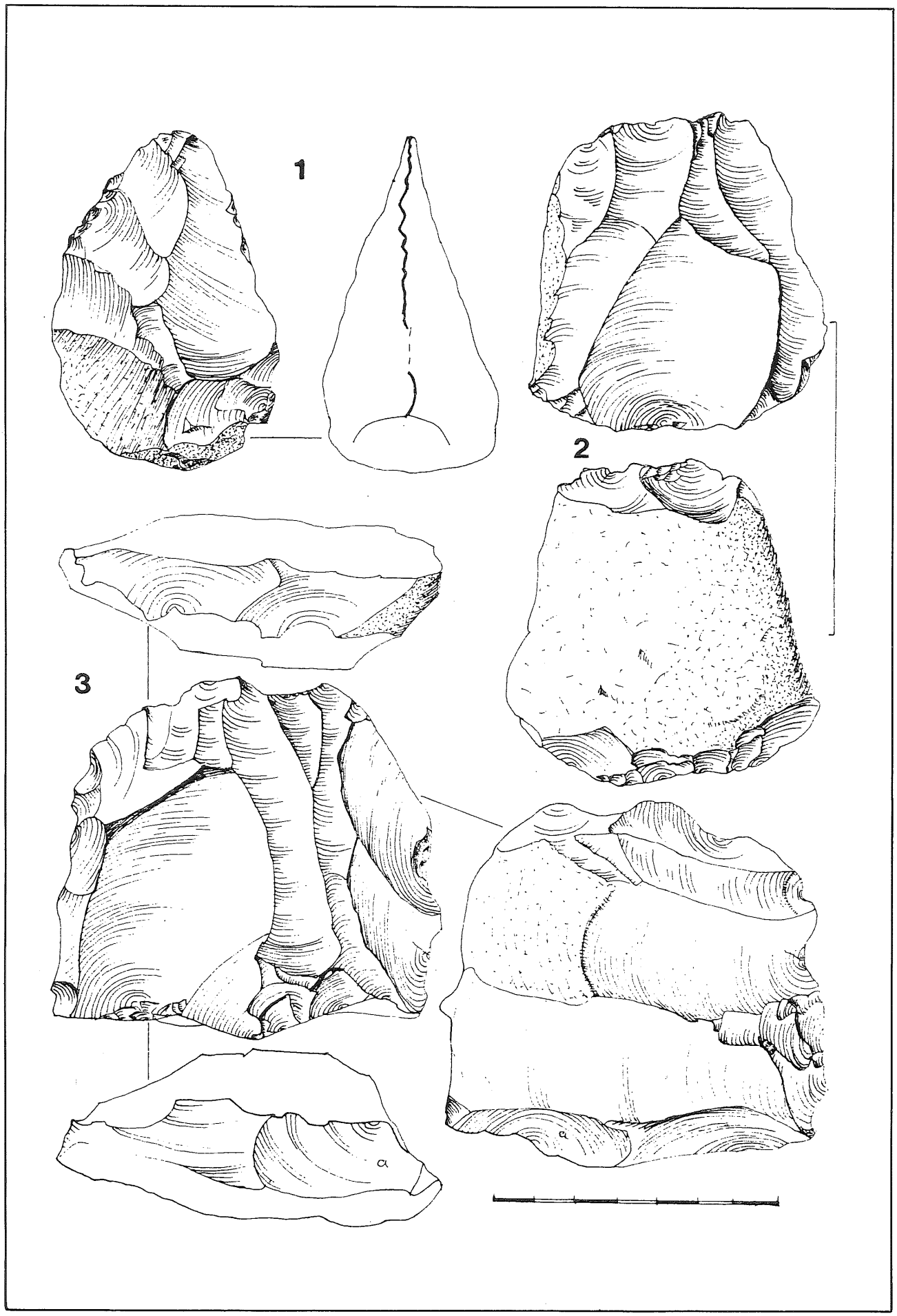

Fig. 20: Artefacts from surface sites 30c (1) and 30b (2 & 3); 1, Short amygdaloid biface; 2, Bipolar core; 3, Double, reversed direction core.

