II. THE OBSIDIAN OF TRES ZAPOTES, VERACRUZ, MEXICO*

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It may be said that the discovery and beginning of the study of Olmec culture occurred at the site of Tres Zapotes in the southern part of the state of Veracruz (Maps 1 and 4). Jose M. Melgar published in 1869 a brief notice of a colossal sculpture from Tres Zapotes (called by him Hueyapan) in the form of a human head (Melgar 1869).[1] This huge sculpture was the first reported of what has become, at latest count, a series of fourteen coming from five or six localities, this last count varying according to how one defines and identifies colossal heads and the discovery sites.[2]

After Melgar's trip to Tres Zapotes to see the head of "Ethiopian type," the archaeological site was visited at infrequent intervals - in 1892 by a Museo Nacional de Mexico expedition searching for more sculptures (Stirling 1943:7), by C. Seler-Sachs and E. Seler in 1906-07 to photograph stone monuments and secure (probably by purchase rather than excavation) pottery and figurines (Seler-Sachs 1922) and by A. Weyerstall in 1926 (Weyerstall 1932:30-36). Not until 1939 was the first serious attempt made to excavate in the several series of mound groups which together comprise the site of Tres Zapotes, this work being under the direction of Matthew W. Stirling who has described the stone sculptures recovered there in three field seasons (Stirling 1939; 1940; 1943:7-26; 1965; 1968). The ceramics found in 1939 were described by Weiant (1943) and those found in 1940 by Drucker (1943). The interpretation of occupation history of the Tres Zapotes site provided by Drucker is rather different from that proposed by Weiant, and for an explanation of these differences the reader is referred to Drucker (1952). A third and still different interpretation[3] of the cultural chronology of the Tres Zapotes site offered by M. Coe (1965:684-686, 714) is as follows:

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Period	Coe (1965)	Weiant (1943)	Drucker (1943)
Early Postclassic	Tres Zapotes V		"Soncautla"
Late Classic	Tres Zapotes IV	Upper	Upper II
Early Classic	Tres Zapotes III		Upper I and
Protoclassic	Tres Zapotes II	Middle B	Lower II
Late Preclassic	Tres Zapotes I	Middle A	Lower I

There are no radiocarbon dates from any part of the Tres Zapotes site. A carbon sample collected in 1967 at the locus of Drucker's Trench 26 was dated, but an impossibly old age was secured, probably because the sample was contaminated with asphalt. The site comprises about 50 mounds arranged in "groups" and extending for nearly two miles along the Arroyo de Hueyapan (Maps 2 and 3). The presence of a colossal stone head in Olmec style at Drucker's Mound Group 1 (Weiant's Cabeza Group) and a second such colossal head (now in the town of Santiago Tuxtla) discovered about three kilometers north of the village of Tres Zapotes in a mound group which seems not to have been recorded by either Weiant or Drucker (for details see Clewlow et al 1967:30) as well as several other stone sculptures in pure Olmec style would argue for a Middle Preclassic (= La Venta/San Lorenzo phase) Olmec occupation of two or possibly three of the Tres Zapotes mound groups.

The obsidian artifacts described here were recovered by Weiant and Drucker in 1939 and 1940. Weiant (1943:121, Pls. 77, 78) devoted only ten lines and two plates to obsidian artifacts and Drucker's report of 1943 was intentionally strictly limited to description of ceramic materials. Unfortunately the obsidian artifacts were not catalogued in the United States National Museum (as were the ceramic materials) with reference to the excavation units from which they were recovered so that there is no means of determining by associated ceramics to what period the obsidian pieces belong, nor do we know from which mound groups the obsidian came. Weiant (1943:121) notes that "prismatic obsidian blades and cores occurred abundantly throughout the site," although he apparently did not excavate in the North Group (Drucker's Mound Group 3).

All we can surmise, therefore, is that the obsidian in the collection reported here came from the several mound groups which are collectively called the Tres Zapotes site, and that they probably range in time from Middle or Late Preclassic times to Postclassic times.

The collection numbers 855 pieces and is part of the permanent collection of the United States National Museum. We thank Dr. Clifford Evans for his aid in securing the Tres Zapotes obsidian on loan and for shipping it from Washington to Berkeley. We were interested in studying the Tres Zapotes obsidian materials since this locality represents one of the places occupied by the Preclassic Olmecs. Earlier studies of obsidian from the southeastern Mexican lowland region have produced some interesting results - we refer here to several papers reporting results of trace-element analysis ("finger-printing") of site artifacts and geologic source samples aimed at identifying the place of origin of the obisidian used in prehistoric times (Stross et al 1968; Jack and Heizer 1968; Weaver and Stross 1965; Heizer, Williams and Graham 1965; Stross, Heizer and Graham 1970). At Yale University M. D. Coe is conducting a trace-element study of the obsidian recovered from the recent excavations of the Olmec site of San Lorenzo (Coe 1970), but his results have not yet been published. Until the San Lorenzo obsidian data are published we cannot compare the use of this resource (either in terms of implement-making techniques or sources from which obsidian was secured) from San Lorenzo and La Venta, or these two sites with Tres Zapotes.

We wish to thank Mr. Robert W. Cobean and Professor Michael D. Coe (Yale University) for providing a geologic source sample of obsidian from Guadalupe Victoria, and Sr. Juan Sanchez Bonilla and Dr. A. Medellin Zenil of the Museo del Estado, Jalapa, Ver. for providing a geologic source sample of obsidian from Zaragosa, Pue.

The lithic assemblage from Tres Zapotes is based wholly on the use of obsidian (except for the two flint or chert peices noted in Table 7) and is characterized by a core-blade industry and associated debris resulting from industry-related preparation, trimming and rejuvenation activities. Core-blade industries, as is well known, are temporally and spatially wideapread in Mesoamerica (W. Coe 1959:14-15; MacNeish et al 1967:17-29). The basic technologies involved in core preparation and the detachment of blades from cores have received extensive treatment in the literature (Holmes 1919; Marcou 1921; Cabrol and Coutier 1932; Linne 1934; Ellis 1940; Kidder, Jennings and Shook 1946; Barnes 1947a; 1947b; Crabtree 1968). We think that it is appropriate here to reproduce the sixteenth century accounts by Torquemada and Motolinia, both of whom provide firsthand descriptions of the Aztec blade-making process in early post-Conquest times. The translations which appear below were prepared by J.E.S. Thompson and were published in Kidder, Jennings and Shook (1946:135-136).

The account of Torquemada (slightly condensed):

> "They had and have craftsmen to make knives of a certain black stone or flint, and to see them detach them from the stone is a marvellous thing, worthy of much admiration. They make them and detach them from the stone in this manner (if one can make it understandable): An Indian one of these craftsmen, seats himself on the ground, and takes a piece of that black stone, which is almost like jet and hard as flint, and which one might class as a precious stone, more beautiful and lustrous than alabaster or jasper, so much so that they make earrings and mirrors of it. This piece they take is about a palma [about 20 cm.] long or a trifle more and as thick as the leg, or a trifle less, and cylindrical. They have a stick of the thickness of a lance and three cubits [135 cm.] long or a little more, and at the head of this shaft they glue on and firmly tie a section of wood of a palm tree [as thick as the upper arm and a little more and this has its face flat and cut. (This sentence is supplied from the parallel passage in Torquemada, bk. 13, ch. 24.-J.E.S.T.)] and the purpose of this section is to add weight to that part. They place their bare feet together, and with them they press against the stone as though with pincers or the vise of a carpenter's bench, and with both hands they take the stick, which is also flat and cut [original, tajada. The word tajada is used three times. I have translated it as cut. Tajar means to cut with a stroke of a knife, but it is also used with pluma with the meaning to sharpen a quill pen. It can also mean notched], with both hands and place it firmly against the edge of the stone which also is flat and cut [original, tajada] at that part. And then they press against the chest, and with the force made there springs off a knife with its point and very sharp edges on both sides, just as though they should desire to fashion it with a knife from a turnip or radish, or as though they should fashion it of iron in a smithy, and then should sharpen it on a grindstone and then should give it very sharp edges on whetstones.

And in a very short time these craftsmen detach from the stone in the said manner more than twenty knives. They come off in the same shape, which is that which our barbers use for bleeding, save that they have a little ridge in the middle, and toward the point are somewhat curved in a very graceful manner; they cut and shave the hair when first used, and at first cutting a little less than a steel razor, but at the second cutting the edge blunts, and another is necessary right away and another to finish the beard or hair on the head."

The account of Motolinia:

"[Then] came the master craftsmen who detached the knives, they also had fasted and prayed, and they detached many knives with which the tongues had to be opened [for ceremonial bloodletting], and as they kept detaching them they kept placing them on a clean mantle. And if one should break while being detached, they said that they had not fasted properly. No one who has not seen how they detach these knives can thoroughly understand how they detach them. It is in this manner: First they get out a knife stone [obsidian core] which is black like jet and 20 cm. or slightly less in length, and they make it cylindrical and as thick as the calf of the leg, and they place the stone between the feet, and with a stick apply force to the edges of the stone, and at every push they give a little knife springs off with its edges like those of a razor. And they will detach from a stone more than two hundred knives and some bloodletting lancets. And having placed the knives on a clean mantle, they perfume them with their incense, and when the sun has completely set, all the priests being together, four of them sing songs of the devil to the knives, beating their drums..."

LITHIC ANALYSIS

BIFACES

Finished bifacially-flaked artifacts are described in this section.

Projectile Points

No. of specimens: 2 (Fig. 2,k; Pl. 1,a)

Description: There are two identifiable projectile points in the Tres Zapotes collection. A third specimen illustrated by Weiant (1943:Pl. 78,1) was not available for study.

One specimen is a side-notched arrow point, triangular in outline with a concave base (Fig. 2,k; also illustrated in Weiant 1943:Pl. 78,4). It is made of translucent obsidian (Type E). Length is 27 mm., maximum width is 14 mm. and maximum thickness is 3 mm. Similar specimens from Mexico have been termed "Harrell" points (Suhm, Krieger and Jelks 1954:500; Cook 1967: 71; Tolstoy, in press).

The second projectile point is also made of obsidian. It is much larger and heavier and probably functioned as a dart point (Pl. 1,a; also illustrated in Weiant 1943:Pl. 78,2). It has a parallel-edged rounded stem and the body of the specimen is marked by parallel flake scars on both faces. The distal tip is missing and there is a burin facet (struck from the break) present along one edge of the body (see Pl.1,a).

Comments: The small side-notched point was found on the surface at Tres Zapotes (Weiant 1943:121). Both Kidder (1947:13) and Tolstoy (in press) have noted that small side-notched points are widespread in Mesoamerica in late times, especially during the Postclassic period. The large stemmed point was excavated at the Ranchito site at Tres Zapotes; occurring with it were "Upper Tres Zapotes" ceramics (as defined by Weiant 1943:121). Drucker (1943) sees Teotihuacan-style features in the Upper Tres Zapotes ceramic assemblage, and it is perhaps significant that stemmed points similar to the one described here are common at the site of Teotihuacan in the Valley of Mexico (Linne 1934:149; Tolstoy, in press; Spence 1967:Fig. 3,c; collections from Ostoyhualco, Teotihuacan, at Berkeley; see also Holmes 1919).

Miscellaneous Bifaces

No. of specimens: 8 (Pl. 1,b-h).

Description: Eight bifacially-chipped artifacts of unknown function are briefly described below:

(1) basal fragment of triangular biface; retouched along lateral edges (Pl. 1,b); obsidian; length, 33.5 mm.; maximum width, 28 mm.; thickness:33.5 mm.

(2) fragment of stemmed dart point or knife; stem has been snapped off (Pl. 1,c); medial areas of the piece show scratching and abrasion on both faces; light retouch on lateral edges; obsidian; length, 46.5 mm.; maximum width, 29 mm.; thickness, 6.5 mm.

(3) crude triangular biface with unifacial beveling along both lateral edges and steeply beveled base (Pl. 1,d); dulling is present along portions of both lateral edges (Pl. 8,d); the piece possibly functioned as a knife; obsidian; length, 57 mm., maximum width, 42 mm.; thickness, 6.5 mm.

(4) distal fragment, crudely chipped and having a single beveled edge (Pl. 1,e); may have functioned as a scraper or knife; obsidian; length, 42 mm., maximum width, 28.5 mm.; thickness, 8 mm.

(5) ovate biface battered along two portions of the circumference (Pl. 1,f); obsidian; length, 43 mm.; maximum width, 38 mm.; thickness, 10.5 mm.

(6) distal fragment of a dart point or knife (Pl. 1,g); made of translucent gray obsidian with reddish-brown streaks; length, 50 mm.; maximum width, 26 mm.; thickness, 7 mm.

(7), (8) both are rectangular multifaceted pieces of obsidian (Pl. 1,h); battered at both ends, with some battering along one lateral edge of one specimen. These may be exhausted cores put to heavy use as hammerstones; length, 55, 56 mm.; maximum widths, 32, 30 mm.; thicknesses, 24, 22 mm.

UNIFACES

A series of unifacially-chipped artifacts is described below.

Miscellaneous Unifaces

No. of specimens: 5 (Pl 1,i-m).

Description: Five obsidian pieces show extensive unifacial modification. All have plano-convex cross sections and three are roughly rectangular in outline. On one specimen (Pl. 1,l), the flake scar ridges on the modified dorsal surface are abraded and dulled. On another specimen, there is nibbling or "chattering" (cf. Hole, Flannery and Neely 1969; White 1969; Hester 1970) along the heavily retouched lateral edges (Pl. 1,i). Similar wear was observed on the blunted distal end of this piece. The third triangular specimen is broken at the proximal end and there are several long flake scars on the dorsal surface (Pl. 1,m). The edges show heavy use-wear, primarily in the form of nibbling and crushing (Pl. 8,c); the piece may have functioned as a scraper.

One uniface is a large flake on which the striking platform and bulb of percussion have been trimmed away (Pl. 1,k). The piece is pointed at one end and constricted at the other. In addition to the flake which removed the bulb of percussion, several small flakes have been removed from the ventral surface near the tip.

The fifth uniface is circular in outline and has a plano-convex cross section (Pl. 1,j). The dome-like dorsal surface is extensively modified; a portion is heavily ground. Nibbling and light dulling are present on the edges (Pl. 8,f). Though there are random scratches on the ventral surface, no definite use-wear striations (cf. Semenov 1964) could be identified. The specimen was probably used as a scraper. Edge angle is 50°; Wilmsen (1968:156) has inferred several uses for scraping tools with similar edge angle values, including skinning and hide-scraping, sinew and plant-fiber shredding and heavy cutting, perhaps of bone or horn. Length of the piece is 30 mm., maximum width is 29 mm., and thickness is 16 mm.

CORES

We describe here 142 polyhedral blade cores of obsidian. Each represents the ultimate residue of the original block from which blades were detached. The sides have a fluted appearance, due to the scars left by blade removal. Descriptive terminology used below is illustrated in Fig. 1.

In our analytical procedure cores were sorted according to the types of preparation evident on the striking platform. Most of the cores represent exhausted pieces discarded when usable blades could no longer be detached. A. White (1963:6) has used the term "nucleus" in referring to such worn-out cores (see also Witthoft 1957). At other sites, these discarded nuclei were sometimes fashioned into eccentrics (Kidder 1947; W. Coe 1959:14), reworked to form scraping tools (Smith and Kidder 1943:163) or used as drills (Ricketson 1931:Pl. 15,a) and rubbing tools (Smith and Kidder 1943:163). At Tres Zapotes, the most frequent uses for discarded cores were as hammers or anvils.

In the introductory section of this paper, we reproduced early Spanish accounts of blade manufacture; for additional data on core preparation and blade removal, the reader is referred to discussions by Ellis (1940), Crabtree (1968) and Bordes (1969).

Cores with Single Facet Platforms

No. of specimens: 16 (Fig. 3,a; Pl. 4,a-h).

Description: These are core nuclei with simple prepared, single-faceted platforms (the "flat flake" platform of Crabtree 1968:457). The platform is a flat to slightly concave surface; in most examples, we can identify them as remnants of simple prepared platforms of once larger cores. It should be emphasized that these platforms are not the result of rejuvenation truncations (see below). There are occasional light scratches on some platforms. Most are characterized by tiny step-flakes (nibbling) around the edge of the platform. These can result from either unsuccessful attempts to detach blades or from preliminary trimming activities designed to remove the overhang (negative bulb of percussion) left by previous blade removals. Several of the cores have short, arc-shaped flakes on the platform, emanating from the edges. These may have been intended to provide a seat for a punch or crutch tip for the removal of additional blades.

A single specimen has transverse flaking along one lateral edge, probably representing preparation of a ridge flake (see below; Sanger 1968). Two of the cores are heavily battered and crushed along one edge of the platform; such alterations may have resulted from secondary use as hammers. On two other specimens, the distal ends have been intentionally detached (Pl. 4,h).

Core lengths vary from 31 to 83 mm. (mean, 54.4 mm.), maximum platform diameter is from 11.5 to 24 mm. (mean, 17.6 mm.) and maximum core width is from 14 to 24 mm. (mean, 19.3 mm.).

Comments: MacNeish et al (1967:27) refer to similar cores from Tehuacan as having "unprepared striking platforms." However, their descriptions indicate that these cores have platforms identical to the simple prepared (flake surface) platform cores at Tres Zapotes. The term "unprepared," as used in the Tehuacan descriptions, is misleading in that it is often applied to cores with cortex-covered or natural striking platforms (cf. Epstein 1969:72).

Cores with Multifaceted Platforms

No. of specimens: 42 (Fig. 3,b-g; Pl. 4,i-w).

Description: Most specimens of this class appear to have been nearly exhausted cores which were truncated by a technique described below. However, the new planar surface or platform created by the truncation (often at an acute angle to the long axis of the core) was then prepared by the removal of a number of flakes running across the platform. As a result, a multifaceted surface was formed. After this preparation of the platform, several blades (or microblades) were usually detached before the nuclei were finally discarded. Some specimens have heavily battered platform edges, perhaps the result of difficulties in blade removal. Many of the nuclei have pumice inclusions that may have inhibited further whole blade removals after the preparation of the multifaceted striking platform. Four specimens have been truncated at the distal end; in at least two instances, the truncation was caused by a "plunging flake" (J.F. Epstein, personal communication) struck from the proximal (platform) end. A few cores have battered spots on the blade scar ridges, indicating that core nuclei may have sometimes seen secondary use as anvils and/or hammerstones. Three specimens have transverse flaking along one side, again evidence of ridge flake preparation (Sanger 1968).

Lengths of the cores vary from 27 to 83.5 mm. (mean, 56.5), maximum platform diameter from 11 to 33 mm. (mean, 20.5) and maximum core width from 12 to 32 mm. (mean, 21.7).

Comments: Crabtree (1968) has recognized this type of platform preparation; he terms them "multiple-flake platforms" (see Crabtree 1968: Fig. 4,d).

