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Grateful acknowledgment is made to Dean Sanford S. Elberg, Graduate Division, for a Grant-in-Aid to publish the present volume.

UNIVERSITY OF CALIFORNIA
DEPARTMENT OF ANTHROPOLOGY
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CONTENTS

I. AN HYPOTHESIS ON OLMEC ASTRONOMY, WITH SPECIAL REFERENCE TO THE LA VENTA SITE[1]

Marion Popenoe Hatch

This paper is the outgrowth of an inquiry to discover, if possible, the reason for the orientation of the main axis of the Olmec site of La Venta along a line 8° west of true north. The site (Fig. 1) consists of a group of mounds arranged on, or on either side of, a central axis leading north from the conical La Venta "pyramid." This architectural complex represents a tremendous expenditure of effort not only to build the huge pyramid construction itself (with a mass of about 3.5 million cubic feet), but also the mound and court complex to the north whose base was in part artificially built up to maintain its direction rather than being allowed to simply follow the natural contour of the land (Heizer 1968:17; 1961:44). It therefore seemed probable that the carefully planned orientation to 8° west of north was not simply a random placement, but a deliberate alignment established for some specific reason or purpose (Heizer 1961:51). It has been earlier suggested, though admittedly without supporting evidence, that the La Venta pyramid may have performed some astronomical horizon-sighting function, i.e., serving as an "observatory" (Heizer, Graham, and Napton 1968:137).[2] The results of the present investigation seem to support this idea.

Before continuing, it must be stressed that the writer is not an astronomer and cannot profess to have more than the most rudimentary knowledge of astronomical principles. However, having become interested I began to make investigations[3] which have resulted in an hypothesis which is presented here and which seems to explain the orientation of La Venta site; at the same time it provides the lead for suggesting an interpretation of

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[1] Superior numbers refer to Endnotes which will be found following the text. The reader's attention is called to Endnote 1 for meanings of certain abbreviations used in this paper.

certain elements of Olmec symbolism. While the analysis offered here is only a theory based on relationships which seem due to more than mere coincidence, I am well aware that there are areas of the topic yet to be explored and also that some details remain subjective opinions which may require modification as more information comes to light. However, as an entirely new explanation of the nature and purpose of the La Venta site complex, I hope it will elicit interest and invite suggestions, with the ultimate objective of gaining further insight and a better understanding of Olmec culture.

The Olmec "heartland" is situated on the lowland Gulf coast of southern Veracruz and northern Tabasco and the small volcanic area of the Tuxtla Mountains. Three major Olmec sites in the area are La Venta, Tres Zapotes, and San Lorenzo Tenochtitlan. All three may have been political-religious capitals or ceremonial centers of the Olmec group during the first millennium B.C., but of the three sites, La Venta seems to have been the preeminent if we judge from the dimensions of the site, the number and size of stone sculptures, the unique fluted-cone "pyramid," the wealth of jade objects in offering caches, and other features. However, it is not the purpose of this paper to discuss the La Venta site in comparison or contrast to other major lowland Olmec sites, something which has been recently done by Bernal (1969), but merely to examine the possible reasons why the builders of the La Venta site chose to align the constructions along a precise line of orientation.

The La Venta site lies on a small "island" with a surface area of about two square miles, formed by the Tonala River and its backwater sloughs in the alluvial coastal plain of northern Tabasco, about ten miles inland from the shore of the Gulf of Campeche. There is no evidence that there has been any change in the island's dimensions, elevation, or situation with reference to the river and surrounding swamps in the last few thousand years. Except where there are swamps, the whole region is covered with dense tropical forest (West, Psuty and Thom 1969). The island of La Venta will not support more than 150 persons by slash-and-burn farming (Drucker and Heizer 1960:36-45). Since this number of persons would have been quite insufficient to have provided the labor force to build and maintain such a large site, one may surmise that the site was a detached ceremonial precinct which was built by a population living elsewhere. The varied constructions at the site are all of a religious nature, and no occupation debris or trash deposits occur anywhere within the area of the central site itself (Heizer 1961:45). Trash deposits occur outside the site area (Drucker 1952) but they do not indicate that a numerous population lived on the island, and this refuse can be attributed to a resident corps of priests and their attendants who maintained the site and served the religious needs of the people. Thus the known facts strongly imply that La Venta was an isolated ceremonial center which existed at some distance from the population which built and supported it (Drucker and Heizer 1960:44; Drucker, 1961; Heizer 1961).