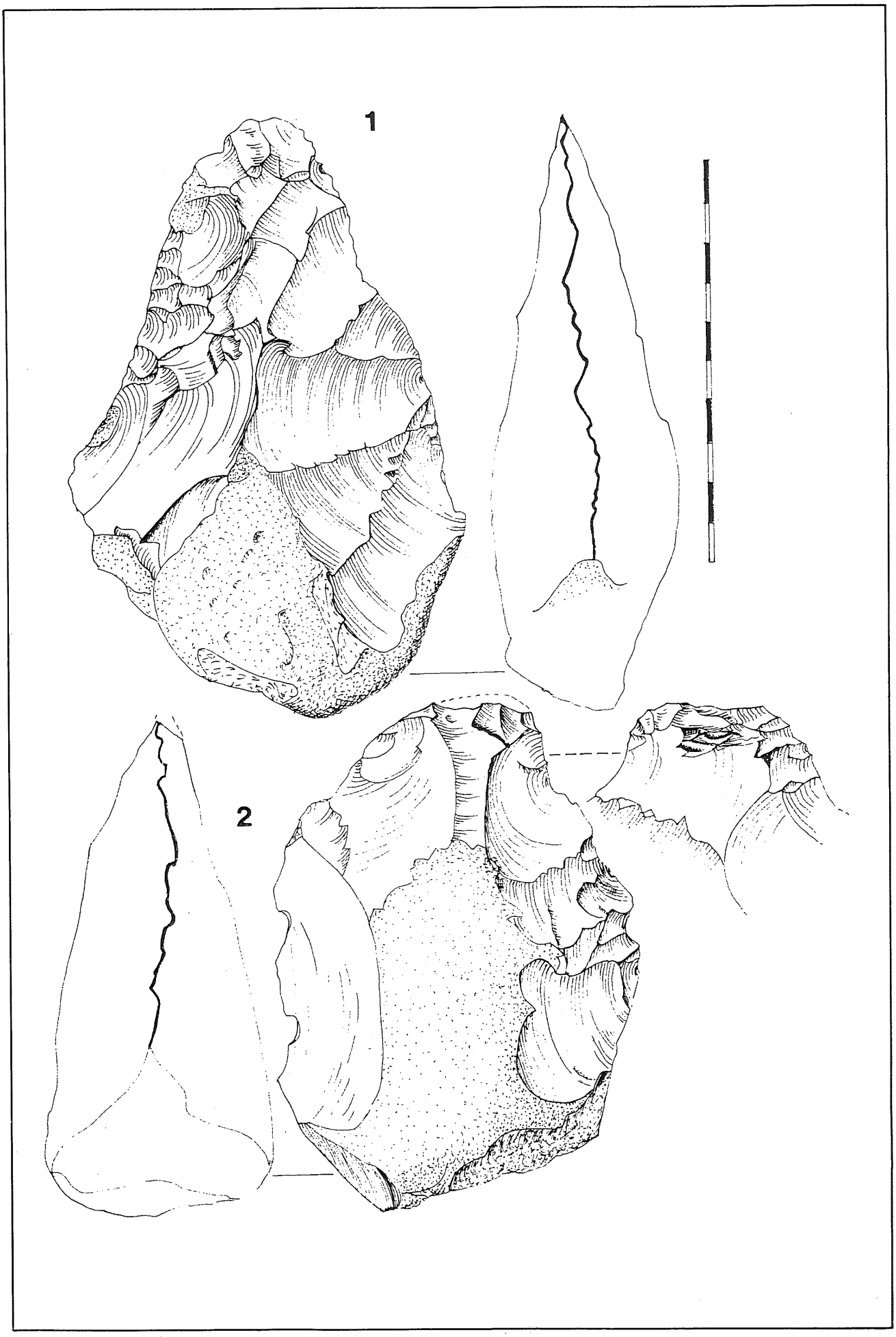

Fig. 17: Artefacts from surface site 30c: 1, Amygdaloid biface; 2, Partial ovate biface.

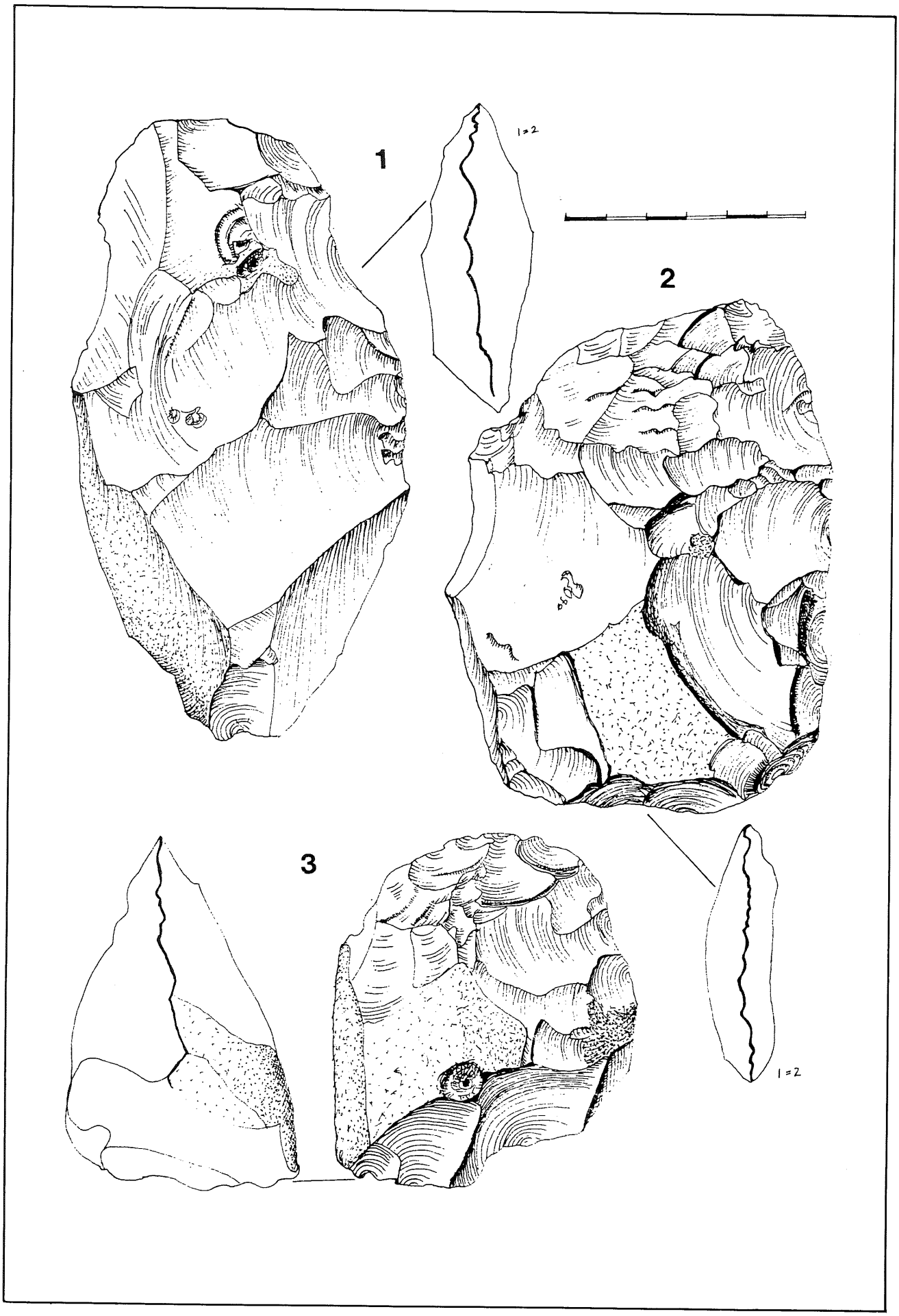

Fig. 18: Artefacts from surface site 30c; 1, Biface rough-out, tending to a bifacial cleaver; 2, Bifacial cleaver with straight oblique tip; 3, D-shaped biface. Profiles of 1 and 2 are drawn half-size.