MacNeish _et al_ (1967:28) have described similar cores from Tehuacan, ascribing them to a period lasting from earliest ceramic times to the Spanish conquest. They note (p. 28) that "...this type of core has not been commonly recorded from Mesoamerica, except for the early El Arbolillo phase in the Valley of Mexico."

Cores with Ground Platforms

No. of specimens: 13 (Fig. 5,a-c; Pl. 5,a-j).

Description: The platforms of 12 specimens have been prepared by heavy grinding; a 13th specimen has a portion of the platform heavily ground and the remainder shows scratching and polishing. Six specimens expand at mid-core, three are cylindrical, three are conical and another is subrectangular. One medially-expanded specimen has transverse flaking along one side, representing ridge flake preparation. Two others were crudely flaked by percussion along one side, probably after they had been discarded; both are distally truncated. Measurement data are given in Table 1.

Comments: Tolstoy (in press) notes that ground platform cores are present in collections from central Mexico, occurring most commonly in Postclassic contexts. A collection from Ostoyhualco, Teotihuacan (here at Berkeley) contains two cores with ground platforms. MacNeish _et al_ (1967:28) note ground platform cores from Tehuacan; these are also attributed to the Postclassic. Both Barnes (1947a) and Crabtree (1968) have observed that such grinding of the platform may have helped to prevent slippage of the punch, or crutch tip during blade removal.

Proskouriakoff (1962) has described "used cores" from the site of Mayapan, Yucatan. All but one of the cores show a "...flat, dull, evenly grained, pebbly striking platform" (Proskouriakoff 1962:367). She believes these platforms are cortical ("natural weathered surface"), although from the description it seems highly likely that they have been prepared by grinding. All of the complete blades at Mayapan exhibit identical platforms.

Length	Maximum Diameter of Platform	Maximum Diameter of Core
78	15	20
73	16	24
71	18	24
71	8	13
70	15	17
68	18	20
67	14	22
60	14	25
59	21	24
56	21	21
44	13	14
43	15	17
33	12	14
Mean: 61.0	15.4	19.6

Table 1. Dimensions of Cores with Ground Platforms. All measurements are in millimeters.

Proximally-Truncated Cores

No. of specimens: 59 (Fig. 4,a-i; Pl. 5,m-x).

Description: This is a group of core nuclei which have been truncated at the proximal (platform) end. The truncation was performed when the cores had become nearly exhausted; the creation of a new platform (via the truncation) enabled a few more blades to be detached before the core was finally discarded. The truncation was in most cases accomplished by a blow struck perpendicular to the long axis of the core, just below the old platform surface (Fig. 5,j-k). This blow removed a tabular shaped piece (core tablet; see below) sometimes leaving a negative bulb of percussion on the newly-created proximal surface. Fifty-seven of the specimens described here have no modification of the proximal surface subsequent to truncation. One specimen does have a small area of grinding on one edge of the newly-created surface. In 36 instances, the new platform formed by the truncation permitted the removal of several additional blades (generally microblades) from the cores. On the remaining 23 cores, there is no evidence of further blade detachment from the platform created by the truncation. In some instances, the truncation made the core shorter than perhaps desired, while in other examples, the truncated surface was at too acute an angle to the long axis of the core.

These cores are usually conical, elongate-conical or wedge-shaped, and most expand near mid-core. In four cases, maximum width occurs at or near the distal end. The platform created by the truncation process is often slightly concave and there are slight vertical protrusions on one edge. A few of the platforms are mildly convex and angle to one side, indicative of an oblique truncation blow.

On two specimens the distal end is a ground flat surface. Three others have been bi-truncated (i.e., at both the proximal and distal ends). Transverse flaking (ridge flake preparation) is present on one specimen. Many of the cores have pumice inclusions. Others have dulled blade scar ridges, and in some instances battered spots are present on the sides. On four cores, the distal end has been detached by a plunging flake struck at the proximal end. Several cores were ultimately discarded because attempts at blade removal resulted in repeated hinge fractures.

Core length ranges from 26 to 78.5 mm. (mean, 56.2), maximum platform diameter is from 9 to 33 mm. (mean, 17.6) and maximum core width is from 10 to 33 mm. (mean, 19.3).

Comments: There is little discussion of truncated cores in the Mesoamerican literature. Cores truncated in a fashion identical to the specimens described here are known from Atetelco, Teotihuacan (surface collection, Texas Archeological Research Laboratory, Austin). Crabtree (1968:463) and Graham and Heizer (1968:107) have suggested that core truncation noted on specimens from Papalhuapa, Guatemala, might have been effected through some sort of controlled heat fracture. However, a reexamination of these cores show them to be no different than the truncated cores from Tres Zapotes. Experimentation is an obvious means of learning more about how these short, solid cylindrical obsidian nuclei were so neatly sheared in two.

<u>Cores with Scratched Platforms</u>

No. of specimens: 5 (Pl. 6,a-d).

Description: There are five core nuclei with varying degrees of scratching on the surface of the striking platform. The scratches may have been made to prepare the platform for blade detachment. The largest specimen has a heavily scratched platform and a small portion is heavily abraded. On another, the proximal end has been truncated and there is scratching on the distal end. This scratching may have been intended to prepare the distal surface as a striking platform (though no blades were removed from that end). A third specimen has a platform reduced by oblique removals (perhaps corner platform flakes; see Movius _et al_ 1968:5); a small remnant is scratched. The two remaining specimens have randomly-scratched platforms.

Core length ranges from 42 to 78 mm. (mean, 56.4), maximum platform diameter is from 13 to 30 mm. (mean, 17.4), and maximum core width varies from 15 to 34 mm. (mean, 22.6).

Comments: Crabtree (1968:450) has discussed scratching as core platform preparation; like the grinding technique, it was probably intended to prevent a punch or pressure tool from slipping. Scratched and abraded cores are present in the Papalhuapa, Guatemala, collection (Lowie Museum, Berkeley).

Cores with Splintered Platforms

No. of specimens: 6 (Fig. 5,d-f; Pl. 6,e-g).

Description: All are core nuclei. Three have proximal ends which have been badly battered and splintered apparently by the removal of corner platforms (cf. Movius _et al_ 1968:5). The splintering does not appear to have resulted from use of the cores as hammers. Two specimens are splintered at both the distal and proximal ends. Another appears to have been split longitudinally. Only one specimen retains a remnant (5 mm. in diameter) of the striking platform. It is unclear as to why these cores were modified in this manner.

The pieces range in length from 34.5 to 73 mm. (mean, 53.7) and in maximum core width from 14 to 20 mm. (mean, 17.1).

Comments: Cores with splintered platforms identical to these are in collections from Papalhuapa, Guatemala and Teotihuacan (Lowie Museum, Berkeley).

Distally-Truncated Core

No. of specimens: 1 (Pl. 6,h).

Description: The proximal end of this core has a ground platform. When this platform became too small for effective blade removal, the distal end was truncated by a blow perpendicular to the long axis of the core. The distal surface created by the truncation was then scratched, and three blades (43 to 57 mm. long) were detached using this surface as a platform. Other distally-truncated cores have been included in previously described categories, but none of them had blades removed from the distal surface. The specimen is 69 mm. long, with a maximum proximal diameter of 14 mm., and a maximum distal diameter of 22 mm.

Core Fragments

No. of specimens: 19 (Fig. 6,a,b; Pl. 6, i-l).

Description: This is a residual category that includes cores broken in a variety of manners. A number probably represent cores broken during attempts at core rejuvenation. One specimen (Pl. 6,k) is a longitudinal fragment of a blade core, and blades have also been removed from fractures at both ends. At one end there was apparently an attempt made to detach a core tablet, but the truncating flake did not behave as desired and hinged upward about halfway across the core, leaving a 10 mm. vertical protrusion. Another piece (Pl. 6, i) is a longitudinal (or vertical) fragment of a blade core and is retouched along its sides. Five other core fragments are also marginally retouched. There are two proximal ends of cores which may represent oblique truncations (Pl. 6,l). Another specimen (Fig. 6,b) is the distal end of a large core (maximum diameter is 49 mm.). The proximal end was evidently removed through truncation, following which considerable rough percussion flaking was done on the truncated surface in an attempt to prepare a striking platform. However, this effort seems to have been unsuccessful since no new blades were detached. Finally, there is a distal core fragment (Pl. 6,j) on which the proximal (platform) end was removed by a "plunging flake" struck from the distal surface. This may have been intended as a rejuvenation technique but too much of the core was detached in the attempt and it was rendered useless. This technique is the opposite of one illustrated by Crabtree (1968: Fig. 9,d).

CORE MODIFICATION DEBRIS

In the Tres Zapotes collection there are numerous pieces which are the result of various core modification techniques. Some of these activities were related to the rejuvenation of nearly exhausted cores and others were directed toward the preparation of the core and striking platform for blade removal. The debris which we believe is attributable to these endeavors is described below.

Core Tablets

No. of specimens: 10 (Fig. 5,g-i; Pl. 6,m-q, Fig. 6,c).

Description: The term "core tablet" follows the definitions provided by Epstein (1964:166), Movius et al (1968:5) and Hole, Flannery and Neely (1969:100). They are tabular pieces, ovoid in outline with segments of blade scars present on the sides. A bulb of percussion is present at one edge of one surface indicating removal from the parent core by a blow transverse to the long axis of the core (see Fig. 5,k: see also Hodges 1964: Fig. 19). This technique of core rejuvenation appears to have been performed on nearly-exhausted cores. The new platform created by the truncation often enabled the removal of additional blades.

The largest core tablet (Pl. 6,n) is 61 mm. in diameter and 11 mm. thick. The piece was utilized subsequent to its detachment, and a 27 mm. area along one edge is heavily dulled and striated, perhaps from later use as a scraping tool. Another core tablet is 37 mm. in diameter and 9 mm. thick (Pl. 6,m). The old platform surface is multifaceted and heavy battering is present along 30 mm. of one edge. Six core tablets (Fig. 5,g,h; Pl. 6,o-q) are small, 16 to 24 mm. in diameter (mean, 20.3) and 7 to 17 mm. thick (mean, 7.6). Five of these may result from secondary truncations since negative bulbs of percussion (indicative of previous truncations) are present on one surface. This would mean that the primary truncation did not achieve the desired result and a secondary truncating blow was needed to create a suitable new platform.

One of the core tablets in the collection has been intentionally retouched around its circumference (Pl. 6,q). There is a ground area on a portion of the old platform surface. Diameter is 27 mm., thickness, 7 mm. Another specimen is the result of an oblique truncation at the distal end of a core (Fig. 5,i). Diameter of the piece is 31 mm., thickness is 27 mm. There is also a tabular fragment of obsidian which may be a core tablet (Fig. 6,c). One surface is heavily battered and crushed around the edges, with an area (13 x 33 mm.) of heavy scratches near the center of the same surface. The opposite face has light battering and some dulling of the edges, as well as a group of parallel scratches. Diameter is 60 mm. and thickness is 26 mm.

Ridge Flakes

No. of specimens: 8 (Pl. 6,r-v).

Description: Sanger (1968:197) describes ridge flakes as follows:

> "In some prepared core-blade techniques, the fluted surface of the core is prepared by extensive flaking perpendicular to the long axis of the core, which results in a projecting ridge down the length of the core. The blade manufacturer aims the first blow on the striking platform at a point slightly behind the ridge, detaching a long spall, or ridge flake, which is triangular in transverse section. The two dorsal surfaces of this ridge flake are covered with flake scars which originate at the central ridge...and run perpendicular to the long axis of the ridge flake. The ventral surface of the ridge flake is, of course, smooth and unfaceted."

Evans (1872:25) states that the ridge flake (he termed them "crested ridge flakes") acted as a guiding ridge for the removal of subsequent blades.

Based partially on definitions provided by Sanger (1968:197), three ridge flake forms have been recognized in the Tres Zapotes materials.

(1) Primary Ridge Flake (Pl. 6,r). This is a single specimen representing the first flake to be removed from the fluted surface. It has a

single median ridge with transverse flake scars on either side. Length is 55 mm., width is 8 mm., and thickness is 8 mm. The striking platform is 1 mm. wide and 7 mm. long; bulb length is 20 mm.

(2) Ridge Flakes with One Faceted and One Unfaceted Surface. Four specimens are included in this category; on one side of the dorsal median ridge are transverse flake scars, while the other is smoothed and unfaceted. One specimen (Pl. 6,v) is very large (116 mm. long, 32 mm. wide and 15 mm. thick) and retains a patch of cortex on the dorsal surface. It may have resulted from the initial preparation of a large core. Two others are small medial fragments (Pl. 6,u) and the fourth is a proximal fragment (Pl. 6,t).

(3) Miscellany. There are three additional flakes in the collection, unfaceted on either side of the dorsal ridge (Pl. 6,s); we cannot be certain that these are ridge flakes. One is the distal end of a hinge flake and the others are proximal fragments, one of which is retouched laterally.

Comments: Holmes (1900:Fig. 48; 1919:Fig. 100) illustrates several probable ridge flakes from the extensive obsidian workshops at Cerro de Navajas (Pachuca); Barnes (1947b:Pl. 1,10) illustrates another specimen from the same locality. Bordes (1947) and Sankalia (1967) provide discussions of the ridge flake technique in the Old World. Watson (1950: Fig. 12) illustrates a ridge flake from Magdalenian contexts; he describes it as a "...rejuvenating flake struck from the edge of a large blade core in order to improve the direction of flaking."

Transverse Modification Flake

No. of specimens: 1 (Pl. 6,w).

Description: This term is applied to a flake (Pl. 6,w) which was detached from the side of a polyhedral core by a blow transverse to the long axis of the core. The dorsal surface of the flake retains remnants of five blade scars. The intent of such modification is not known. The specimen is 22 mm. long, 14 mm. wide, and 4 mm. thick.

Miscellaneous Core Modification Detritus

No. of specimens: 7 (Fig. 6,d,e; Pl. 6,j-l).

Description: These are pieces which may have resulted from the initial shaping and trimming of large obsidian cores (macrocores, in the terminology of Tolstoy, in press; see also Holmes 1919; Coe and Flannery 1964). All have very prominent bulbs of percussion and broad single faceted platforms, some of which are heavily battered. Three of the specimens show portions of large blade scars. One piece (Fig. 6,e) appears to be a corner portion of a large blocky obsidian nucleus (similar to those illustrated by Holmes 1919:Fig. 97). Another specimen (Fig. 6,d) has been ventrally retouched. The pieces range in length from 38 to 95 mm., while thickness varies from 15 to 36 mm.

BLADES

There are 385 blades and blade fragments represented in the Tres Zapotes collection. A blade is defined here as a parallel-edged flake, whose length is at least twice that of its width, and which was derived from a specially-prepared core (Dumond 1962:419; Oakley 1964:39; Honea 1965:29; Bordes 1968:27). Other terms have been applied to such flakes, including "flake blades," "prismatic blades," "lamellar flakes" and "bladelets" (for a discussion of these terms see Heizer and Kelley 1962:94; Tolstoy, in press). The term "microblade" is employed in this paper to refer to a blade with a maximum width of 10 mm. or less (cf. Taylor 1962:425).

These razor-sharp objects were undoubtedly used for a variety of utilitarian purposes (cf. MacCurdy 1900:420-421). Torquemada (in Kidder, Jennings and Shook 1946:135) documents their use for shaving and hair-cutting (see also Tylor 1861:97). Vaillant (1931:404) notes that blades and bone tools were found associated with burials at Ticoman; to him, this association indicates the use of blades in leather-working activities. Kidder (1947:20-21) has discussed the ceremonial functions of blades, and Smith and Kidder (1943:164) comment on the use of fine blades as mortuary offerings. A number of blade fragments were part of a cache excavated near Stela A at Tres Zapotes (Weiant 1943:7).

Descriptive terminology applied to blade attributes in this paper is illustrated in Fig. 1.

Length	Max. Width	Thickness	Platform Length-Width	Bulb Length	Dorsal Ridges	Remarks
111	14	5	7 x 6	14	2	Pachuca obsidian; ground platform; light retouch.
92	21	7	12 x 5	13	2	single facet platform; retouched.
86	13.5	3	7 x 3	9	2	single facet platform; recent nicking.
86	9	3	5.5 x 3	7	M	single facet platform; no retouch.
74	10	2.5	5 x 2	6.5	2	single facet platform; no retouch.
73.5	24.5	7	8 x 5	12	M	single facet platform; no retouch.
70	29	9	19 x 6	18	2	scratched platform; retouched.
65	26	4.5	*	*	M	nicking on both edges.
63	14	5	5 x 3	7	1	battered platform; recent nicking.
61	27	8	11.5 x 6	15	2	ground platform; retouched.
60	21	8.5	15 x 14	14	M	battered platform; use-scarring.
57	16	4	12 x 4	*	1	battered platform; no retouch.
51	12	2	8.5 x 2	4	2	single facet platform; nicking (recent?).
50	7.5	2	4 x 1.5	6	2	single facet platform; no retouch.
50	10	1	5 x 1	6.5	1	single facet platform; use-scarring
47	29	5	23 x 4	18.5	1	recurved single facet platform; some battering; hinged; 1 nicked edge.
45	20	3.5	6.5 x 15	10	2	single facet platform; no retouch.
40	12	3	6 x 2.5	6.5	1	single facet platform; crushing evident under magnification.
37	9	1	4 x 1	6	2	single facet platform; no retouch.

Table 2. Complete Blades from Tres Zapotes. All measurements are in millimeters. M indicates a multifaceted dorsal surface.

* bulb and platform trimmed away.

Complete Blades

No. of specimens: 19 (Fig. 2,b-f; Pl. 2,a-l).

Description: These are intact specimens, retaining both the proximal (platform) and distal ends. Detailed descriptive data are presented in Table 2. Blade fragments are described separately.

Thinned Blades

No. of specimens: 7 (Fig. 2,a,a'; Pl. 2,m-p).

Description: There are seven blades in the collection which have been bifacially thinned at the proximal ends by the removal of several long vertical flakes (see Fig. 2,a). This thinning may have been performed to facilitate hafting of the specimens. The distal ends of four have been snapped off, presumably as a result of use. On three of the snapped pieces, the truncating force was directed from the dorsal to the ventral surface. The only complete specimen differs in having been obliquely truncated by intentional unifacial retouch (Pl. 2,p). Length varies from 18 to 75 mm. (the complete specimen is 41.5 mm. long), maximum width is from 24 to 36 mm., and thickness ranges from 4 to 8 mm.

Trimmed Blades

No. of specimens: 15 (Pl. 2,q-z).