The site consists of a linear complex of constructions made of heaped-up clay, the centerline of the alignment bearing 8° west of true north. These mounds extend for a distance of over a mile along the low central ridge of the island. Main mounds are bisected by the north-south centerline, and secondary mounds are paired, lying equidistant on either side of the main axis (Fig. 1). The general bearing of the island's central ridge, though roughly that of the site's centerline, diverges some degrees to the east at the northern end of the site so that the builders were required to deposit at those points some very extensive earth fills in order to permit the site to maintain its precise line of orientation (Drucker, Heizer, and Squier 1959:63, 121, 124). It was for this reason that it was suspected that the site's alignment may have been astronomically determined. Furthermore, the location of the site is such that the apex of the pyramid provides a spectacular view of the whole sky overhead, appearing as a vast inverted bowl resting on the wide perimeter of the horizon-line; the central axis leading from the pyramid carries one's gaze northward out across the flat swampy lowlands to the smooth horizon-line of the sea where it meets the sky. The pyramid has every qualification to make it an ideal astronomical observation platform in a locality where the tall forest trees may reach higher than 30 meters.

La Venta is situated at 18° north latitude; therefore the North celestial pole would lie 18° above the horizon, and stars within 18° of the

South celestial pole would not be seen. As the earth rotates on its axis, the stars would seem to rise in the east after sunset and move westward across the sky (i.e., clockwise for an observer looking southward). The stars within 18° of the North celestial pole would never set, but would be continuously visible above the northern horizon after sunset as they rotated counter-clockwise, as seen by an observer facing northward. Since a complete rotation takes approximately 24 hours, each circumpolar star will describe a half circle, more or less, in one night for an observer at latitude 18° North. In the journey from east to west, the half-way point lies on an imaginary line bisecting the sky running north and south. This line is the <u>meridian</u>, and when a star is on it directly overhead from the observer's position, it is at <u>zenith</u>. When a star is on the meridian at midnight, it means that after sunset that star is in the east, and by sunrise it has moved across the sky to the west. When a star has traveled an equal distance from one side of the meridian to the other on one night (thereby crossing the meridian or "culminating" at midnight), its progression is easy to measure, and such an event is a logical way to begin the observation of that star's motion through the year.[4]

The sun, the moon, and the stars can all be used to measure the passing of time, for each follows a certain and predictable path through the sky, varying slightly from day to day. By using devices such as solstice markers or shadow sticks, the length of a year can be measured by noting the exact day when the sun arrives at its most northern or southern point (summer and winter solstices) on two successive years. This time interval is termed the solar or tropical year. The year can also be measured by observing the precise day and hour when the sun, the earth, and a star are exactly in line (i.e., the midnight meridian transit of that star). The time interval between two successive midnight meridian transits of a star is a sidereal year. A sidereal day is four minutes shorter than a solar day, so the two measurements do not exactly coincide. Stars will appear to shift west about 30° (two hours) each month, until they reach the same position at the same hour again after the lapse of a year.

During a human lifetime, stars (without the aid of precise sighting instruments) will appear to remain fixed in relation to the celestial pole.

However, the effect of precession causes a small drift westward of the vernal equinox in the amount of 1°.396 per century. The diagram in Fig. 7 illustrates the slow precessional path followed by the celestial pole around the pole of the ecliptic. Polaris conveniently marks the North celestial pole for us today, although it will not be at its closest until the year 2100 when it will still be 28 minutes of arc from the pole of the equator. Nevertheless, it has been sufficiently close for the past 2000 years to serve as a reference point of observable phenomena in the northern sky, as it appears stationary in position relative to the motion of the stars. The last star that was close enough to serve as a Polestar was Alpha Draconis in 2600 B.C. However, it must be borne in mind that in the millennia between that era and the present one, the North celestial pole was not marked by any star but was instead a point in space.[4]

According to modern evidence, the epoch between 3000 and 1500 B.C. witnessed the full development of agriculture from the earlier gathering economy of Mesoamerican peoples (MacNeish 1964). With the preoccupation of planting and harvesting times, anticipation of rainy and dry seasons, some knowledge of where the farmers were in the year would have been essential. There must have been a period of intense interest in forecasting the seasons and weather pattern. Days and months can be counted by moons, but this tells nothing of seasons; furthermore, twelve lunar months add up to only 354 days which is 11 days short of the solar year. The movements of the sun are a good indication of seasonal change. Correlating the solar year with the nightly celestial motions at the same time would provide a fairly accurate measure of time, and thus allow a determination of the date of the beginning of the rains, the times for clearing, burning, planting, harvesting, etc., etc.[5] It seems implicit that there must have been a vital need for some sort of calendar in order to correlate the various natural measures of time, the solar day, the lunar month, and the year of the seasons. Such a feat is not a simple one for, as we have seen, the measures do not fit evenly into one another. I think that the Olmecs were preoccupied with this matter, and that the pyramid and mound complex were built for the purpose of making astronomical observations and calendrical computations.