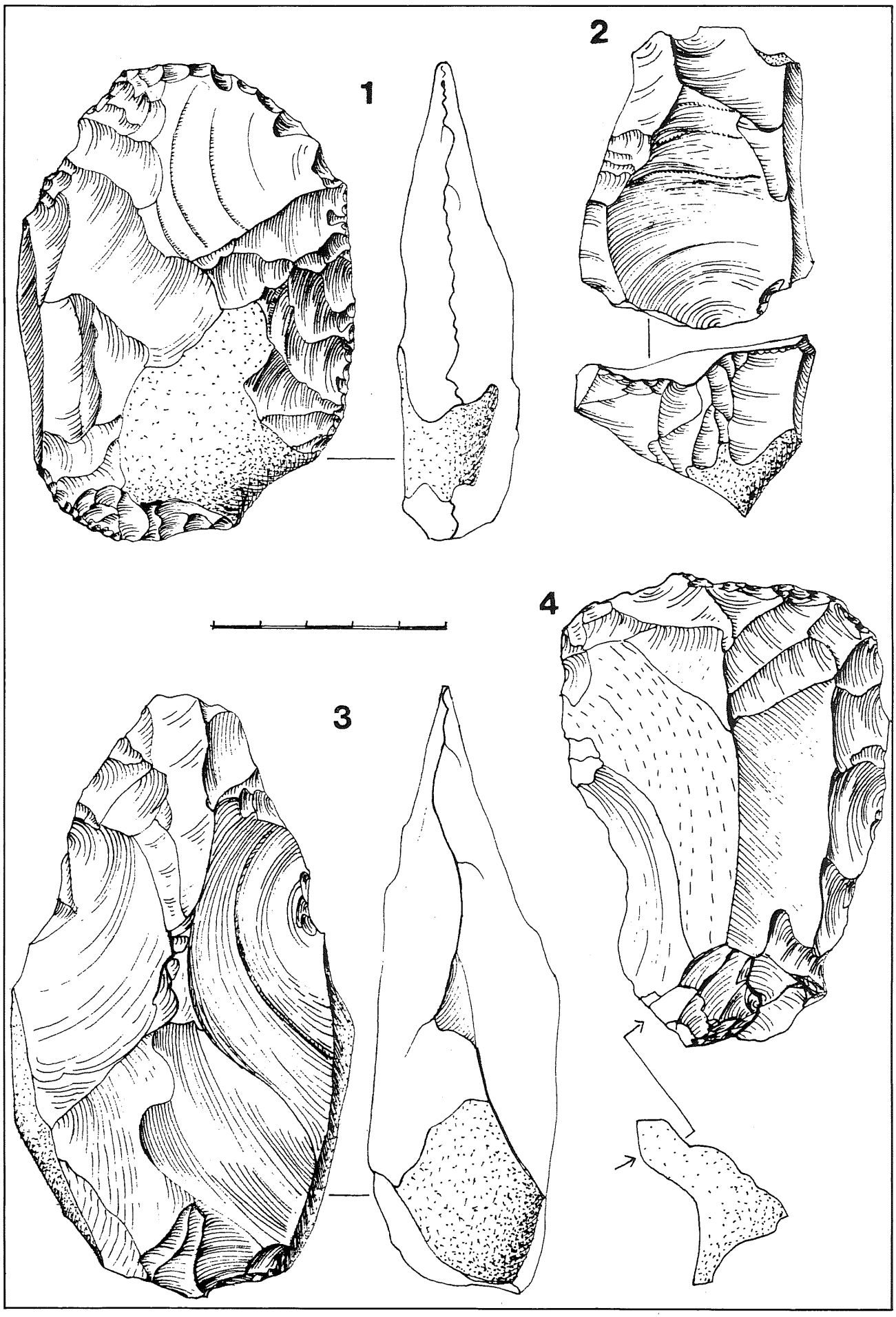

Fig. 21: Artefacts from surface sites 3 (1-3) and 135 (4); 1, Bifacial cleaver or partial ovate biface; 2, Nubian type of bipolar core; 3, Lanceolate biface; 4, Racloir on a flake with cortex butt.