Description: These are obsidian blades which have been trimmed to a point, usually by unifacial marginal retouch. Though convergent retouch is present on most, some have been modified by oblique retouch (for example, Pl. 2,s). In some instances, bifacial modification is evident. One specimen could have functioned as a projectile point since the distal end has been thinned and trimmed (Pl. 2,x). The edges of most, however, appear to have been used for cutting; five have heavily dulled edges near the tip (see Fig. 2,w; Pl. 8,b). Several pieces have been broken by snapping which occurred during use. One specimen retains a ground striking platform. Another has a ground and scratched area on the dorsal surface. Lengths range from 25 to 72 mm., maximum width ranges from 11.5 to 29 mm., and thickness is from 2 to 9.5 mm.

Comments: Vaillant (1931:Pl. 85) illustrates several trimmed blades from the sites of Ticoman. Blades trimmed to a point are also known from Santa Marta rockshelter, Chiapas (MacNeish and Peterson 1962:27), and may have functioned as drills.

Notched Blades

No. of specimens: 2 (Fig. 2,g; Pl. 2,aa).

Description: Both are blade fragments. On one (Pl. 2,aa) there are two broad shallow notches, one unifacially chipped into each of the lateral edges. Both notches show considerable nibbling resulting from use (perhaps as spokeshaves). In European terminology, similar specimens are called "strangulated" or "strangled" blades (Bordes 1968:Fig. 56). Length of the piece is 54 mm., maximum width is 10 mm., and thickness, 4 mm. The second specimen (Fig. 2,g) retains a section of a notch on one lateral edge of the ventral surface; the remainder of the notch was detached when the blade was snapped. Length is 46 mm., maximum width, 13 mm., and thickness, 3 mm.

Burin-Faceted Blade

No. of specimens: 1 (Fig. 2,h).

Description: This is an obliquely snapped blade, with two burin facets present at one end of the fracture. This type of burin has been termed a "break burin" (Movius et al 1968:22). A binocular microscope was used to examine the burin point, and dulling and abrasion were observed on the tip (Pl. 8,e). Length of the specimen is 40 mm., maximum width, 14 mm., and thickness, 3.5 mm. The initial burin facet is 5 mm. long and the secondary facet is 3 mm. in length.

Proximal Blade Fragments

No. of specimens: 151 (Pl. 3,a-p).

Description: This abundant class consists of the proximal ends of blades which retain both the striking platform and bulb of percussion. Four types of striking platforms were recognized. The first is a simple prepared or single facet platform; all 123 examples have a smooth, flat flake surface platform (this definition follows that of Epstein 1969:72; Honea 1965:28 refers to such platforms as "unfaceted"). Sixteen specimens have ground platforms (Honea 1965:28), and were obviously detached from ground platform cores. Platforms on seven others are splintered or shattered, probably fragmented during the blade removal precess. Lipped (overhanging) single facet platforms were observed on five specimens. In some lithic industries, lipped blades often result from biface thinning activities (for example, see MacDonald 1968; Hester 1971). Epstein (quoted in Tolstoy, in press) has noted similar lipped obsidian blades from El Arbolillo; he believes that the lipping is attributable to the use of a "softer than stone" percussor (perhaps a billet or cylinder-hammer or wood, bone or antler) in blade removal. Similar views are expressed by Honea (1965:30).

On the dorsal surface of the proximal blade fragments, 39 have a single median ridge, 89 have two ridges and 23 are multifaceted (Crabtree 1968: 465 discusses the blade-making methods which determine the number of median ridges). Additional descriptive and measurement data are given in Tables 3 and 4.

Proximal blade width	No.
0 - 5.0:	2
5.1 - 10.0:	39
10.1 - 15.0:	73
15.1 - 20.0:	22
20.1 - 25.0:	11
25.1 - 40.0:	4
Total :	151

Bulbar length	No.
0 - 4.0:	13
4.1 - 5.0:	15
5.1 - 6.0:	19
6.1 - 7.0:	28
7.1 - 8.0:	24
8.1 - 9.0:	17
9.1 - 10.1:	10
10.1 - 12.0:	13
12.1 - 24.0:	9
bulb trimmed:	3
Total :	151

Table 3. Proximal blade dimensions. Criteria for ascertaining bulb length are illustrated in Fig. 1. Measurements are in millimeters.

Platform Length	No.
0 - 1.0:	0
1.1 - 2.0:	1
2.1 - 3.0:	5
3.1 - 4.0:	20
4.1 - 5.0:	22
5.1 - 6.0:	21
6.1 - 7.0:	25
7.1 - 8.0:	18
8.1 - 9.0:	13
9.1 - 10.0:	5
10.1 - 11.0:	3
11.1 - 12.0:	5
12.1 - 13.0:	1
13.1 - 14.0:	1
14.1 - 25.0:	4
N.M. :	7
Total :	151

Platform Width	No.
0 - 1.0:	22
1.1 - 2.0:	61
2.1 - 3.0:	40
3.1 - 4.0:	15
4.1 - 5.0:	5
5.1 - 10.0:	1
N.M. :	7
Total :	151

Table 4. Platform Dimensions of Proximal Blade Fragments. The platform width is the dorsoventral distance. N.M. indicates specimens not measurable. Measurements are in millimeters.

Medial Blade Fragments

No. of specimens: 111 (Pl. 3,q-x).

Description: These are the medial sections of blades lacking both the proximal (platform) and distal ends. On the dorsal surface, 25 specimens have a single median ridge, 77 have two median ridges and nine have three or more facets. Lengths of these fragments are from 15 to 72 mm., and thickness ranges from 1 to 8 mm. Twenty-six of the specimens can be classed as microblades as they have maximum width of 10 mm. or less (cf. Taylor 1962; see Table 5). Other measurement and modification data are given in Tables 5 and 6.

Distal Blade Fragments

No. of specimens: 79 (Pl. 3,y-ff).

Description: All are the distal tips of blades, and most are thin, light and narrow (measurement data for 75 of the pieces are presented in Table 5). Four are large fragments and three of these exhibit deliberate marginal retouch (Pl. 3,ee). Twenty-four specimens have a single median ridge on the dorsal surface, 46 have two ridges and five are multifaceted (three or more facets). Modification data are given in Table 6.

Medial blade width	No.	Distal blade width	No.
0 - 5.0 :	0	0 - 5.0 :	3
5.1 - 10.0 :	26	5.1 - 10.0 :	24
10.1 - 15.0 :	59	10.1 - 15.0 :	29
15.1 - 20.0 :	20	15.1 - 20.0 :	15
20.1 - 25.0 :	5	20.1 - 25.0 :	3
25.1 - 40.0 :	1	25.1 - 40.0 :	1
Total :	111	Total :	75

Table 5. Widths of Medial and Distal Blade Fragments. Measurements are in millimeters.

Use-scarring on edges	Proximal	Medial	Distal
1 edge	29	7	1
2 edge	60	21	17
Heavy unifacial retouch			
1 edge	1	3	0
2 edge	4	5	4
Light unifacial retouch			
1 edge	4	5	1
2 edge	11	11	5
Bifacial edge retouch			
1 edge	0	0	0
2 edge	0	3	1

(Table continued on next page)

	Proximal	Medial	Distal
End retouch	0	1	0
Concave retouch (notching)	1	0	0
No modification	41	55	46
Totals	151	111	75

Table 6. Numbers of Blade Fragments Showing Certain Kinds of Modification.

FLAKE DEBRIS

Debitage resulting from a variety of flint-working activities is abundant in the Tres Zapotes collection.

Waste Flakes

No. of specimens: 142 (Fig. 7,d-f; Pl. 7,a-l).

Description: These are irregularly shaped flakes none showing any evidence of use. Retouched flakes are described later. Waste flakes have been sorted according to the types of striking platforms present:

(1) Single facet platforms: 85 flakes, ranging in length from 15 to 65 mm.; large specimens (about 15 examples) may result from core preparation techniques; platforms are smooth flake surfaces, usually triangular (Fig. 7,d) up to 27 mm. long and 12 mm. wide; bulbs are massive; the remaining flakes are small and thin; some retain vestiges of core platform edges and apparently derive from platform trimming procedures; two specimens are hinge flakes; two flint or chert flakes are included.

(2) Multifaceted platforms: 12 specimens, mostly thin and small; nine have lipping characteristic of biface thinning flakes; if bifaces similar to those present in the Tres Zapotes collection were manufactured at the site, such flakes would naturally result.

(3) Ground platforms: 12 specimens, probably result from platform trimming.

(4) Crushed/splintered platforms: 29 flakes, most of which have thin (1 to 2 mm.) crushed or splintered platforms (Fig. 7,f); 27 specimens are small and thin, while two others are heavier with thick platforms (5,7.5 mm.).

(5) Convergent platforms: 13 flakes detached by blows struck at the apex of two intersecting (convergent) flake scars (see Fig. 7,e); four are large (ca. 50 mm. long) with massive bulbs; the remainder are smaller and thin.

Comments: Little attention has been given to the analysis of waste flakes in Mesoamerica (Tolstoy, in press). Persons studying waste flake assemblages from known contexts may find the discussion presented by Mayer-Oakes (1966:261-270) useful regarding analytical procedures.

Retouched Flakes

No. of specimens: 45 (Fig. 7,a-c; Pl. 7,m-v).

Description: As mentioned above, waste flakes showing utilization, primarily in the form of edge retouch, were sorted separately in the analysis. Nine specimens are retouched unifacially along both edges of the dorsal face. Bifacial edge retouch is present on ten others. One piece is obliquely retouched (see Pl. 7,t; Fig. 7,b), convergent retouch is present on eight others (Pl. 7,s), and transverse retouch was noted on three specimens (Pl. 7, u,v). There is also a flake which has a steeply retouched edge; this edge is dulled and microscopic examination revealed apparent use-wear striations on the ventral surface perpendicular to the edge. One large flake (Fig. 7,c) is roughly rectangular and is retouched laterally and distally.

Scraper Rejuvenation Flakes

No. of specimens: 2 (Fig. 2,i,j; Pl. 8,a).

Description: Both are small, thin flakes which were apparently detached from a unifacial scraper edge as part of a specialized rejuvenation (re-sharpening) technique (cf. Frison 1968; Shafer 1970). When a scraper edge became dull (Pl. 8,a), a blow was directed just above the edge detaching it along with a portion of the adjacent ventral surface.

Flakes detached by this type of blow exhibit these additional characteristics; (1) a portion of the dulled, multifaceted scraping edge is retained (it served as the striking platform); (2) adjacent to this edge is a prominent bulb of percussion; (3) the flakes are usually oval in outline.

With the removal of several of these flakes, a new scraper edge could be obtained and trimmed for use. Microscopic examination of the two specimens from Tres Zapotes revealed several groups of use-wear striations on the ventral surface, nearly perpendicular to the detached scraping edge. Dulling and crushing are also evident. These striations, most of which emanate from the edge, indicate that these flakes were detached from the edge of a cutting/scraping unifacial tool, and are not simply portions of a core platform. Unfortunately, no unifacial scrapers modified by this technique were collected at the site.

Dimensions of the specimens are: length, 17,24 mm.; maximum width, 23,25 mm.; maximum thickness, 2.5, 4.5 mm.; length of detached scraping edge, 16,23 mm.

<u>Flake Fragments</u>

No. of specimens: 77 (not illustrated).

Description: These are obsidian flakes (not including blade fragments) on which the platform and bulb of percussion are missing. Edges of core platforms may be represented on some specimens, indicating that they may have come from platform trimming activities.

MISCELLANEOUS OBSIDIAN ARTIFACTS

<u>Lunate Objects</u>

No. of specimens: 2 (Pl. 7,w,x).

Description: Both were excavated by Weiant (1943:121; Pl. 78;7,8) at the Ranchito site, Tres Zapotes. Both are of obsidian and exhibit flaking and grinding. The first (Pl. 7,w) is bifacially chipped and the inner edge of the semicircle has been ground or dulled. The specimen is 48 mm. long, 33 mm. wide and 7 mm. thick. The other lunate piece (Pl. 7,x) is heavily ground on both faces, with the inner edge retouched and dulled. It is possible that the dulling results from the use of this specimen as a scraper. Length is 63.5 mm., width is 36.5 mm., and thickness is 8 mm.

Comments: W. Coe (1959:29) refers to similar specimens as "crescents" and notes their occurrence at Piedras Negras, Copan, Teotihuacan and other Mesoamerican sites. Additional distributional information is given by Kidder (1947:30). A fragment of a bifacially chipped lunate was collected by Kroeber from Teotihuacan (Lowie Museum, Berkeley) and Kidder (1947: Fig. 12,c) illustrates another from the Valley of Mexico.

X-RAY FLUORESCENCE ANALYSIS

The 855 pieces of obsidian (including two pieces of chert or flint) from the site of Tres Zapotes have been analyzed in the Department of Geology and Geophysics, University of California, Berkeley, by semi-quantitative (rapid-scan) X-ray fluorescence technique for the trace elements rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). In addition, 125 samples collected from the surface at La Venta, Tabasco, in February and March 1970 and 7 samples excavated near the Stirling Group Plaza (for location, see map in Heizer, Graham and Napton 1968) at La Venta have been analyzed. These results combined with those reported earlier (Jack and Heizer 1968) provide an opportunity to compare a total of 295 obsidian samples from the La Venta site with 865 samples from the Tres Zapotes site (see Table 8).

The analytical procedures utilized are the same as those reported earlier (Jack and Heizer 1968; Jack and Carmichael 1969) with two exceptions. A spectograph head with a sample chamber accommodating large specimens, designed and constructed under the supervision of Leonard Vigus of the Department of Geology and Geophysics, University of California, Berkeley, was used for this study. The spectographic data were processed on the CDS 6400 computer and the resulting normalized ratios of the elements Rb, Sr, and Zr were machine plotted from the punched card output of the computer. The raw spectograph data for the samples reported in 1968 were also processed by the computer for comparison with the results of the study.

These analyses bring to 1160 the total samples of obsidian from the sites of La Venta and Tres Zapotes which have been analyzed by rapid scan X-ray fluorescence technique. The same obsidian chemical types (designated A through E; Jack and Heizer, 1968) are present in the two collections but in differing proportions. Obsidian type D makes up 93.4% of the National Museum collection from Tres Zapotes whereas this type makes up less than 2% of the La Venta sample. In the La Venta sample obsidian types A,B, and C dominate, comprising 84.1% of the combined surface and excavated samples; these three types make up a combined total of only 2.2% of the Tres Zapotes sample. These results are plotted in Figures 8, 9 and 10 and are tabulated in Table 8. In the figures dashed lines have been drawn around the point clusters indicating the assumed compositional limits of each obsidian type used in tabulating the data in Tables 7 and 8. The compositional fields of type D and type B overlap somewhat so that points representing the composition of a few samples lie in the fields of both types B and D. The samples whose compositions lie in this dual field have been assigned to type B. Based upon 15 samples in the Tres Zapotes collection and 3 in the La Venta collection, another type, designated F, may be recognized. This type is very close in composition to both types B and D, but visually the samples most closely resemble, and may be a variant of, type D. Six Tres Zapotes samples are assigned to type E, following the designation used previously for the La Venta samples. In both the Tres Zapotes and the La Venta collections there are obsidian samples whose plotted compositions form a group in the center of the ternary diagram (Figs. 8 and 9). Due to unusually low concentrations of the elements Rb, Sr and Zr, the plotted points show a rather high statistical scatter. This group has been designated obsidian type G. All other specimens, which include some non-igneous samples, have been assigned to the category "other" in Tables 7 and 8.

The sources of the obsidian raw material are not known for some of the chemical types identified. The source of type A at Cerro de Navajas

(Pachuca), Hidalgo, has been previously reported (Weaver and Stross 1965; Jack and Heizer 1968). A geologic sample of obsidian from the vicinity of Zaragoza, Puebla, has a composition (for these elements) identical to obsidian type D (see Fig. 10). Samples of obsidian from the Tozongo and Alpatlahua areas of Pico de Orizaba are in part similar in composition to type E, and a sample of obisidian from Guadalupe Victoria, Puebla, matches in composition the samples designated type G. The geological source for our types B and C obsidians from which most of the La Venta artifacts were fashioned has not been located.

OBSIDIAN CHEMICAL TYPES

	A	B	C	D	E	F	G	OTHER	TOTAL
Projectile Points				1	1				2
Miscellaneous Bifaces				4			2	2	8
Miscellaneous Unifaces		1		3				1	5
Lunate Objects				2					2
Total		1		10	1		2	3	17
Percent		5.9		58.8	5.9		11.8	17.6	100.0
Complete Blades	1	1		17					19
Thinned Blades				7					7
Trimmed Blades			1	13		1			15
Notched Blades				2					2
Burin on Blade				1					1
Proximal Blade Frag.		2	1	136	2	5	3	2	151
Medial Blade Frag.	1	5		97		5	2	1	111
Distal Blade Frag.		1	1	74	1	2			79
Total	2	9	3	347	3	13	5	3	385
Percent	0.5	2.3	0.8	90.1	0.8	3.4	1.3	0.8	100.0
Single Facet Cores				16					16
Multifaceted Cores				41		1			42
Ground Platform Cores				12	1				13
Proximally-Truncated Cores				59					59
Scratched Platform Cores				5					5
Splintered Platform Cores				6					6
Distally-Truncated Core				1					1
Core Fragments				19					19
Core Tablets				10					10
Transverse Modification Flake				1					1
Core Modification Detritus				7					7
Total				177	1	1			179
Percent				98.9	0.6	0.6			100.1
Ridge Flakes				7		1			8
Waste Flakes									
Single Facet Platform				84				2[a]	86
Multifaceted Platform				12					12
Crushed Platform				28			1		29
Ground Platform				2					2
Convergent Platform				12			1		13
Scraper Rejuvenation Flake				2					2
Retouched Flakes				44	1				45
Flake Fragments		1	1	74			1		77
Total		1	1	265	1	1	3	2	274
Percent		0.4	0.4	96.7	0.4	0.4	1.1	0.7	100.1

Table 7. <u>Correlation of Artifacts and Obsidian Chemical Types at Tres Zapotes.</u>

[a] Both samples probably non-igneous (e.g. flint or chert).

OBSIDIAN CHEMICAL TYPES

		A	B	C	D	E	F	G	OTHER	TOTAL
TRES ZAPOTES:										
Nat. Museum Coll.	No.	2	11	4	799	6	15	10	8[b]	855
	%	0.2	1.3	0.5	93.4	0.7	1.8	1.2	0.9	100.0
1968[a]	No.		2		6			2		10
	%		20.0		60.0			20.0		100.0
Combined	No.	2	13	4	805	6	15	12	8	865
	%	0.2	1.5	0.5	93.1	0.7	1.7	1.4	0.9	100.0
LA VENTA, SURFACE:										
1970	No.	10	58	32	2	5	2	7	9	125
	%	8.0	46.4	25.6	1.6	4.0	1.6	5.6	7.2	100.0
1968[c]	No.	24	62	44	3	9	1	3	5[d]	151
	%	15.9	41.0	29.1	2.0	6.0	0.7	2.0	3.3	100.0
Combined	No.	34	120	76	5	14	3	10	14	276
	%	12.3	43.5	27.5	1.8	5.1	1.1	3.6	5.1	100.0
LA VENTA, EXCAVATED:										
Stirling Plaza[e]	No.	1	4	2						.7
	%	14.3	57.1	28.6						100.0
1968[f]	No.	3	2	6					1	12
	%	25.0	16.7	50.0					8.3	100.0
Combined	No.	4	6	8					1	19
	%	21.0	31.6	42.1					5.3	100.0

Table 8. Obsidian Chemical Types at Tres Zapotes and La Venta.