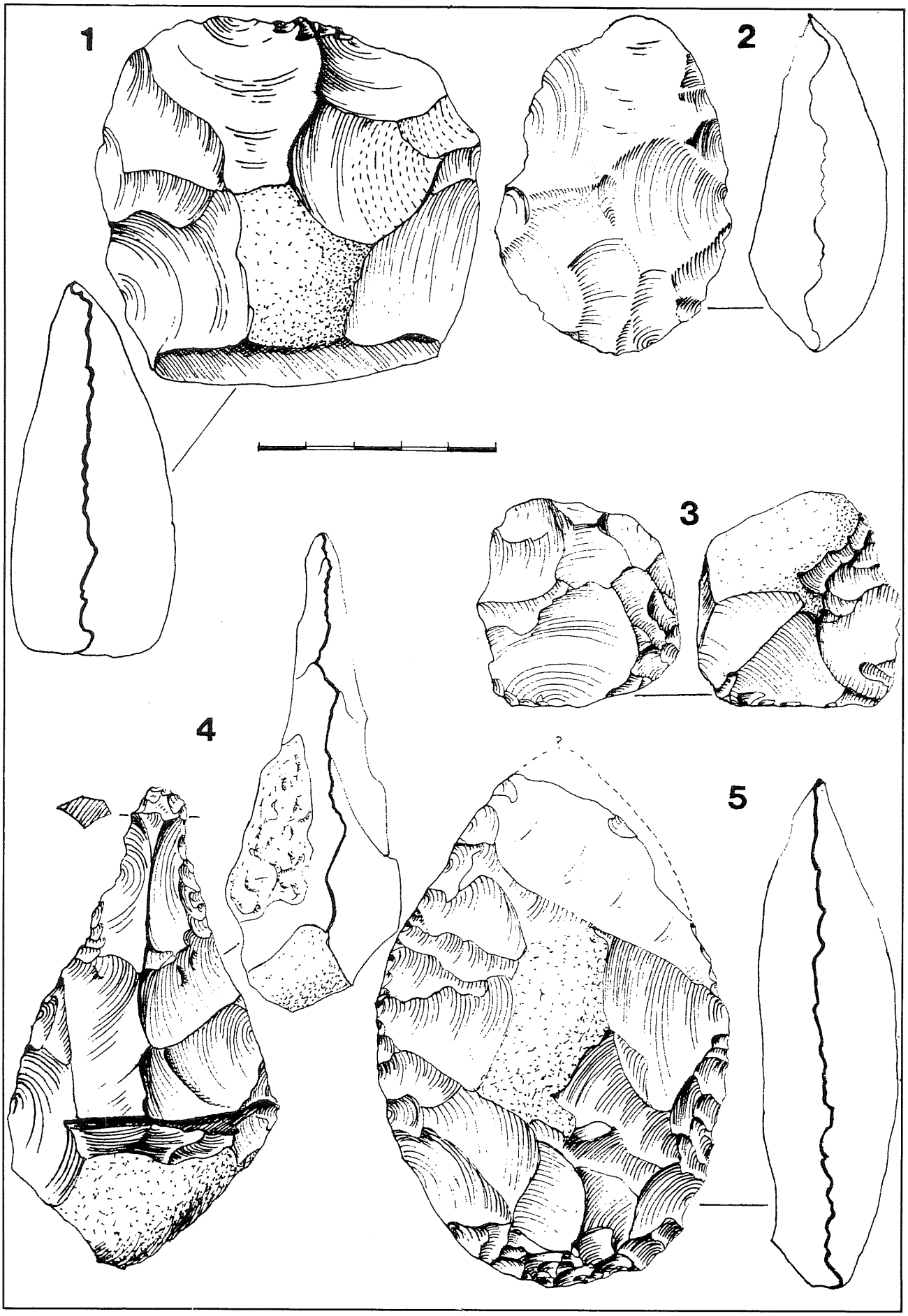

Fig. 22: Artefacts from various surface sites: 1, Bifacial cleaver or D-shaped biface (site 30a); 2, Minute ovate bioface (site 135); 3, Small Levallois core-base (site 14); 4, Pick (site 14); 5, Broken Ovate biface (site 4).

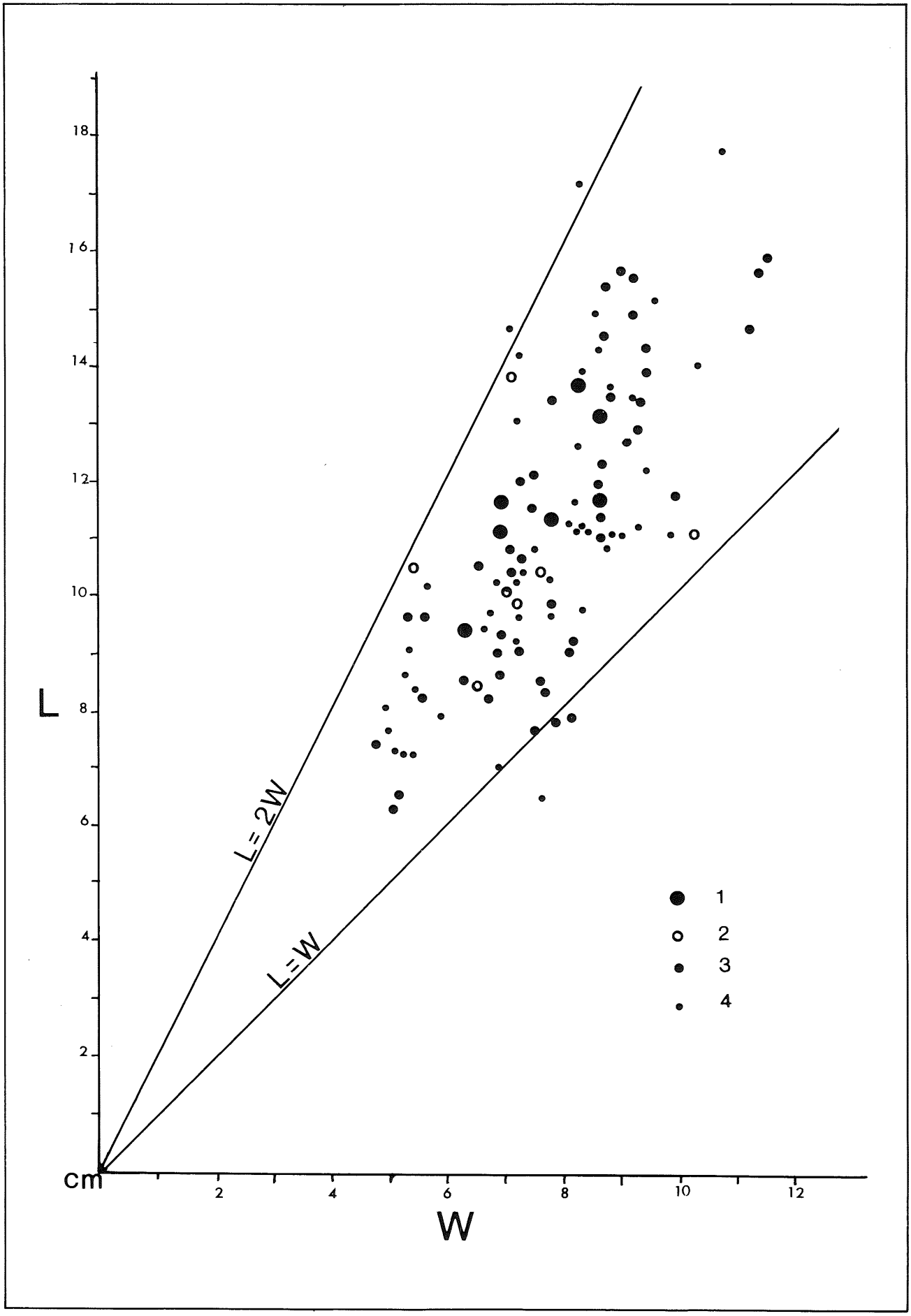

Fig. 23: Length and Width of 100 bifaces in the Zarqa/Samra sector. 1=Qf2 Sites; 2=Qf1 sites; 3=surface of site 30; 4=other surface sites.