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[a] Collected from excavation in bank of Arroyo Hueyapan at locus of Drucker's 1940 Trench 26. These analyses were published earlier in Jack and Heizer (1968).

[b] Includes 2 samples which are probably non-igneous (e.g. flint or chert).

[c] Data from Jack and Heizer (1968).

[d] Includes 1 sample probably non-igneous.

[e] Recovered from test pits excavated by C. Clewlow and P. Hallinan in May, 1970, between the two mounds at the south end of the Stirling Group Plaza. For location, see map in Heizer, Graham and Napton (1968).

[f] Recovered from test pits. See Hallinan, Ambro and O'Connell (1968) for locations. These data published earlier by Jack and Heizer (1968).

CONCLUDING STATEMENT

In this paper, we have presented data on obsidian artifacts collected in 1939 and 1940 from the site of Tres Zapotes, Veracruz, Mexico. The site was probably occupied from the Middle or Late Preclassic to Postclassic times. Though there are inadequate provenience data for this collection, our analyses did provide a number of significant results.

A major objective in our studies was to determine the chemical types of the obsidian used at Tres Zapotes. Using X-ray fluorescence techniques, we found that 93.4% of the obsidian was of type D. An obsidian sample obtained from Zaragoza, Puebla, was found to be of type D, indicating that an obsidian flow in that vicinity was the primary source of obsidian used at Tres Zapotes. The most obvious fact revealed by these analyses is the predominance of obsidian type D at Tres Zapotes as contrasted to the predominance of types A, B and C at La Venta.[5] However, other interesting relationships are revealed concerning the occurrence of obsidian samples of types E and G and those of generally similar composition included in the category "other". First, they are relatively abundant on the surface at La Venta but, with one possible exception, are absent from the excavated samples from the same area. Secondly, obsidian samples of these compositions are more common among certain artifact groups at Tres Zapotes (see Table 7). One of the two projectile points and one of the retouched flakes are of obsidian type E. Of the eight bifaces, two are of type G and two are of a composition intermediate between types E and G (included in the category "other"). One of five unifaces is included in the category "other," being of a composition near that of type G. In contrast, the cores, blades and flakes at Tres Zapotes are almost entirely of type D obsidian (see Table 7). Thus, Zaragoza seems to have been the source from which the Tres Zapotes stone-workers secured raw materials for a period of about 1500 years. Type A obsidian from Cerro de Navajas (Pachuca), Hidalgo, is the least abundant and probably the most distant of sources. Obsidian from Guatemala is absent at Tres Zapotes, though it occurs in small quantities at La Venta (Jack and Heizer 1968) and San Lorenzo (M.D. Coe, personal communication). With inadequate contextual data for the Tres Zapotes obsidian, it is impossible for us to speculate on the cultural meaning of the differences of obsidian types at the site.

Our lithic analysis of the Tres Zapotes obsidian aims at providing more specific technological data on Mesoamerican blade industries than is usually given in published reports. Various aspects of the Tres Zapotes core-blade industry were noted. There are large pieces representing the shaping and preparation of large cores or blocky obsidian nodules brought to the site from a quarry source (cf. Holmes 1919). Ridge flakes, the removal of which guided subsequent blade detachment, were recognized. There is also detritus attributable to methods of core modification and rejuvenation. For example, a number of core tablets are present, indicating that a truncation technique which allowed the rejuvenation of nearly exhausted cores was employed. The occurrence of numerous cores truncated by this technique suggests that it was a standard part of the Tres Zapotes core-blade industry. Numerous waste flakes resulting from core platform trimming activities were also noted.

There are few bifacial and unifacial tools in the collection. Microscopic examination of these implements reveal use-wear patterns (striations, nibbling, dulling and crushing) which indicate that they functioned in several kinds of cutting and/or scraping activities. More extensive studies of large samples of obsidian artifacts from Mesoamerican sites are essential if we hope to derive any general conclusions regarding tool use.

Blades and blade fragments are the most numerous artifact class. Most were probably used for a variety of utilitarian purposes. Some, however, were carefully thinned at one end, perhaps to facilitate hafting. Others have been intentionally trimmed to a point. Two pieces are notched and may have been used as spokeshaves. There is a large number of microblades (blades with a width of 10 mm. or less) at the site; these probably result from the removal of blades from small, nearly-exhausted cores. A burin, made on a snapped blade, exhibits wear on its tip.

Data were also obtained on the size of blade striking platforms and bulbs of percussion (see Table 4). We hoped that these data might provide criteria which could indicate the modes of blade removal used at the site.

Most of the blades have small striking platforms and diffuse, expanded bulbs of percussion. This suggests to us that the blades were detached by pressure techniques, perhaps involving the use of a T-shaped crutch as described in Spanish accounts. Honea (1965:32) believes that blades with salient bulbs may have been produced by indirect percussion, but cautions that there are inherent difficulties in distinguishing blades made by pressure from those made by indirect percussion on the basis of platform and bulb size. Experiments reported by Crabtree (1968) have shown that fine, parallel-sided blades are more consistently produced by pressure (see Crabtree 1968:Fig. 7). Crabtree's observations support our belief that most Tres Zapotes blades were removed by pressure.

Several forms of striking platform preparation are evidenced on the blade cores from Tres Zapotes. A few specimens have ground or scratched platforms; such preparation apparently acted to prevent the slippage of a crutch tip during blade removal. Some cores retain a smooth, single-faceted surface with no evident platform preparation. Nearly 30% of the cores have multifaceted striking platforms. This high percentage is unusual in that similarly prepared cores, judged from available data, are quite rare in Mesoamerica. In fact, Epstein (1964:167) stated that such platform preparation was absent in Mesoamerica. MacNeish et al (1967:28) have indicated that such cores cover a long time span in the region, but are especially common in the early El Arbolillo phase of the Valley of Mexico. Perhaps this type of platform preparation has early origins, and it is therefore unfortunate that we cannot date any of the Tres Zapotes examples. Cores with proximal truncations constitute 34.5% of the Tres Zapotes cores. As mentioned earlier, this is indicative of a widespread core rejuvenation procedure in the local core-blade industry.

The waste flakes at Tres Zapotes are primarily attributable to core shaping and trimming endeavors. There are nine specimens, however, which may result from biface thinning activities, and two flakes which are no doubt derived from uniface resharpening techniques quite similar to those noted in parts of North America (cf. Frison 1968; Shafer 1970). Many waste flakes were retouched for casual or brief use as knives or scrapers.

In our concluding paragraph, we wish to stress the need for additional research on obsidian in Mesoamerica. The importance of source and chemical type analysis of obsidian in this region has been made evident in a number of previous papers and such studies should be continued and greatly expanded (cf. Stevenson, Stross and Heizer 1971). Obsidian assemblages with good contextual data will provide the most meaningful results. Technological analyses of Mesoamerican obsidian materials are also urgently needed. Too often, the obsidian artifacts and debitage have been given cursory treatment or completely ignored. There is a need for the publication of careful studies of obsidian cores, blades and detritus if we are to more fully understand the processes involved in stone-working throughout the region and the changes that these processes underwent through time. Both Epstein (1964) and Mayer-Oakes (1966) have provided suggestions as to how such analyses could be usefully conducted. It would also be desirable for studies of the obsidian quarry sites to be presented in detail, thus giving us some empirically-based concepts regarding the initial phases of the core-blade process. Finally, there remains much room for additional experimentation and replication (cf. Crabtree 1968). For example, the mechanics of core truncation and rejuvenation should be explored. New information could be obtained through experimentation on the relative advantages or disadvantages of the various types of striking platform preparation. More work is needed to determine reliable criteria necessary for sorting blades produced by indirect percussion or pressure methods. The use of freshly-made obsidian tools with different materials may provide leads to the understanding of use-wear patterns on prehistoric specimens.

NOTES

1. Melgar published the almost identical article in 1871; a translation of this has been published in Stirling (1943:17).

2. The most detailed study made to date of the Olmec colossal heads is by Clewlow et al, 1967.

3. See also Wauchope 1950:237-238, 240-241, 242.

4. Weiant (1943:5) refers to an "important mound group" lying west of the North Group but now shown on his map. If he had located this east of the North Group the location would fit the "Nestepe" group where the second colossal head referred to here was discovered. Stirling (1965:733) refers to this as Monument Q, Tres Zapotes. For further discussion see Heizer, Smith and Williams 1965.

5. M. Coe informs us (personal communication) that type G obsidian is predominant at the site of San Lorenzo.

APPENDIX

Rau (1873:359) has provided a description of the Alpatlahua obsidian source (see Map 4) on the Pico de Orizaba. Since this passage is not widely known, it is repeated here in full:

"The following interesting communication was addressed to me by Dr. C. H. Berendt:"

> "During one of many excursions which I made in the years 1853-'56 around the Citlaltepetl, or Pico de Orizaba (in the State of Vera Cruz), I saw an obsidian mine of the western slope of that mountain. I had heard of it from my friend the late Mr. C. Sartorius,* who had visited the place years ago. I was informed that

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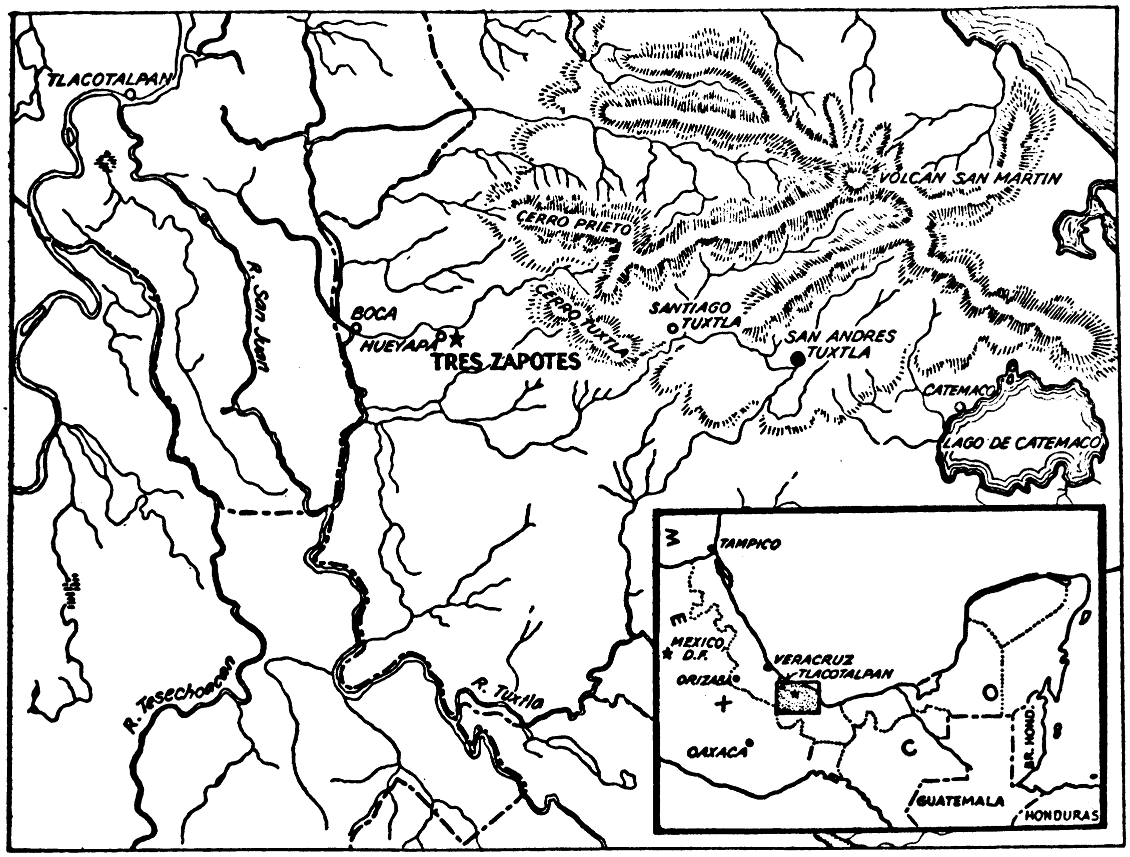
* [Sartorius published a book Mexico, Landscapes and Popular Sketches (Darmstadt, London, New York, 1858) which was reprinted by F.A. Brockhaus, Stuttgart, in 1961 under the title Mexico About 1850. This work does not contain any reference to the information attributed to him by Berendt.]

the Indians of the village of Alpatlahua knew the place, but that they did not like to have it visited. Some say they have treasures hidden in the caves of the neighborhood; while others believe that they had idols in those lonely places which they still secretly worship. The cura of San Juan Coscomatepec, who was of this latter opinion, gave me the name of a mestizo farmer in the neighborhood who might be induced to show me the place. Our party followed from Coscomatepec the road which leads to the rancho Jacal and the pass of La Cuchilla. We did not find the mestizo at home, but his wife, who directed her boy to show us the cave. Reaching the bridge of the Jamapa river, we took a by-road parting to the north, which brought us to the village of Alpatlahua and about four miles farther north to a branch of the Jamapa river, which we crossed. We then left the road and proceeded about half a mile up the river through thick woods, when we found ourselves suddenly before the entrance of the cave. It was about fifty feet high and of considerable width, but obstructed by fallen rocks and shrubs. Heaps of obsidian chips of more than a man's height filled the bottom of the grotto, which had apparently no considerable horizontal depth. To the left the mine was seen, an excavation of from six to eight square yards, the bottom filled up with rubbish and chips. Obsidian, evidently, had not only been quarried, but also been made into implements at this spot, the latter fact being proved by the occurrence of cores, or nuclei, of all sizes, from which flakes or knives had been detached. We were not prepared for digging, and it was too late for undertaking explorations that day. So we left, with the purpose to return better prepared at another time, hoping to find some relics of the miners and workmen, and, perhaps, other antiquities. But it happened, that I never had an opportunity to visit the place again. Mr. Sartorius saw in this cave three entrances walled up with stone and mortar, but these I did not discover, having as stated, no time for a careful examination. Future travelers, I hope, will be more successful.

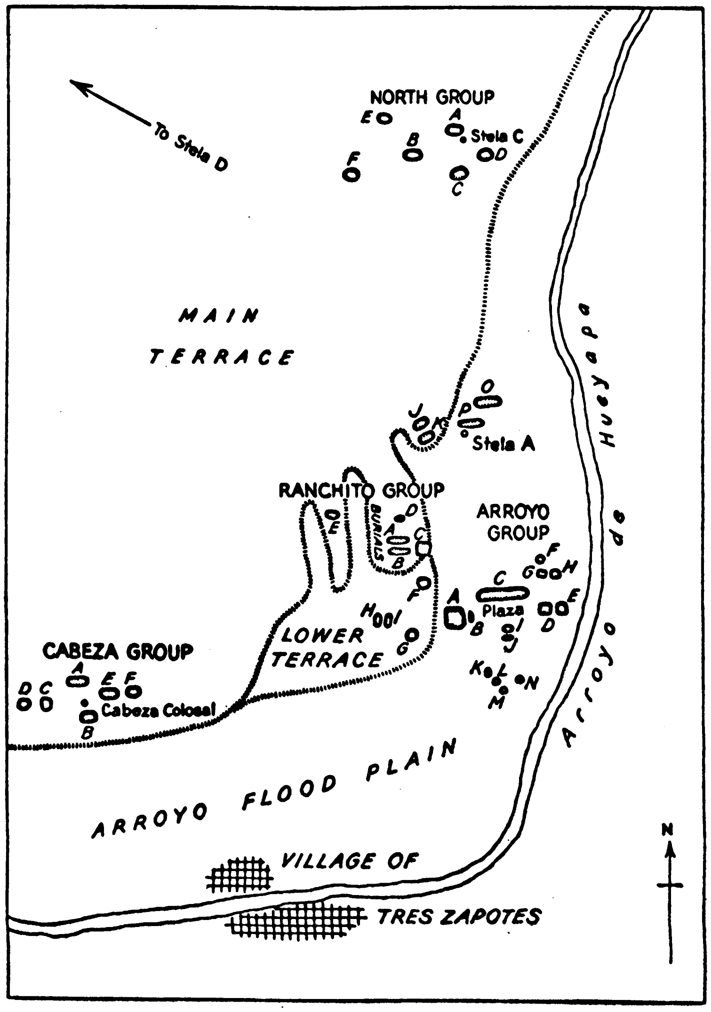
"Mr. Sartorius mentioned another place, likewise in the State of Vera Cruz, where obsidian formerly was quarried. This place is situated in the chain of mountains extending from the Pico de Orizaba to the Cofre de Perote. One of the intervening mountains, called Xalistac, is distinguished by a white spot that can be seen at the distance of many miles, even at Vera Cruz. It is produced by an outcropping of pumice-stone resting on an immense mass of obsidian that has been worked in various places. I know the mountain well, but not the road leading to it, never having traveled in that direction."

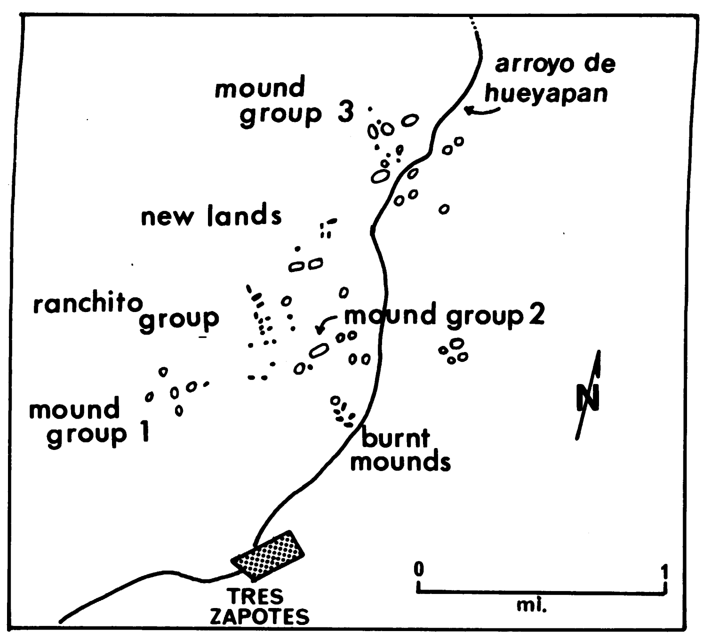
ILLUSTRATION CREDITS

The photographic illustrations were prepared by Mr. A. A. Blaker of the University of California Scientific Photo Laboratory. Mr. Joe Singer is responsible for the line drawings of the artifacts.



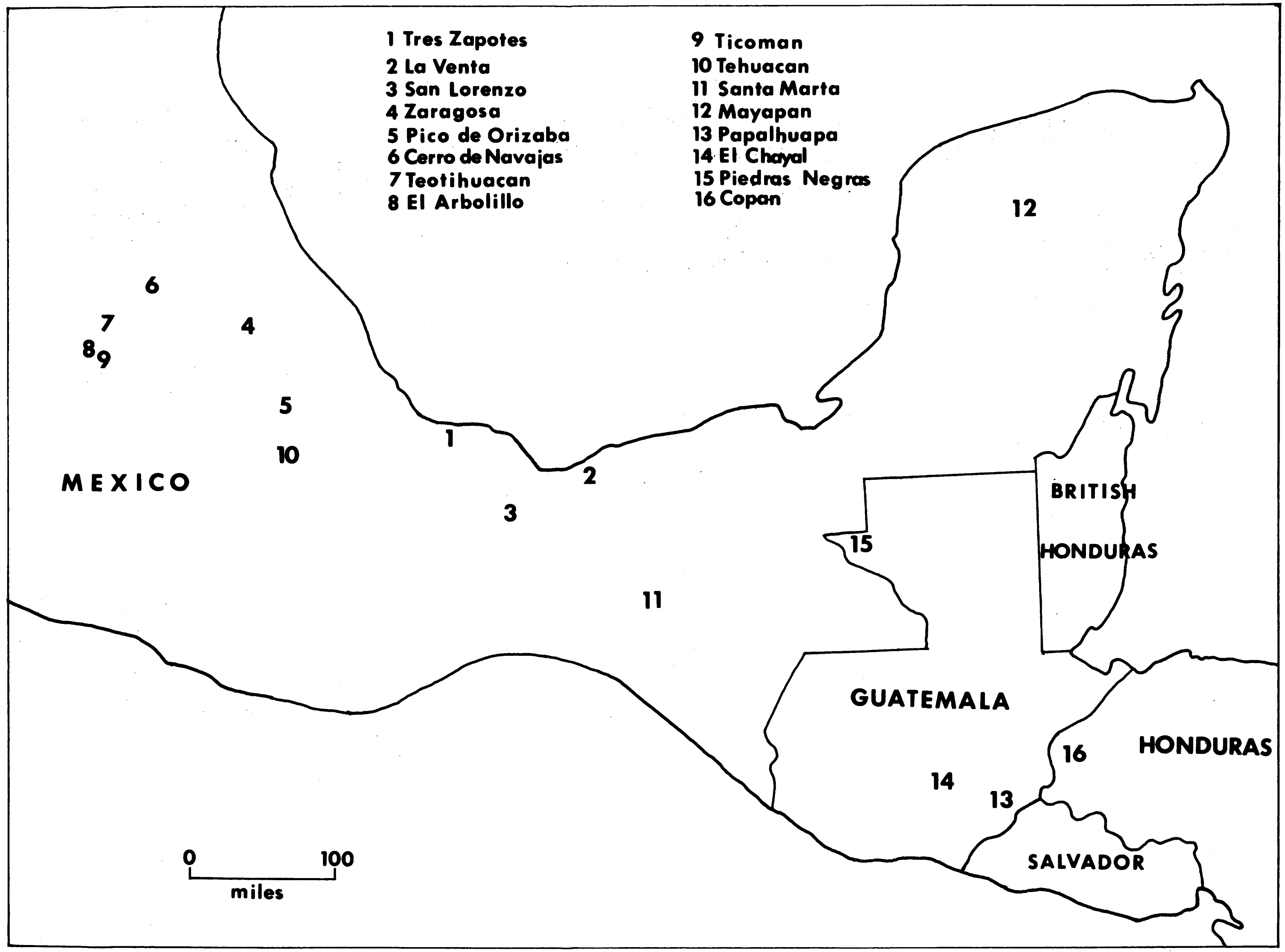
Map 1. Location of Tres Zapotes. (from Drucker 1943)





Map 2 (upper). The Site of Tres Zapotes (from Weiant 1943).

Map 3 (lower) The Site of Tres Zapotes (from Drucker 1943)



Map 4. Sites and Localities Mentioned in the Text.

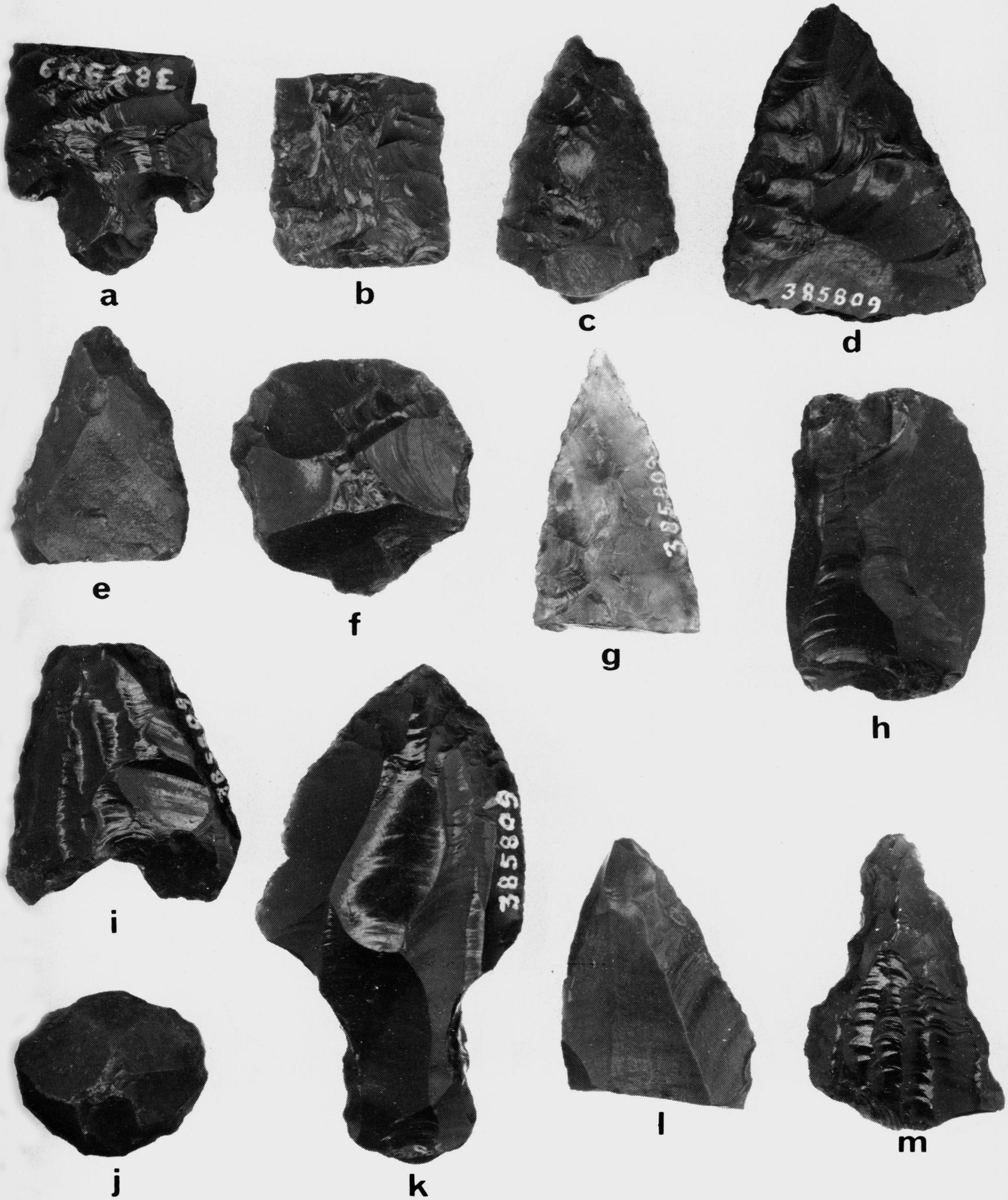


Plate 1. a, projectile point; b-h, miscellaneous bifaces; i-m, miscellaneous unifaces. (illustrated actual size)

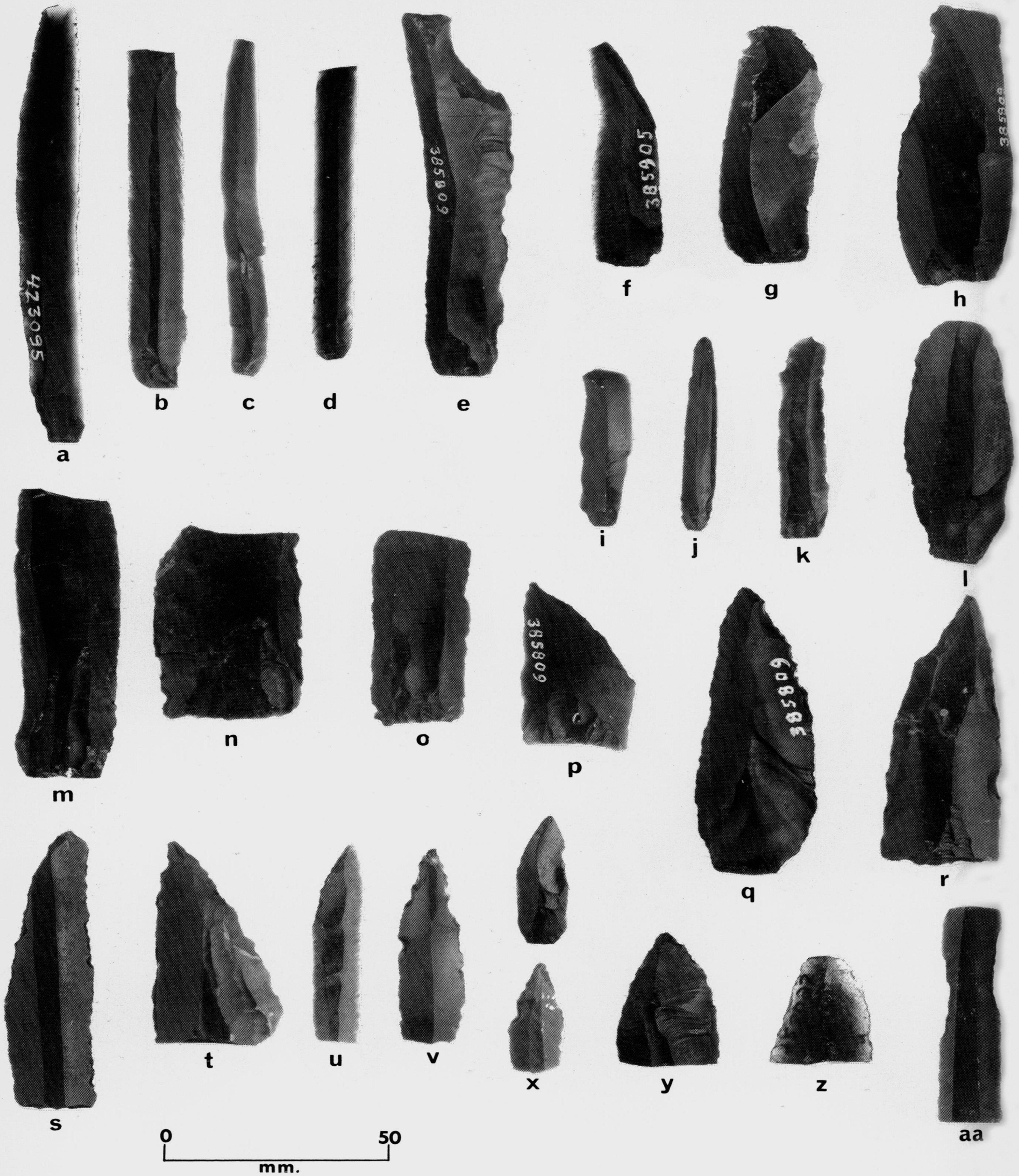


Plate 2. a-l, complete blades (all oriented with bulbs of percussion down); m-p, thinned blades; q-z, trimmed blades (dashes indicate dulling on z); aa, notched blade.

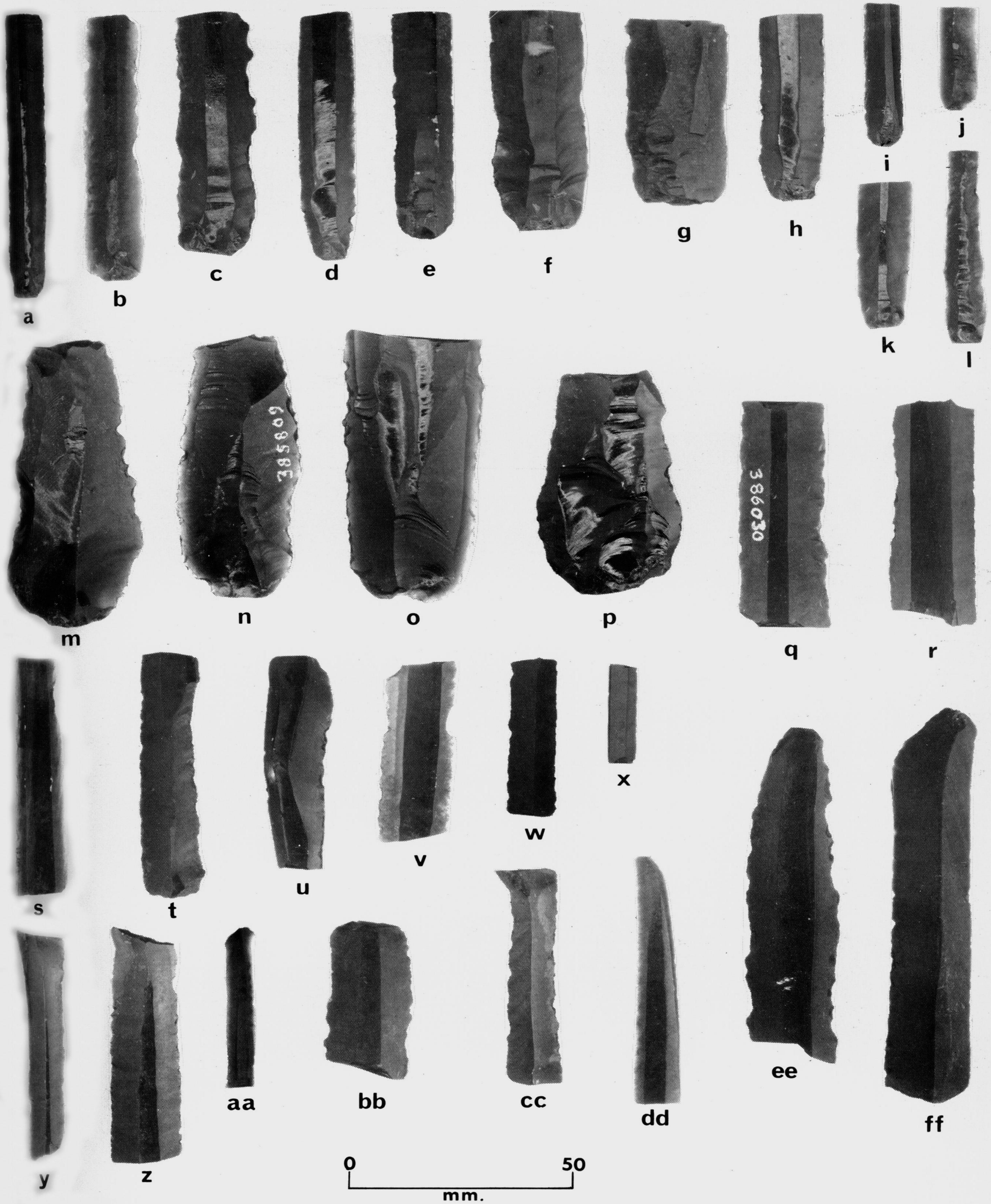


Plate 3. Blade Fragments. a-p, proximal; q-x, medial; y-ff, distal.