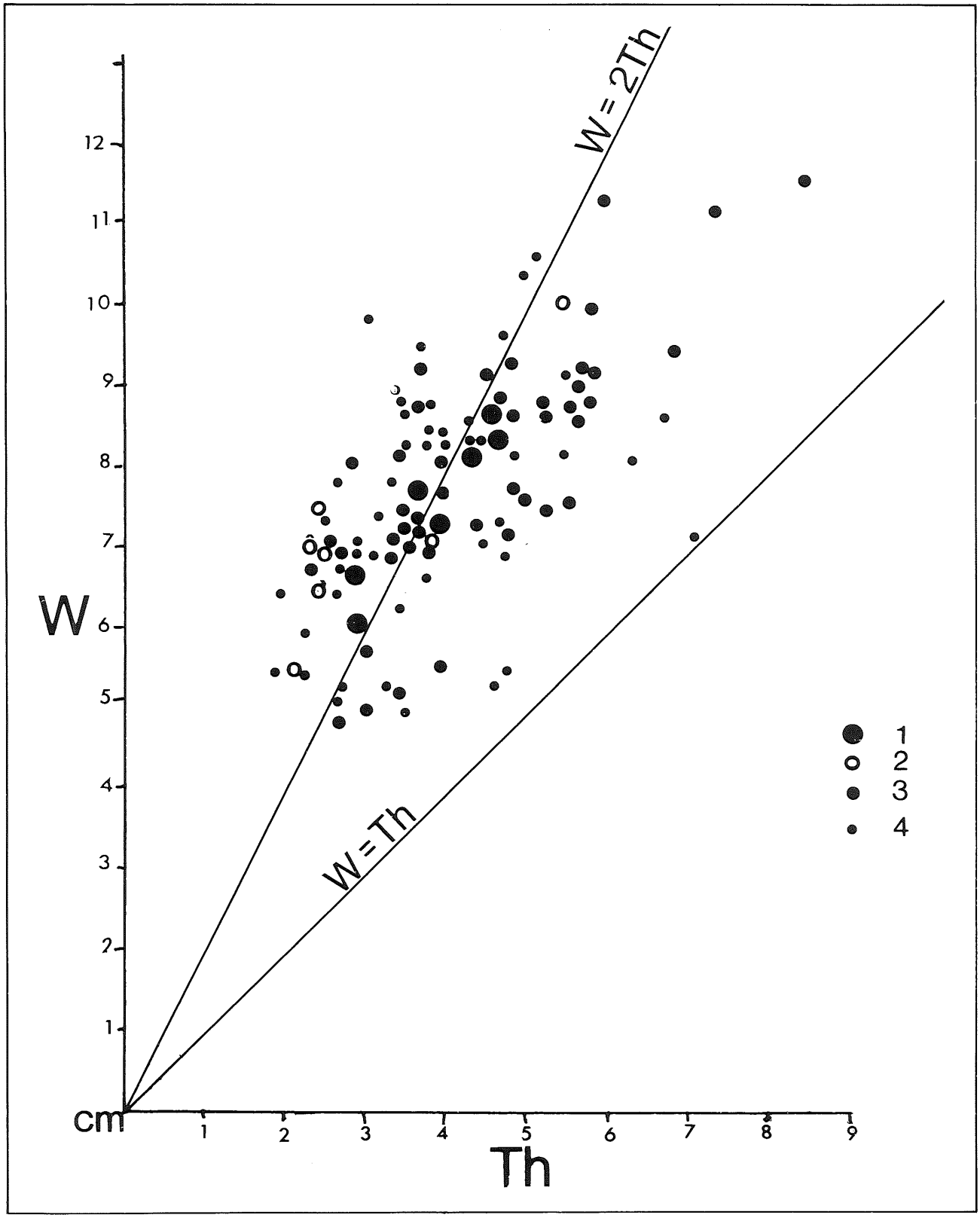

Fig. 24: Width and Thickness of 98 bifaces in the Zarqa/Samra sector.
1=Qf2 sites; 2=Qf1 sites; 3=surface of site 30; 4=other surface sites.

Table 1: Inventory of lower and Middle Paleolithic sites used in this study, listed in chronostigraphic order.

Formation	*Site number*	*Arti-facts*	*Industry*	*Remarks*
Df3	19	12	Indeterminate	1 chopper
Dauqara	21	2	Indeterminate	interesting because of the position
	22a1	9	Indeterminate	
	22b	12	Indeterminate	
	31b	2	Indeterminate	interesting because of the position
	110	2	Indeterminate	,, ,,
	119a	1	Indeterminate	,, ,,
	124	2	Indeterminate	,, ,,
Qf2	22a2	26	Acheulean	embedded in the Qf3
Bire	24	1	Indeterminate	
	29a	17	Indeterminate	
	106	1	Indeterminate	
	116	6	Acheulean	1 biface
	118	10	Indeterminate	
	119b	39	Acheulean	3 bifaces
	130a	6	Indeterminate	
	134	8	Acheulean	3 bifaces
Qf2-1	7a	34	Middle Paleo	in fact Qf1
Bire-	9a	14	Mixture?	Middle Paleo and 1 biface
Samra	10	4	Middle Paleo	in fact Qf1
	11	5	Indeterminate	
	12	9	Middle Paleo	or older
Qf1	5b	54	Middle Paleo	5 bifaces
Samra	13	26	,,	"Middle" Terrace-levallois
	26b	10	,,	"Middle" Terrace-levallois 1 biface
	107	1	,,	
	109	27	,,	Early Middle Paleolithic 1 biface
	115a	11	,,	
	115b	14	,,	Blade industry
	129a	3	indeterminate	Lower Terrace
	132	12	,,	Qf1
Surface	3	133	Late Acheulean	
Sites	4	95	,, ,,	
	5a	162	Middle Paleo	
	2b	94	Late Acheulean	some levallois
	14	24	,, ,,	some levallois
	25b	20	Middle Paleo	
	30a	66	Late Acheulean	
	30b	103	,, ,,	
	30c	71	,, ,,	
	128	45	Mixture	Late Acheulean and Middle Paleo
	129b	18	Late Acheulean	Erosion from Qf2?
	130b	24	,, ,,	Erosion from Qf2?
	130c	7	Middle Paleo	
	135	248	Late Acheulean	Site Eponyme-various site

Table 2: Inventory of artefacts in Dauqara Formation sites

	Sites of the Dauqara Formation								
Artefacts	*19*	*21*	*22al*	*22b*	*31b*	*110*	*119a*	*124*	*Total*
Cores	4	—	—	2	—	—	—	—	6
Flakes	7	2	9	10	2	2	1	2	35
Core-tools	1	—	—	—	—	—	—	—	1
Total	12	2	9	12	2	2	1	2	42

Table 3: Flake types and butt types in Dauqara Formation flakes

Flake types	*Butt types*	*Cortex*	*Plain*	*Dihed.*	*Facet.*	*Lipped/ Punctif.*	*Removed*	*Broken*	*Unre-cog.*	*Totals*
Levallois flake		—	—	—	—	—	—	—	—	—
Cortex flake		7	7	—	—	—	1	2	3	20
Preparation flake		—	4	—	—	—	—	5	1	10
Flat debitage		—	2	—	—	—	—	—	—	2
Orthogonal debitage		—	3	—	—	—	—	—	—	3
Blade		—	—	—	—	—	—	—	—	—
Chips		—	—	—	—	—	—	—	—	—
Total		7	16	—	—	—	1	7	4	35

Table 4: Inventory of Artefacts at Bire Formation Sites

	Site of the Bire Formation									
Artefacts	*22a2*	*24*	*29a*	*106*	*116*	*118*	*119b*	*130a*	*134*	*Total*
Cores	6	—	—	—	—	1	5	1	3	16
Flakes	19	1	16	1	5	9	30	4	2	87
Core-tools	1	—	1	—	1	—	3	1	3	10
Debris	—	—	—	—	—	—	1	—	—	1
Total	26	1	17	1	6	10	39	6	8	114