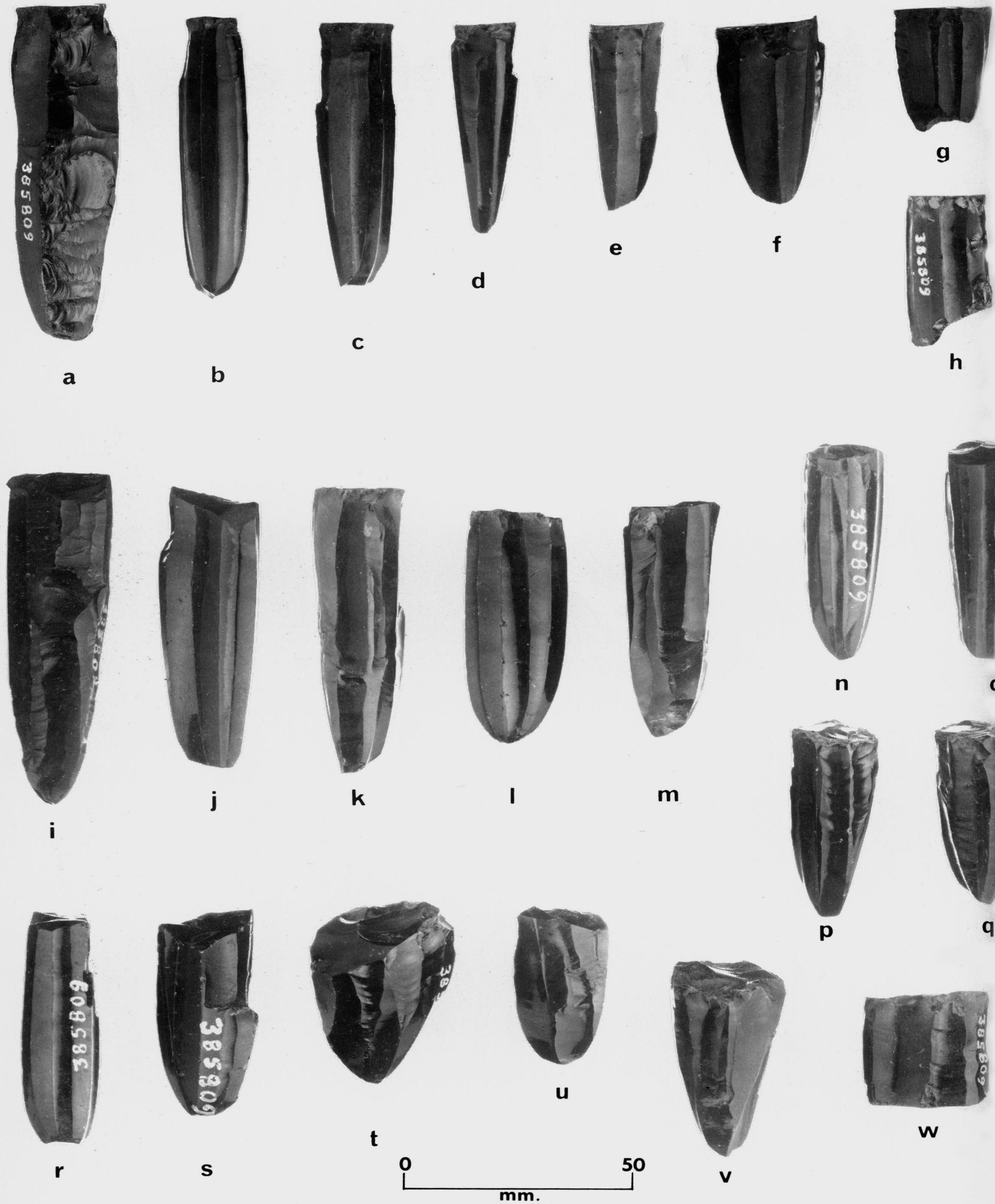
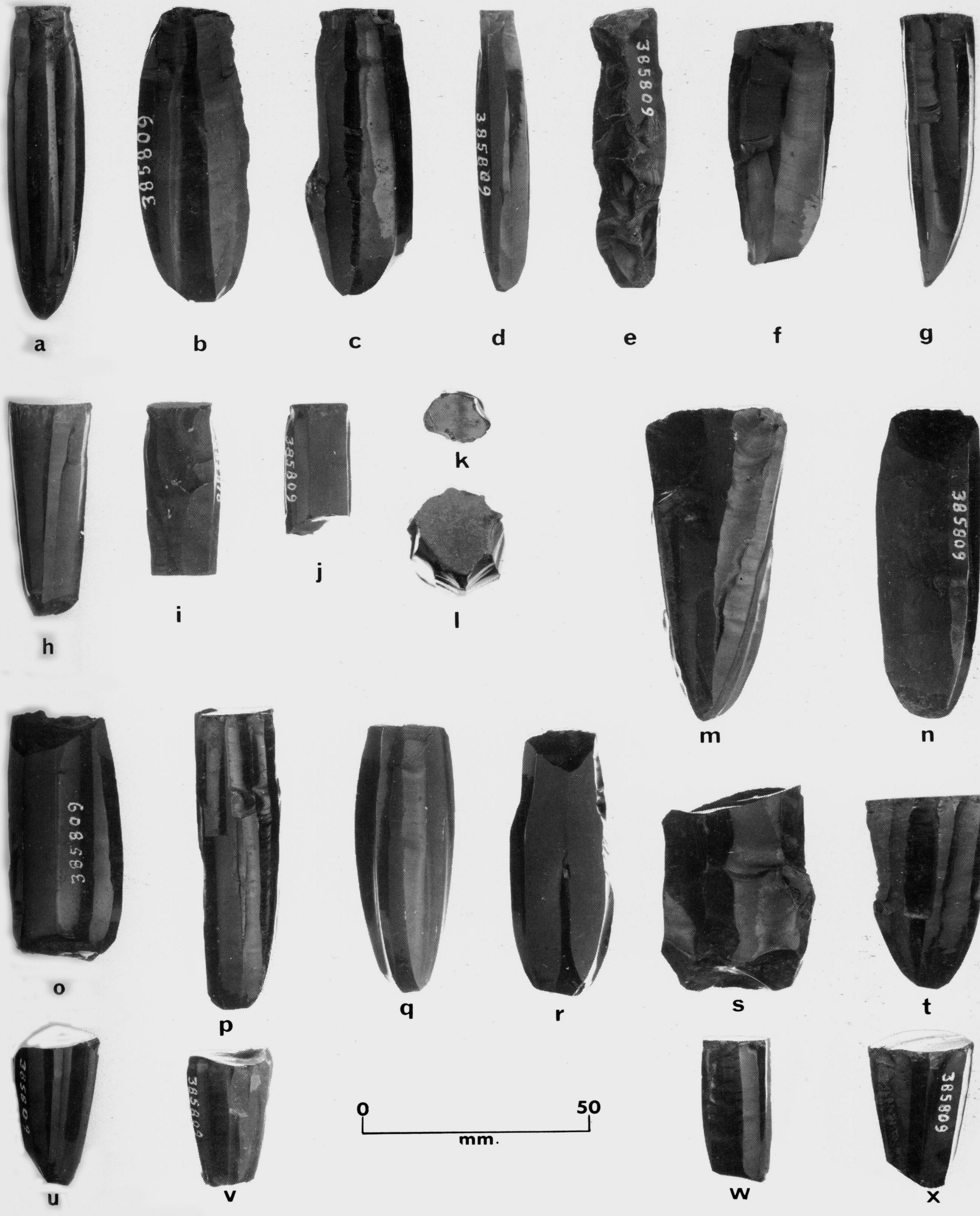


Plate 4. a-j, single facet platform cores; i-w, multifaceted platform cores. Note ridge flake preparation on a.



Plage 5. a-j, ground platform cores; k, l, views of ground platforms; m-x, proximally-truncated cores.

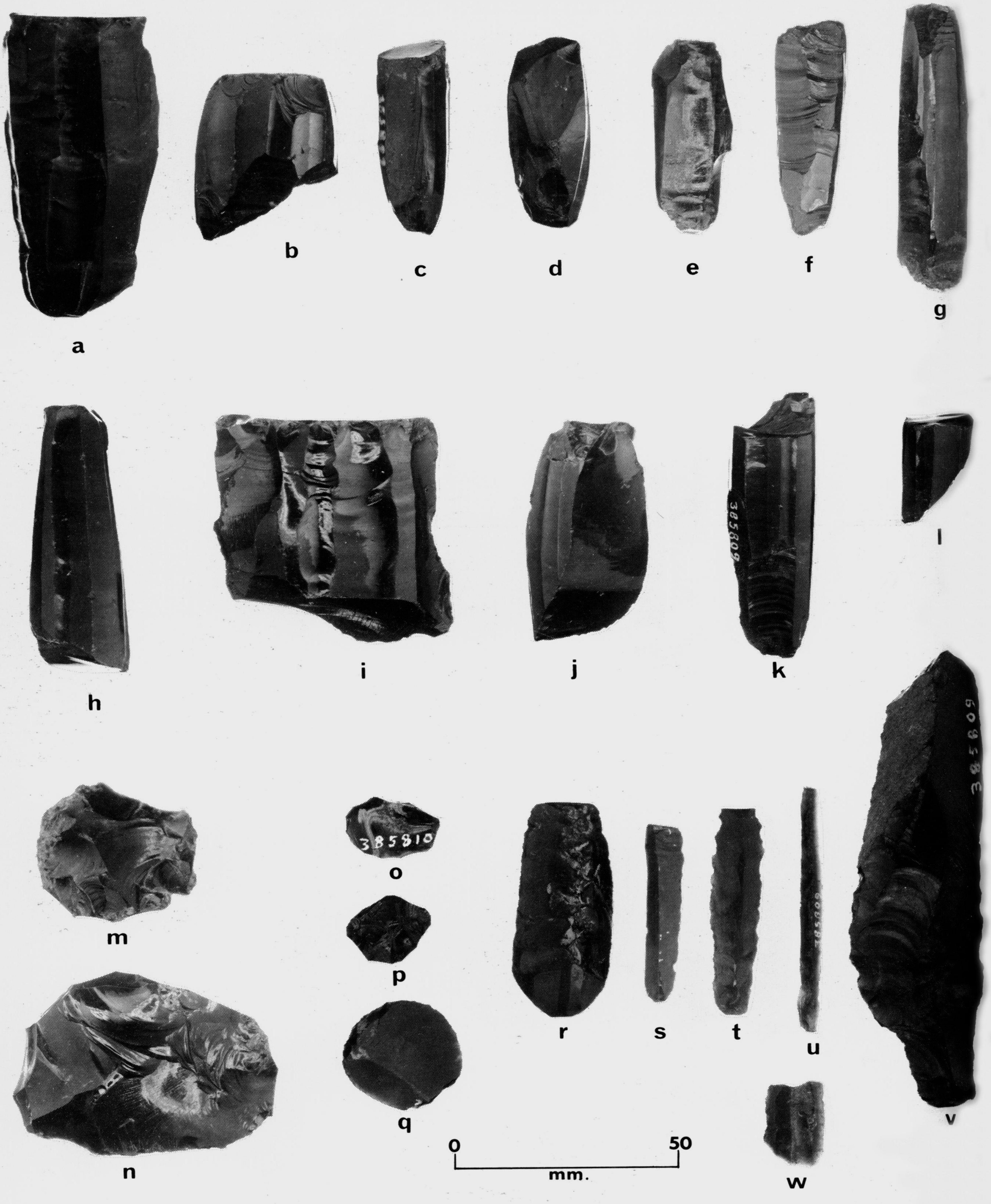


Plate 6. a-d, scratched platform cores; e-g, splintered platform cores; h, distally-truncated core; i-l, core fragments; m-q, core tablets; r-v, ridge flakes; w, transverse modification flake.

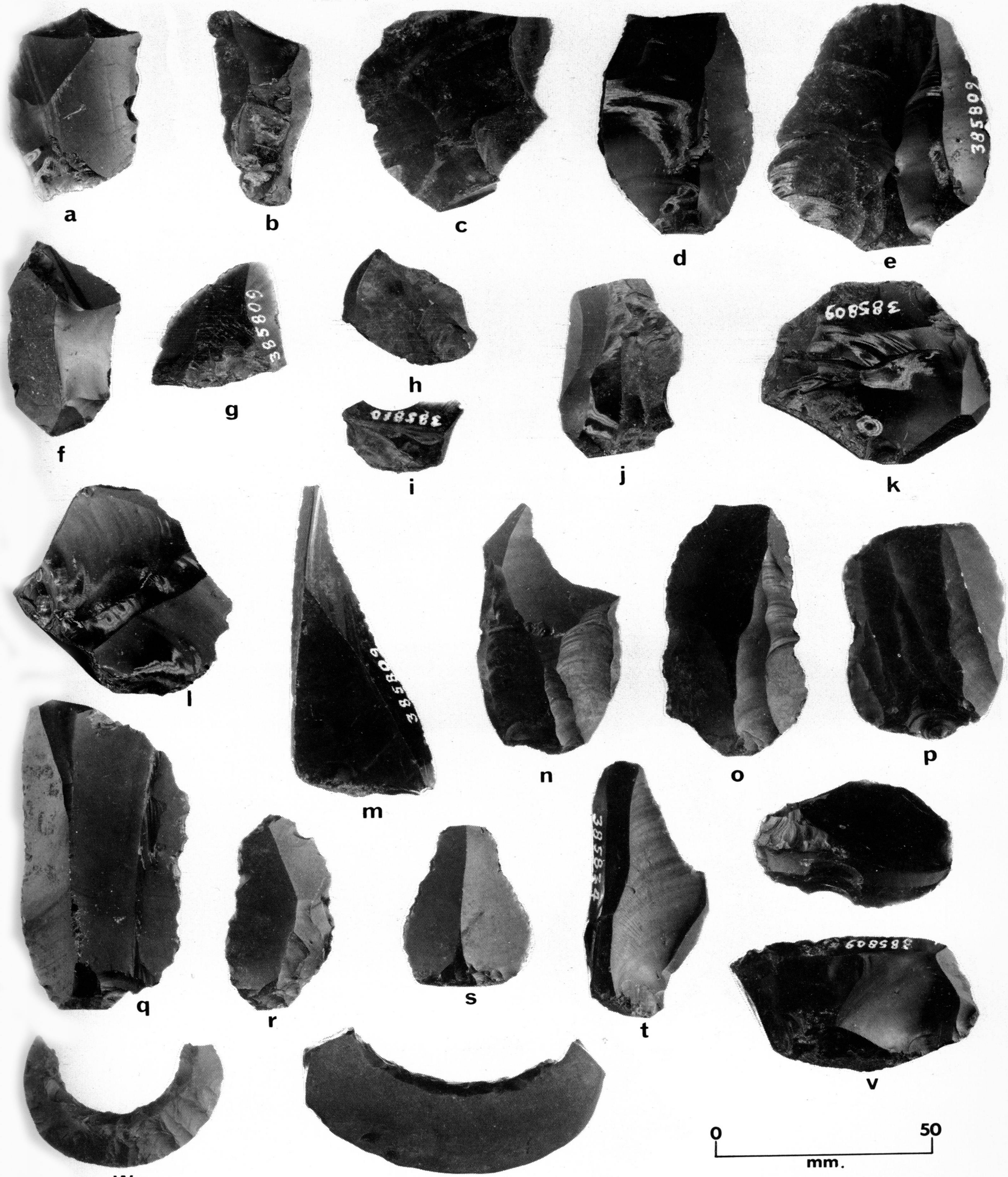


Plate 7. a-l, waste flakes; m-v, retouched flakes; w-x, lunate objects.

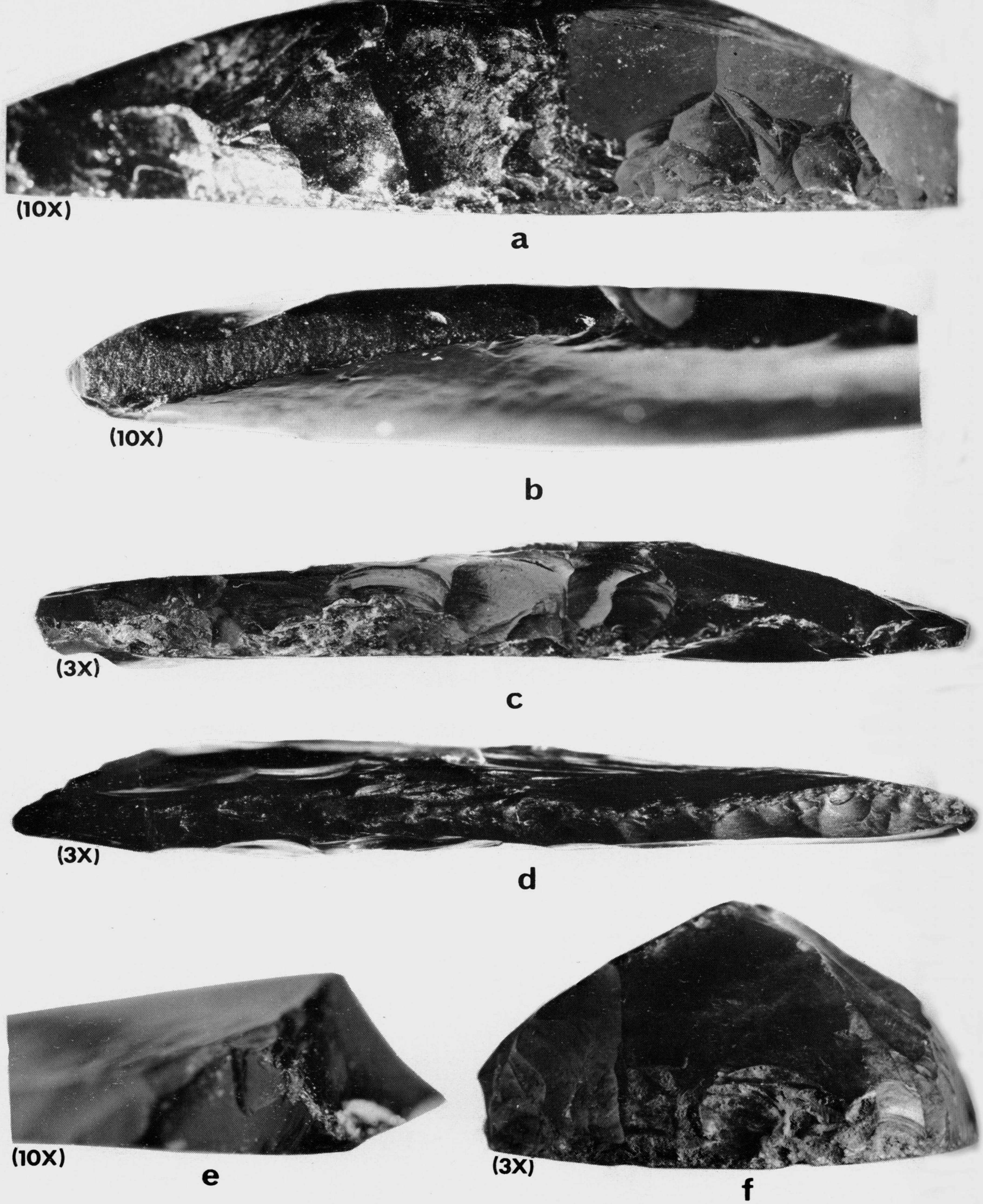


Plate 8. Use-Wear. a,b, and e, enlarged 10 times; c,d,f, enlarged 3 times. a, platform view of scraper rejuvenation flake (see Fig. 2, i); b, dulled blade edge; c, crushing and nibbling on uniface edges (see Pl. 1, m); d, dulling along biface edge (see Pl. 1,d); e, crushing on burin tip (see Fig. 2,h); f, nibbling on uniface edge (see Pl. 1,j).

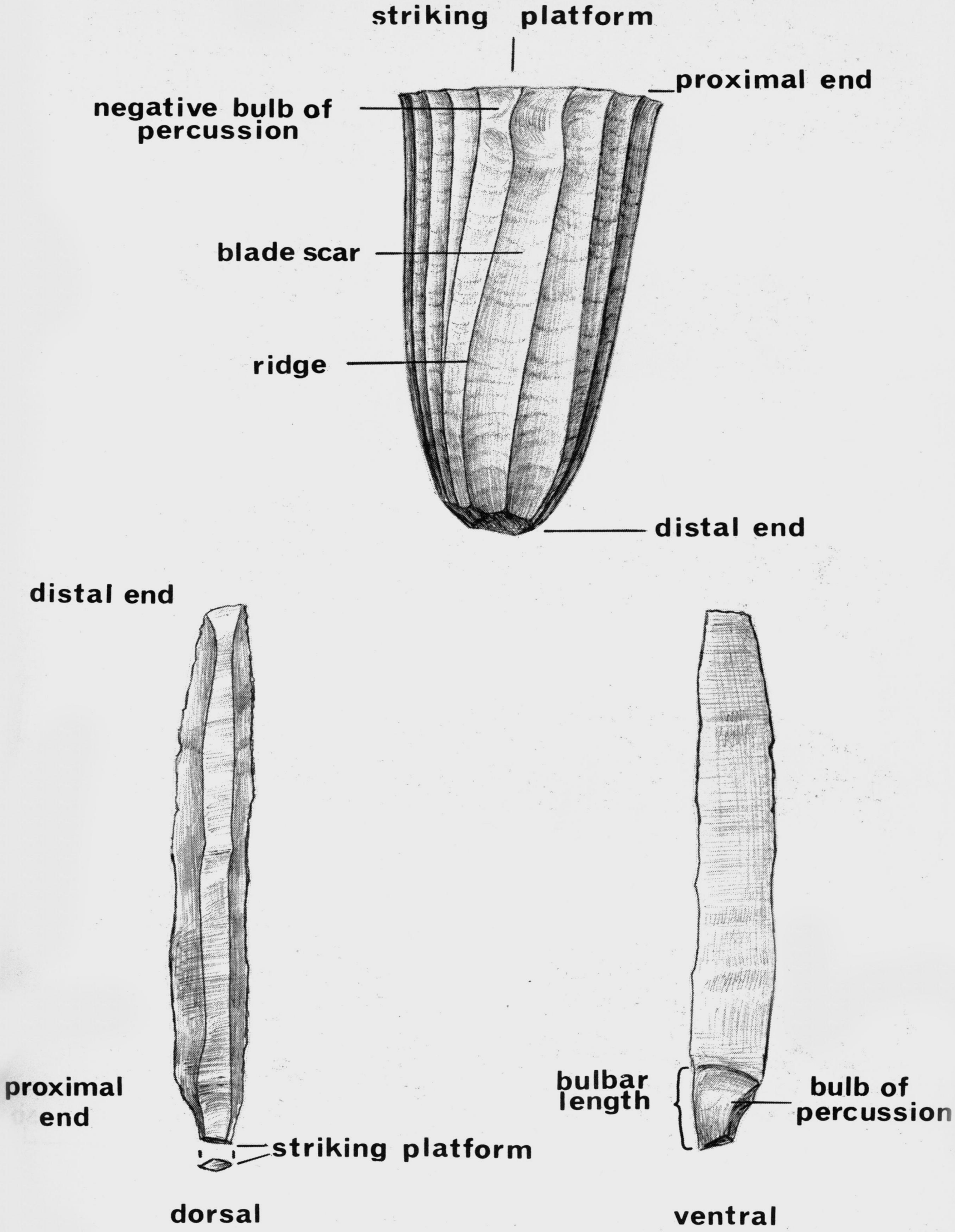


Fig. 1. Upper, Core Terminology;
Lower, Blade Terminology.

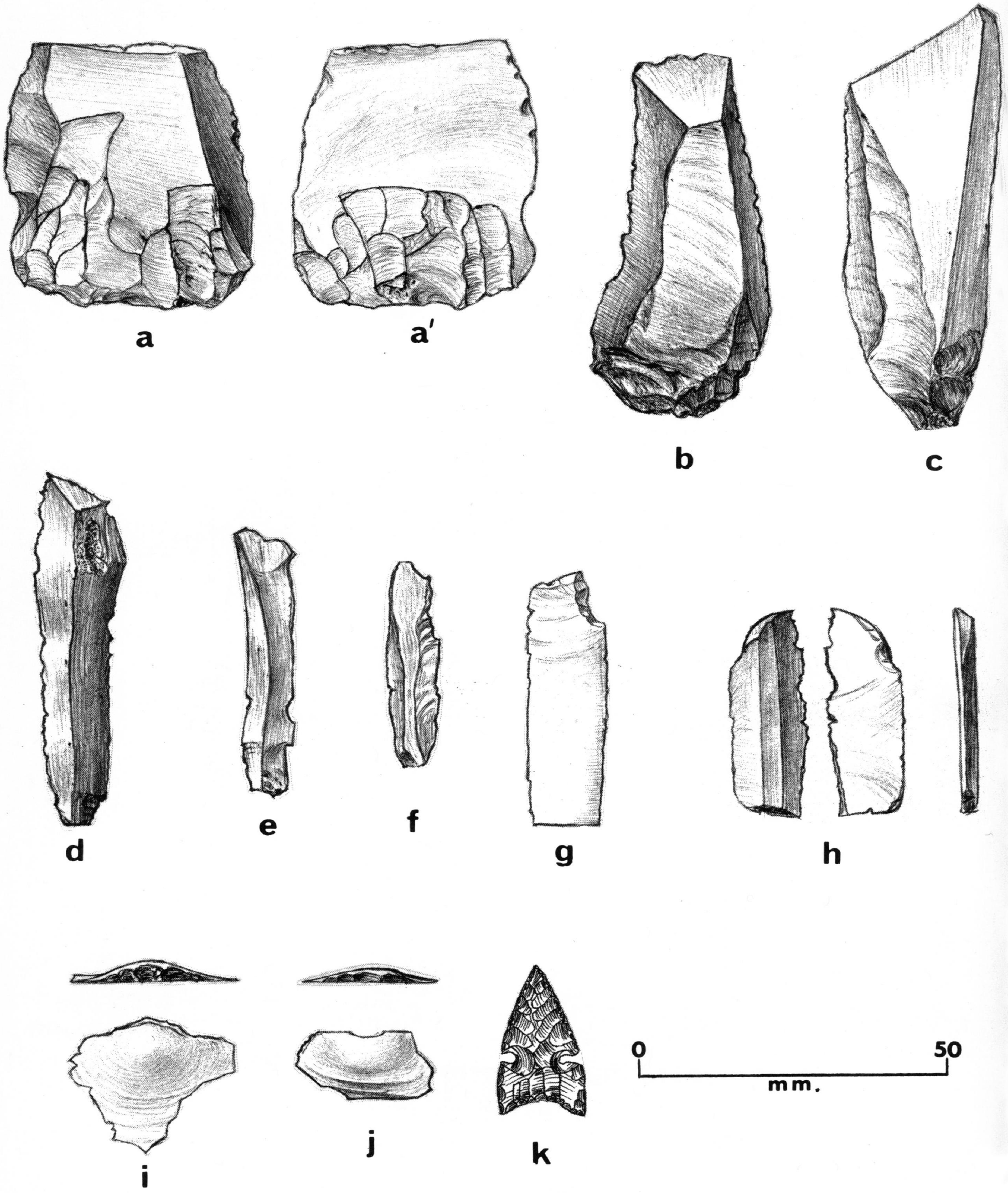


Fig. 2. a, a', thinned blade; b-f, complete blades; g, notched blade; h, burin on blade; i,j, scraper rejuvenation flake; k, side-notched point.

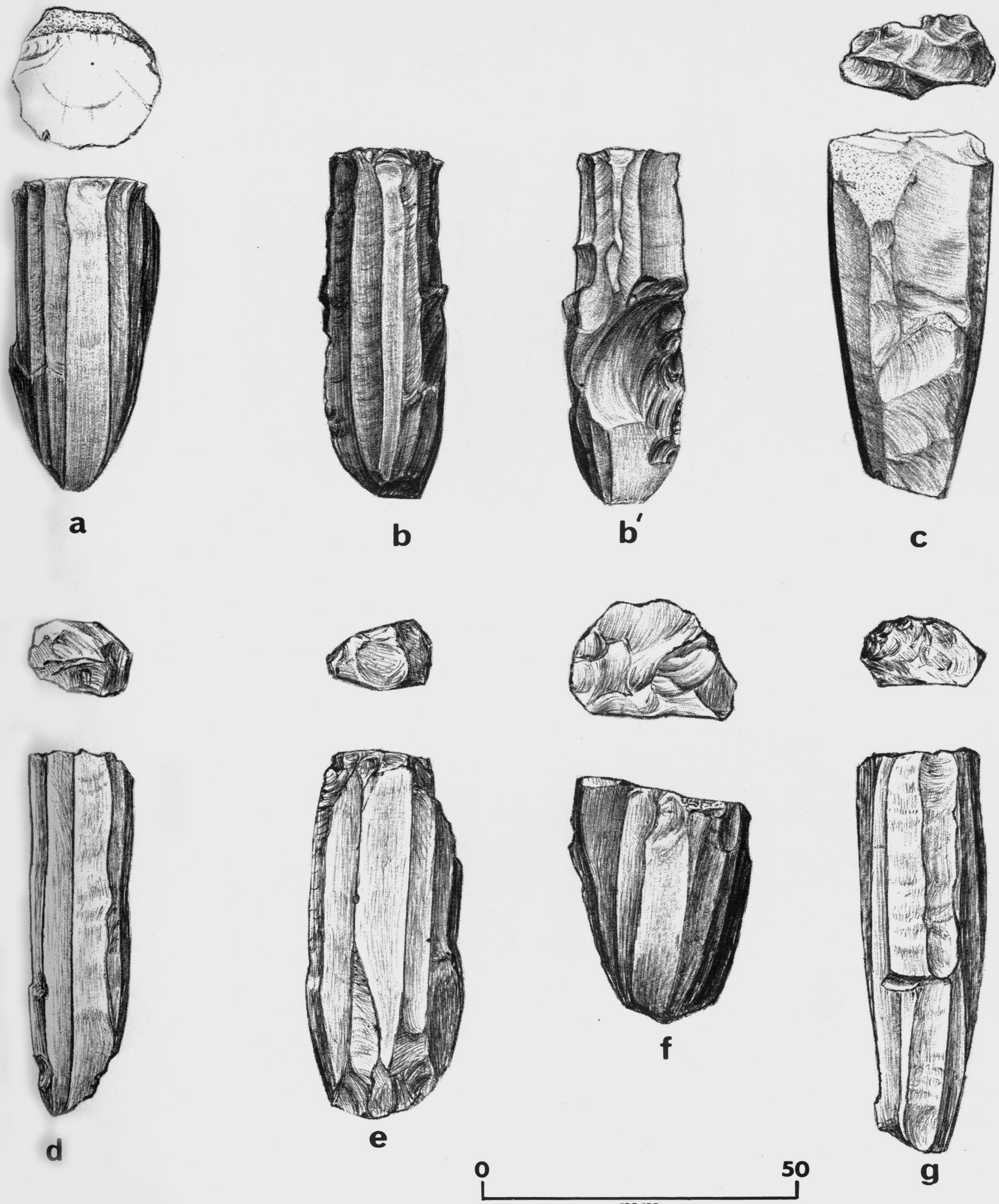


Fig. 3. a, single facet platform core; b-g, multifaceted platform cores. Platform views shown. (a, c-g).

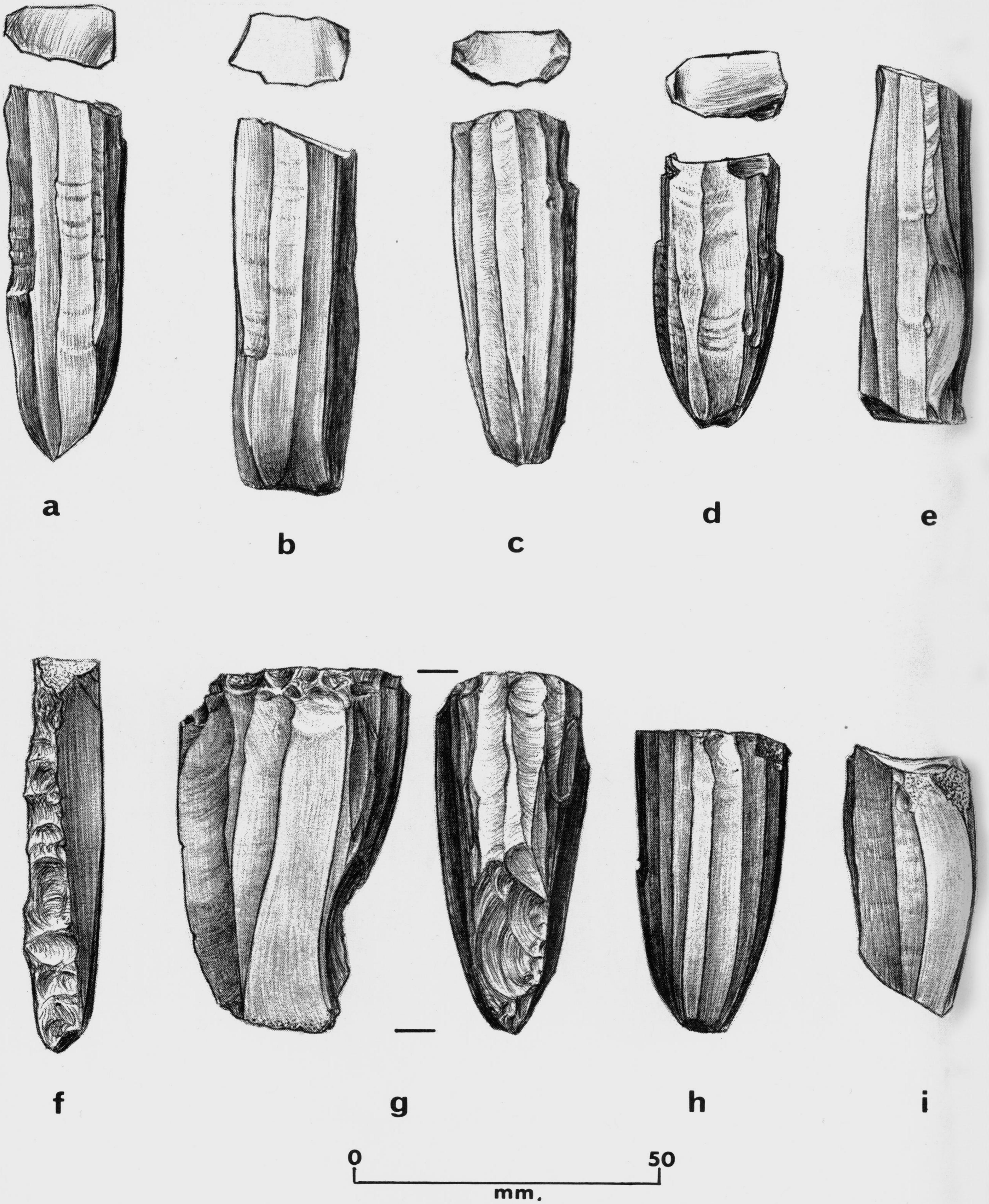


Fig. 4. a-i, proximally-truncated cores; e has been bi-truncated.

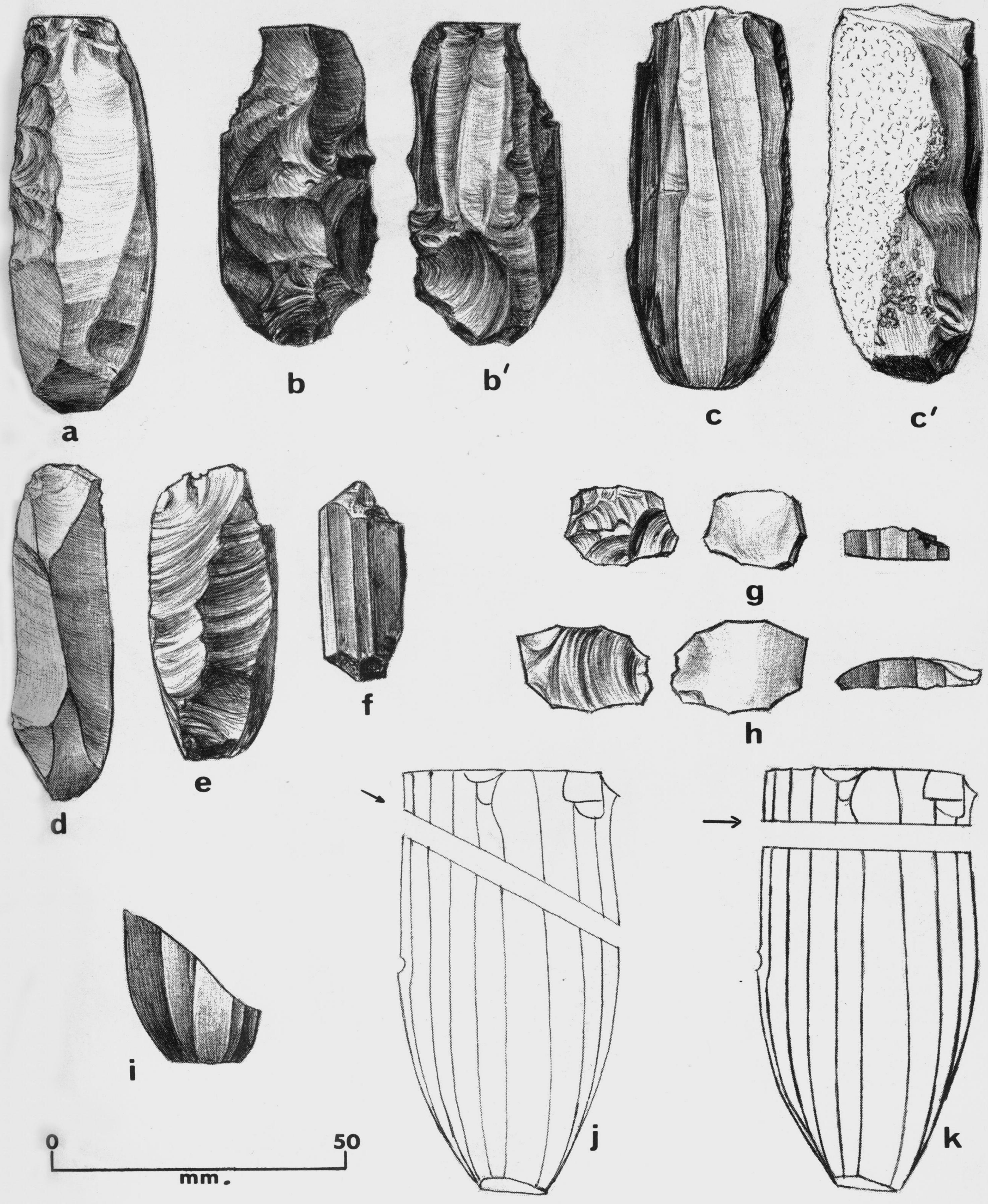


Fig. 5. a–c′, ground platform cores; d–f, cores with splintered platforms; g–i, core tablets; j, k, methods of core truncation.