Table 5: Flake types and butt types in Bire Formation Flakes

Flake types	*Butt types*	*Cortex*	*Plain*	*Dihed.*	*Facet.*	*Lipped/ Punctif*	*Removed*	*Broken*	*Unre-cog.*	*Total*
Levallois flake		—	—	—	—	—	—	—	—	—
Cortex flake		17	16	—	—	—	1	3	4	41
Preparation flake		3	7	2	—	1	—	2	2	17
Flat debitage		3	1	1	2	1	1	3	—	12
Orthogonal debitage		—	1	1	—	—	—	1	2	5
Blade		1	3	1	1	—	—	—	—	6
'Eclat de taille'		—	—	—	—	—	—	—	—	—
Chips		—	—	—	—	—	—	—	6	6
Total		24	28	5	3	2	2	9	14	87

Table 6: Inventory of Artefacts in Bire-Samra (Qf2-1) and Khirbet Samra (Qf1) Formation Sites

	Sites of the Bire-Samra Formation					*Qf2-1*	*Sites of the Khirbet Samra Formation*									*Qf1*	*Combd.*
Inventory	*7a*	*9a*	*10*	*11*	*12*	*Total*	*5b*	*13*	*26b*	*107*	*109*	*115a*	*115b*	*129a*	*132*	*Total*	*Total*
Cores:																	
Levallois for points	—	—	1	—	—	1	2	—	—	—	1	—	—	—	—	3	4
Levallois for flakes	3	—	—	—	—	3	2	2	—	—	1	—	—	—	—	5	8
Levallois 'sommaire'	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	3	3
Mousterian	—	—	—	—	—	—	—	—	2	—	1	—	1	—	—	4	4
Proto-Mousterian	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	2	2
Flat debitage	1	—	—	—	—	1	4	1	—	—	—	—	1	—	1	7	8
Orthogonal	—	1	—	—	—	1	1	—	—	—	—	—	1	—	—	2	3
Prismatic	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polyhedric	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1
Amorphous/fragment	—	—	—	1	—	1	—	—	3	—	—	—	—	—	—	3	4
Exhausted disc.	—	1	—	1	—	2	1	1	1	—	—	1	1	—	2	7	9
Total cores	4	2	1	2	—	9	13	4	6	—	4	2	4	—	4	37	46
Flake & flake tools:																	
Levallois	2	1	—	—	1	4	6	2	2	—	3	—	—	—	1	14	18
Preparation	4	1	1	—	3	9	4	9	—	—	3	3	4	—	5	28	37
Cortex	7	3	1	—	1	12	8	8	—	—	6	2	3	3	—	30	42
Flat	6	3	1	2	1	13	6	3	1	1	3	1	—	—	—	15	28
Orthogonal	6	1	—	—	—	7	5	—	—	—	2	—	—	—	—	7	14
'Eclat de taille'	1	—	—	—	2	3	3	—	—	—	—	1	—	—	—	4	7
Blade	—	—	—	—	—	—	1	—	—	—	—	3	—	—	—	4	4
Chips	—	—	—	1	—	1	—	—	—	—	—	1	—	—	—	1	2
Total flakes	26	9	3	3	8	49	33	22	3	1	17	8	10	3	6	103	152
Core-tools:																	
Choppers	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	4	4
Bifaces	1	—	—	—	—	1	5	—	1	—	1	—	—	—	—	7	8
Total core-tools	1	—	—	—	—	1	5	—	1	—	5	—	—	—	—	11	12
Debris	3	3	—	—	1	7	3	—	—	—	1	1	—	—	2	7	14
Total	34	14	4	5	9	66	54	26	10	1	27	11	14	3	12	158	224

Table 7: Tool types in Bire-Samra and Khirbet Samra Formation Sites

	Sites of the Bire-Samra Formation					*Qf2-1*	*Sites of the Khirbet Samra Formation*									*Qf1*	*Combd.*
Tool types	*7a*	*9a*	*10*	*11*	*12*	*Total*	*5b*	*13*	*26b*	*107*	*109*	*115a*	*115b*	*129a*	*132*	*Total*	*Total*
Levallois flake	2	—	—	—	1	3	—	—	2	—	3	—	—	—	1	6	9
Levallois point	—	1	—	—	—	1	—	1	—	—	—	—	—	—	—	1	2
Levallois blade	—	—	—	—	—	—	6	1	—	—	—	—	—	—	—	7	7
Racloir, simple convex	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	2
Racloir, bifacial	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1
Racloir, offset	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1
End-scraper	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Denticulate	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1
Bec	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1
Various retouch	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Chopper, lateral	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	3	3
Chopper, distal	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1
Biface	—	1	—	—	—	1	5	—	1	—	—	—	—	—	—	6	7
Pick	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1
Total	3	3	—	—	1	7	16	2	3	—	9	—	—	—	1	31	38

Table 8, a and b: Types of flake and types of butt at sites of the a) Bire-Samra and b) Khirbet Samra Formations

Flake type	*Cortex*	*Plain*	*Facet*	*Dihed*	*Lipped/ punctif*	*Removed*	*Broken*	*Unrecog.*	*Total*
a)			Butt types at Bire-Samra Formation sites						
Levallois flake	—	1	2	—	—	—	1	—	4
Cortex flake	4	3	—	—	2	—	3	—	12
Preparation flake	1	3	1	—	—	—	4	—	9
Flat debitage	1	4	1	2	—	—	4	1	13
Orthogonal debitage	—	3	2	1	—	1	—	—	7
Blade	—	—	—	—	—	—	—	—	—
'Eclat de taille'	1	2	—	—	—	—	—	—	3
Chips	—	—	—	—	—	—	—	1	1
Total	7	16	6	3	2	1	12	2	49
b)			Butt types at Khirbet Samra Formation sites						
Levallois flake	—	2	8	1	—	2	1	1	15
Cortex flake	8	10	—	1	1	2	5	—	27
Preparation flake	7	6	1	2	1	1	5	1	24
Flat debitage	3	4	1	—	1	—	3	4	16
Orthogonal debitage	1	4	1	—	—	—	1	—	7
Blade	—	—	—	—	—	—	—	3	3
'Eclat de taille'	—	—	—	—	—	—	—	2	2
Total	19	26	11	4	3	5	15	11	94