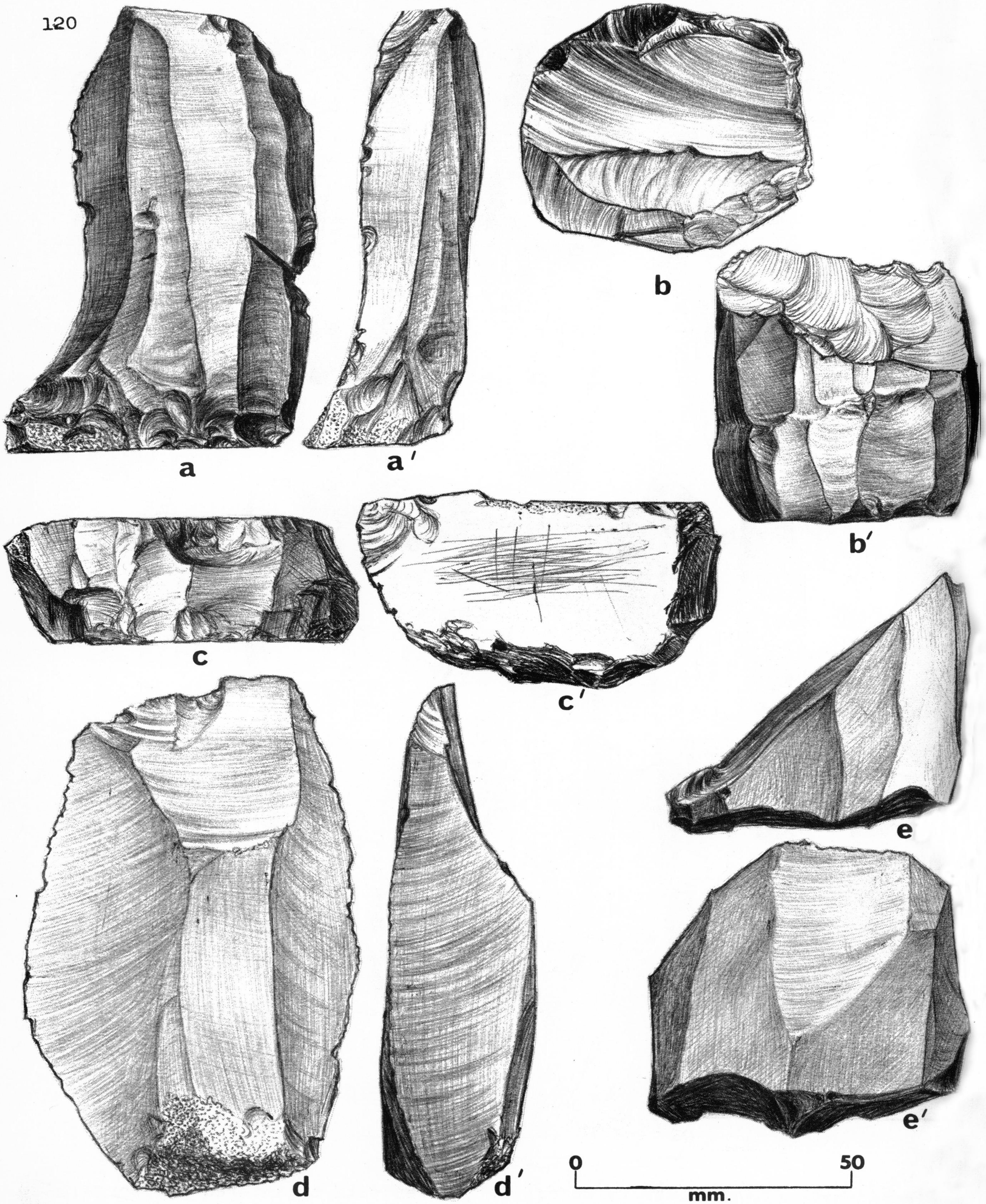


Fig. 6. a,b, core fragments; c, core tablet; d,e′, core modification detritus.

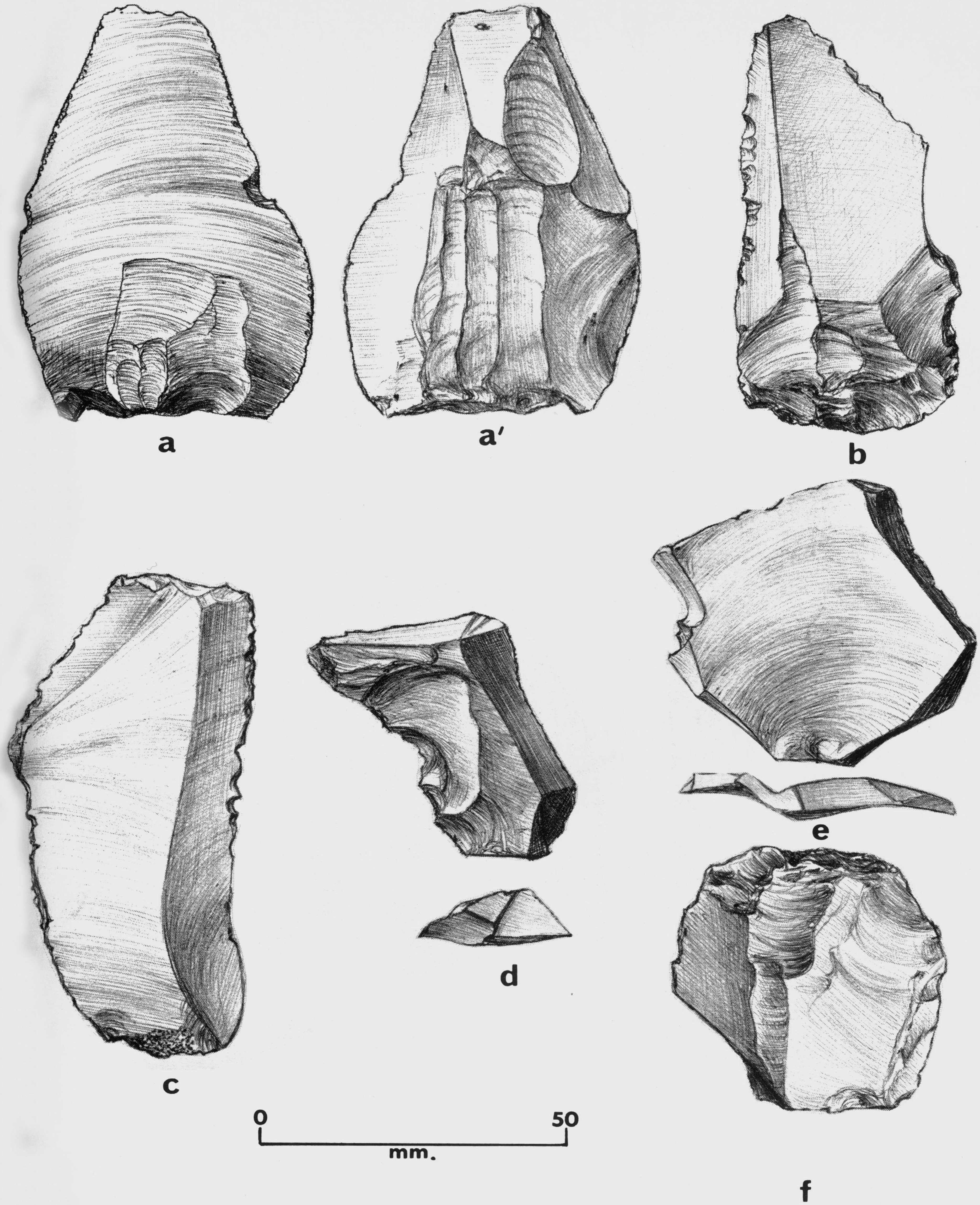


Fig. 7. a–c, retouched flakes; d, flake with single facet platform; e, flake with convergent platform; f, flake with crushed platform.

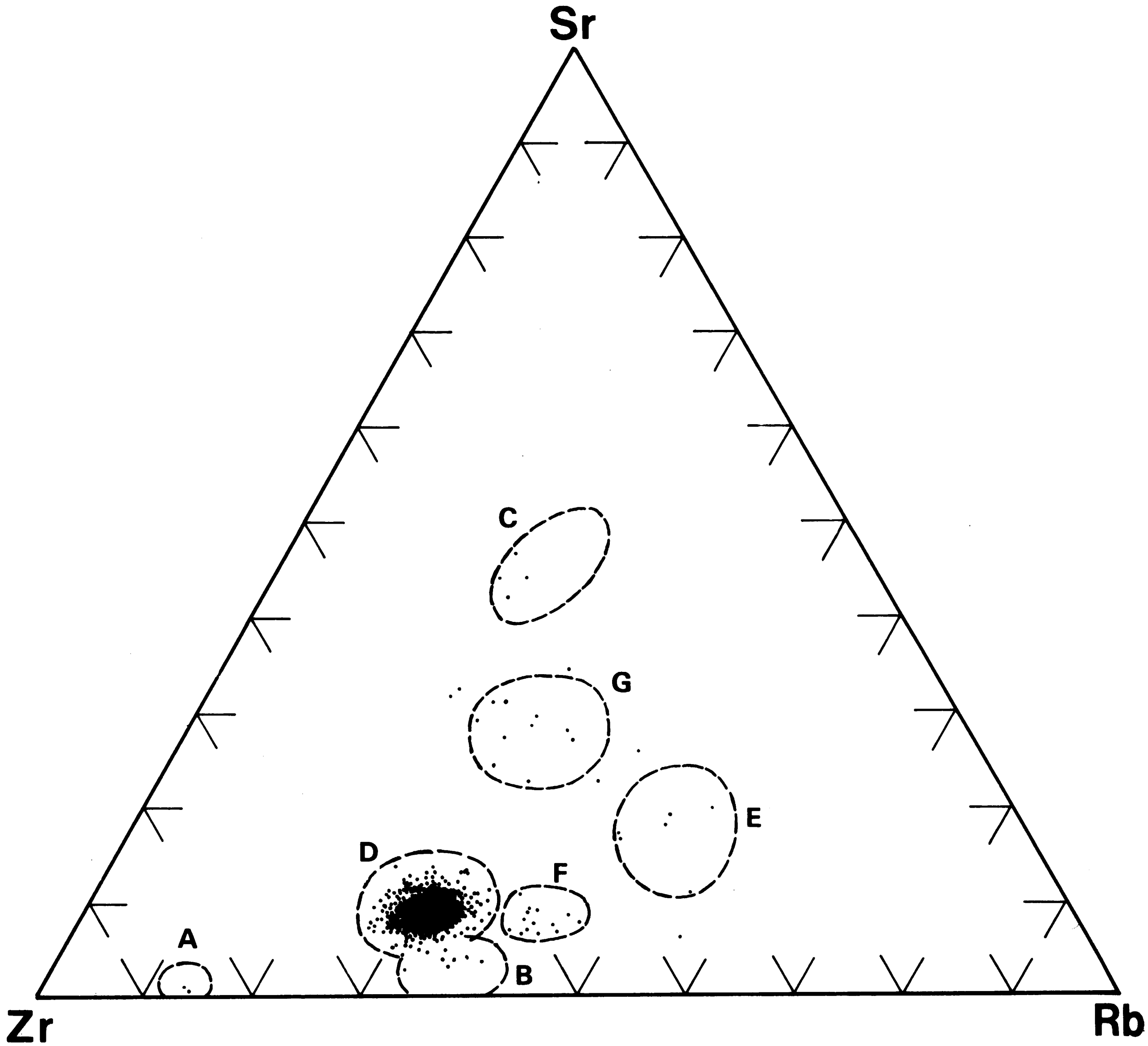


Fig. 8. Tres Zapotes Obsidian Samples.

Each point represents the relative SrKa, ZrKa and RbKa intensities observed for one artifact.

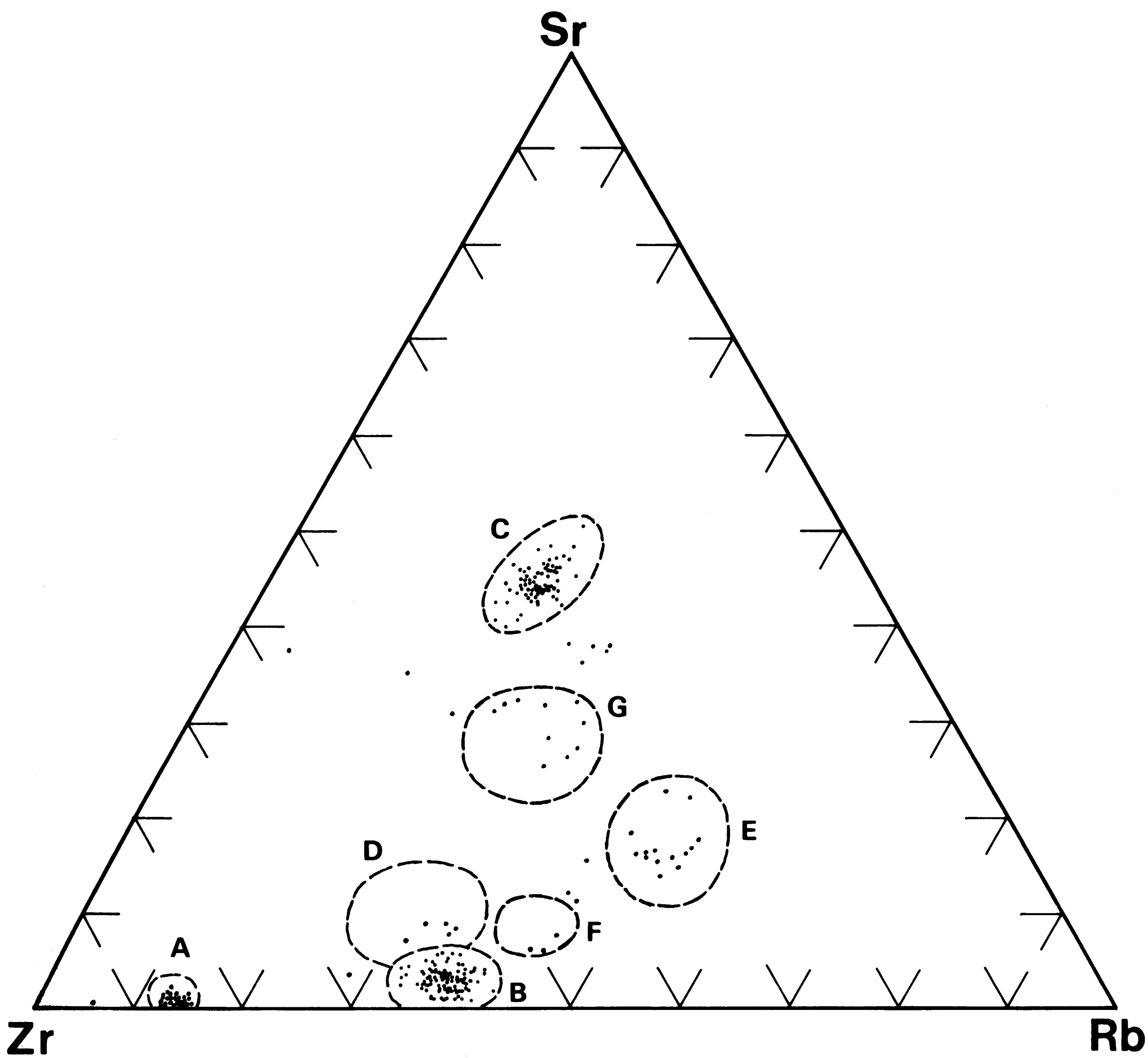


Fig. 9. La Venta Surface Obsidian Samples (combined 1968 and 1970 collections).

Each point represents the relative SrKa, ZrKa and RbKa intensities observed for one artifact.

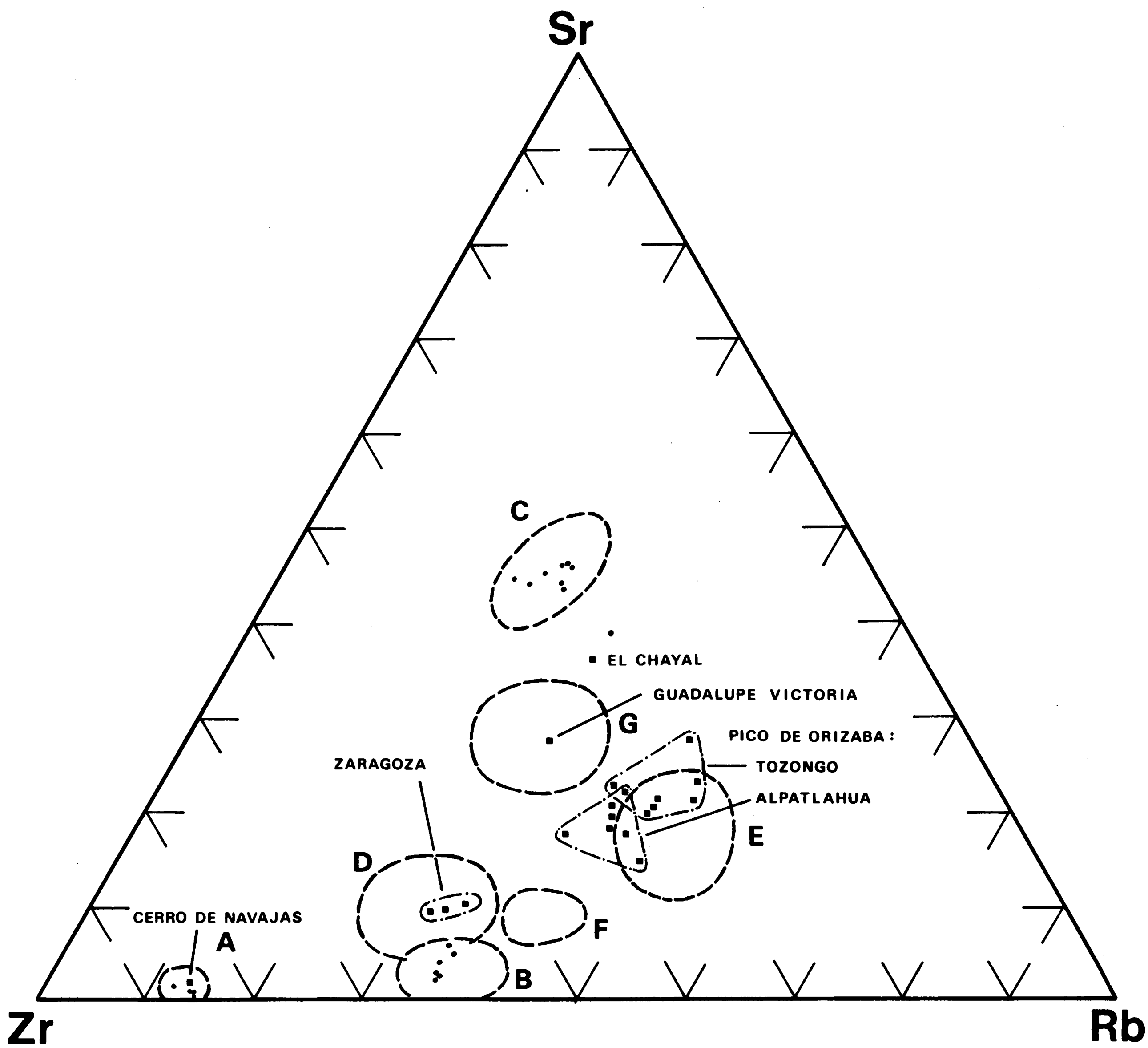


Fig. 10. La Venta Excavated Obsidian Samples and Some Mesoamerican Obsidian Source Types. Dots represent La Venta samples, squares represent source samples.

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AAnt	American Antiquity
BAE -B	Bureau of American Ethnology, Bulletin
UC -CARF	University of California Contributions, Archaeological Research Facility

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