Table 9: Inventory of artefacts in surface sites

Surface sites in the Zarqa/Samra sector

Technological Inventory	*3*	*4*	*5a*	*7b*	*14*	*25b*	*30a*	*30b*	*30c*	*128*	*129b*	*130b*	*130c*	*135*	*Totals*
Cores:															
Levallois for flake	6	4	6	5	3	1	3	9	3	1	—	—	—	6	47
Levallois for point	3	—	5	3	—	—	—	3	3	1	—	—	—	5	23
Levallois *'sommaire'*	—	—	—	2	—	—	2	—	3	2	—	—	—	—	9
Mousterian	5	4	2	2	—	—	6	15	5	—	1	—	—	11	51
Proto-Mousterian	—	—	—	—	—	—	—	5	—	—	—	1	1	—	7
Flat debitage	9	7	9	4	—	2	5	10	3	2	3	4	—	11	69
Orthogonal	1	3	3	2	3	1	—	7	1	2	3	—	—	6	32
Prismatic	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polyhedric	—	—	—	2	1	1	—	—	—	—	1	—	—	2	7
Amorphous	1	—	—	—	—	—	—	—	—	—	2	1	—	—	4
Exhausted disc	8	5	7	5	2	1	2	9	1	—	2	—	—	9	51
Fragment	—	—	—	—	1	—	—	1	—	—	—	—	—	5	7
Core total	33	23	32	25	10	6	18	59	19	8	12	6	1	55	307
Flakes and flake-tools:															
Levallois flake	15	5	—	13	1	1	1	1	4	2	—	—	1	11	21
Levallois point	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Blade	—	—	—	2	—	—	—	—	—	—	—	—	—	19	21
Preparation	29	22	29	19	7	11	4	10	4	10	2	5	2	17	171
Cortex	13	10	28	14	—	—	8	15	10	6	—	5	2	14	125
Flat debitage	16	7	38	11	2	1	12	—	8	8	1	3	—	32	139
Orthogonal debitage	6	7	25	5	1	—	—	2	1	1	—	—	—	12	60
'Eclat de taille'	—	—	—	—	1	—	—	—	—	6	—	—	—	13	20
Flake total	79	51	120	64	12	13	25	28	27	33	3	13	5	118	591
Core-tools:															
Biface & pick	9	14	3	5	1	1	19	6	20	1	3	4	1	25	112
Chopper	1	3	—	—	1	—	4	10	5	3	—	—	—	—	27
Small bifacial piece	1	4	6	—	—	—	—	—	—	—	—	1	—	12	24
Total core-tools	11	21	9	5	2	1	23	16	25	4	3	5	1	37	163
Fragments & varia	—	—	1	—	—	—	—	—	—	—	—	—	—	38	39
Site totals	123	95	162	94	24	20	66	103	71	45	18	24	7	248	1,100

Table 10: Types of flake and types of butt at surface sites in the Zarqa-Samra sector

Flake types \ *Butt types*	*Surface sites, Zarqa-Samra sector*								
	Cortex	*Plain*	*Dihed*	*Facet*	*Lipped/ Punctif.*	*Removed*	*Broken*	*Unre-cog.*	*Totals*
Levallois	—	7	5	21	—	1	10	1	45
Preparation	25	46	14	7	8	7	35	8	150
Cortex	23	38	2	4	2	8	28	6	111
Flat debitage	8	32	10	14	1	14	24	3	106
Orthogonal debitage	7	19	2	6	—	7	14	1	56
Blade	1	—	—	—	—	1	—	—	2
'Eclat de taille'	—	1	—	—	—	—	—	6	7
Chips	—	—	—	—	—	—	—	—	—
Total	64	143	32	52	11	38	111	25	477

Table 11: Tool-types at surface sites in the Zarqa-Samra sector

Tool-types	*Surface sites*														
	3	*4*	*5a*	*7b*	*14*	*25b*	*30a*	*30b*	*30c*	*128*	*129b*	*130b*	*130c*	*135*	*Total*
Levallois flake	14	5	—	7	1	—	1	1	4	2	—	—	—	—	35
Levallois point	1	—	—	1	—	1	—	—	—	—	—	—	—	—	3
Levallois blade	—	—	—	5	—	—	—	—	—	—	—	—	—	—	5
Racloir, single	1	1	—	—	—	—	—	1	—	1	—	—	—	—	4
Racloir, bifacial	1	—	—	—	—	—	—	—	—	—	—	—	—	1	2
Racloir, massive	—	3	—	—	—	—	—	—	—	—	—	—	—	—	3
End-scraper	—	2	—	—	—	—	—	—	—	2	—	1	—	—	5
Burin	2	—	—	—	—	—	1	—	—	—	—	1	—	—	4
Thin denticulate	—	3	—	—	—	—	1	2	—	—	—	—	—	—	6
Thick denticulate	—	3	—	—	—	—	—	—	—	—	—	—	—	—	3
Bec	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Borer	—	2	—	—	—	—	—	—	—	—	—	—	—	—	2
Small bifacial piece	—	—	6	—	—	—	—	—	—	—	—	—	—	10	16
Lateral chopper	1	1	—	—	—	—	—	3	2	3	—	—	—	—	10
Distal chopper (& lat./dist.)	—	2	—	—	1	—	4	6	2	—	—	—	—	—	15
Discoidal chopper	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Burinant chopper	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Biface and pick	9	14	3	5	1	1	19	6	20	1	3	5	1	27	115
Hammerstone	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	31	37	9	18	3	3	26	20	29	9	3	7	1	38	233

Table 12: Numbers and categories of 152 bifaces at *in situ* and surface sites in the Zarqa-Samra sector

Biface Categories / *Context*	*Site*	*Discoid*	*D-shaped*	*Bifacial cleaver*	*Ovate*	*Elongated ovate*	*Partial ovate*	*Subovate-partial*	*Amygdaloid*	*Short amygdaloid*	*A typical amyg.*	*Cordiform*	*Subcordiform*	*Lanceolate*	*Partial lanceol.*	*Backed*	*Pick/trihedral*	*Divers/bifacial pc*	*Rough-out*	*Fragment*	*Sub-total*	*Total*
1. In situ	22a2	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	
(Bire,	116	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	8
Qf2)	119b	—	—	—	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	3	
	134	—	—	—	1	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	3	
2. *In situ*	9a	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	
(Khirbet	5b	1	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	2	5	8
Samra,	26b	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	
Qf1)	109	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	
3. Surface of	3	—	—	1	2	—	—	—	1	—	2	—	—	1	—	1	1	—	—	—	9	
distinct	4	—	1	—	5	—	1	—	—	—	—	1	—	2	—	1	—	—	—	3	14	
sites	5a	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	6	—	1	9	
	7b	—	—	—	2	—	—	—	—	—	—	1	—	—	—	1	—	—	1	—	5	
	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	
	25b	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	
	30a	—	1	—	1	2	—	2	2	—	6	—	—	2	—	—	—	—	—	3	19	132
	30b	1	2	—	1	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	6	
	30c	2	—	1	1	1	—	2	2	3	1	1	2	1	—	1	—	—	2	—	20	
	128	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	
	129b	—	1	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	3	
	130b	—	—	—	—	2	—	1	—	1	—	—	—	—	—	—	—	1	—	—	5	
	130c	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	
	135	1	3	1	3	—	1	3	1	1	3	—	—	1	—	—	2	12	1	5	38	
4. Isolated	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	
Surface	16	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	4
finds	33	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	
	101	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	
Total		5	9	4	19	5	2	10	11	6	17	6	2	7	—	4	5	20	4	16		152

Table 13a: Raw Material of 126 bifaces in the Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Raw Material	*In Situ:*		Surface:					
	Qf2	Qf1	30 & 130b	135	Other			
Flint: opaque or beige	4	2	12	11	18	47		
Flint: dark-grey-blue	—	—	16	2	5	23	77	61.4
Flint: grey-violet-pink	—	—	1	3	3	7		
Dense chert: Eocene	—	—	—	—	1	1		
Chert: grey-beige	2	2	12	11	9	36	49	38.5
Calcareous banded flint	1	—	9	—	2	12		
Total	7	4	50	27	38	126	126	

Table 13b: Blanks used to make 139 bifaces in the Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Blank (support)	*In situ:*		Surface:					
	Qf2	Qf1	30 & 130b	135	Other			
Irregular nodule	1	—	10	4	7	22		
River pebble	—	2	11	3	5	21		
Tabular slab	1	—	11	4	13	29		
Older artefact	—	—	1	1	—	2		
Flake	—	—	1	1	1	3		
Unrecognisable (no cortex)	5	4	14	13	12	48	48	34.53
Unrecorded	1	1	2	2	8	14		
Total	8	7	50	28	46	139		

Table 14a: The condition of 133 bifaces of the Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Condition	*In Situ:*		Surface:					
	Qf2	Qf1	30 & 130b	135	Other			
Heavily rolled	5	—	—	1	—	6		
Very rolled	2	1	1	3	5	12		
Rolled	1	3	4	10	10	28	56	42.1
Weathered ('smoothed')	—	2	34	10	21	67		
Fresh	—	—	4	3	2	9		
Not recorded	—	1	1	—	9	11		
Total	8	7	44	27	47	133		
Pieces with concretion	3	4	14	12	14	—	(47)	

Table 14b: Patinas of 129 bifaces in the Zarqa/Samra sector

Groups	*1*	*2*	*3*			
Patina	*In Situ:*		Surface:			
	Qf2	Qf1	30 & 130b	135	Other	Totals
White	1	2	6	3	9	21
Pink/wine	—	1	1	9	5	16
Grey/beige	2	3	25	12	20	62
Dark grey	—	1	15	1	3	20
Yellow/brown	2	—	3	1	2	8
Brown	3	—	—	—	—	3
Total in sample	8	7	50	26	39	130

Table 15a: Types of tip on 137 bifaces, Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Types of Tip	*In Situ:*		Surface:					
	Qf2	Qf1	30 & 130b	135	Other			
Pointed	2	3	11	7	6	29		27.8
Ogival/broad point	1	—	7	—	6	14		13.4
Rounded	—	—	10	3	14	27		25.9
Straight (broad)	—	—	2	2	—	4		
	—	—	1	—	—	1		
Triangular section	—	—	1	1	2	4		
Reworked (to rounded)	—	1	6	1	3	11		
(to pointed)	2	—	2	2	2	8		
Other	1	1	1	1	2	6	104	
Absent	2	3	8	10	10	33		
Total	8	8	49	27	45	137		

Table 15b: Types of base on 138 bifaces, Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Types of Base	*In Situ:*		Surface:					
	Qf2	Qf1	30 & 130b	135	Other			
Edged	4	1	10	13	16	44	55	39.8
Partially edged	1	—	2	1	7	11		
Not edged: Cortex	—	4	16	4	2	26		
Worked	2	—	18	4	6	30	62	52.9
Mixed c & w	—	1	1	—	4	6		
Fragment	—	—	1	2	—	3		
Unrecognisable	1	2	2	2	11	18		
Total	8	8	50	26	46	138	117	

Table 16a: Types of lateral cutting edges on 138 bifaces, Zarqa/Samra sector
***Straight/sinous edges are those straight overall with small sinuosities**

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Lateral cutting-edges	*In situ:* Qf2	Qf1	Surface: 30 & 130b	135	Other			
Both straight	3	2	17	7	10	39		
1 str., 1 str/sinuous*	—	—	11	5	9	25	71	54.6
1 straight, 1 sinuous	1	1	3	1	1	7		
Both str/sinuous	—	—	4	2	2	8		
1 str/sin., 1 sinuous	3	1	7	9	1	21		
Both sinuous	—	1	2	1	9	13		
One edged: straight	—	—	2	—	5	7	59	45.3
str/sin	—	—	2	1	3	6		
sin	—	—	1	—	2	3		
Three edges	—	—	—	1	—	1		
Unrecognisable	1	2	1	—	4	8		
Total	8	7	50	27	46	138	130	

Table 16b: Types of face retouch on 135 bifaces, Zarqa/Samra sector

Groups	*1*	*2*	*3*			*Sub-total*	*Total*	*Percent*
Face retouch types	*In situ:* Qf2	Qf1	Surface: 30 & 130b	135	Other			
Fine (secondary flaking)	2	1	8	7	12	30	54	44.2
Mainly fine	—	1	12	3	8	24		
Mixed fine & rough	2	1	13	9	7	32		
Mixed fine & cortex	—	—	4	1	2	7	68	55.7
Mainly rough	3	1	4	2	5	15		
Rough (primary flaking)	—	1	7	2	4	14		
Unrecognisable	1	3	2	—	7	13	122	
Total	8	8	50	24	45	135		

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