One of the most useful methods for calculating the passage of time, and one which has been in widespread use throughout the northern hemisphere, is the employment of the constellation Ursa Major as a time clock. The usual method has been to line up the "pointer" stars, Alpha and Beta, with some other point of reference. Fig. 8 shows how such a device is used today, based on the rotation of Ursa Major about Polaris. The configuration of the four stars (Alpha, Beta, Gamma, and Delta), comprising the "bowl" of the Big Dipper, makes an excellent star clock (termed "Nocturnal") in the northern hemisphere, because it is so easy to recognize, because it is circumpolar, and because it is visible (cloud cover permitting) throughout every night of the year.

It seems very possible that early peoples in Mesoamerica may have used Ursa Major as a time-keeping device, and the way this may have come about is proposed below. The theory accounts for the alignment of La Venta, as well as explaining certain aspects of Olmec art which will be demonstrated further on in the discussion. At first it was only a guess that the La Venta people may have been concentrating on the nocturnal course of Ursa Major. In order to check this an investigation was made of the right ascensions and declinations of Alpha, Beta, Gamma, and Delta Ursae Majoris in the second and first millennia B.C. It will be recalled that construction of Phase I at La Venta is radiocarbon dated at about 1000 B.C. (Berger, Graham and Heizer 1967). Also, it must be assumed that the planned lay-out of the site was based on knowledge gained by a long period of celestial observations made before that date. In other words, in view of the elaborate plan of the site and the effort spent in constructing the pyramid that we believe was to be employed as an observation platform, it appears that the La Venta site planners already had in mind their intended object of focus in the sky.

I believe that, for the Olmecs, the critical time for observing Ursa Major was the night of June 21 of the Gregorian calendar, due to a learned tradition originating at a much earlier date. It would have been a convenient day to begin the year count and correlate nocturnal stellar motions with the daily path of the sun. Fig. 9 shows that at 2000 B.C. the center of the bowl of the Big Dipper lay almost exactly on the meridian at midnight on June 21. At 18° north latitude, Beta Ursae Majoris (δ = +68°.32) and Gamma Ursae Majoris (δ = +70°.55) were both below the horizon by about 3° and 1° respectively (allowing for atmospheric refraction) as they crossed the meridian, and therefore would not have been visible to the observer at the time of their transit. The center of the trapezium of the Big Dipper, as determined by the intersection of the Alpha-Delta line with the Beta-Gamma line, had (at 2000 B.C.) a declination of +72°, situated at a distance of 18° from the north celestial pole; thus it would have just touched the horizon-line at 18° north latitude as it crossed the meridian. (This centerpoint of Ursa Major, the point of intersection of the Alpha-Gamma diagonal line with the Beta-Delta diagonal line, will be designated hereafter in this paper as "CP Ursae Majoris," see Fig. 4). The right ascension of CP Ursae Majoris in 2000 B.C. was approximately 87°, or 3° less than the summer solstitial colure which has a right ascension of 90°; another way of saying this is that CP Ursae Majoris made its meridian transit less than fifteen minutes before midnight of June 21, just touching the horizon at the latitude of La Venta as it made its lower transit. A century later, the meridian transit would have occurred almost exactly at midnight. It might be pointed out also that CP Ursae Majoris would cross the meridian at midnight again in its upper transit on the opposite side of the celestial pole on December 21, the winter solstice, 180° from its summer midnight transit.

Looking again at Fig. 9, it can be seen that directly south of Ursa Major, and squarely on the meridian, is located Gamma Cygni, the small center star of the constellation Cygnus. Fig. 5 shows the trapezium of this constellation whose diagonals conform roughly to the shape of an X. Gamma Cygni made its midnight meridian transit exactly on June 21st, having a right ascension of 270° in 2000 B.C Although this culmination was exact at 2000 B.C., it must be borne in mind that without clocks, "midnight" would only have been noted, perhaps, as the half-way point in time between sunset and sunrise, and a meridian transit would have occurred approximately at midnight for several centuries; in the case of Gamma Cygni, its culmination still took place around the time of midnight a thousand years later, in 1000 B.C.

Note the pattern that would have been seen on the night of the summer solstice, half-way in time between sunset and sunrise, in the second millennium B.C.: due north, just touching the horizon at 18° north latitude, the centerpoint of the bowl of the Big Dipper crosses the meridian; this constellation has moved down from the west to meet the horizon, then to rise and move an equal distance to the east by sunrise. The center of Cygnus, which was in the east after sunset, crosses the meridian at midnight, and by sunrise will have traveled the same distance west of the meridian as it was east of it at the beginning of the night. Thus the Big Dipper, a trapezium of four stars, has moved eastward, and Cygnus, also a trapezium, with a fifth star at the intersection of the diagonals, has progressed westward; both pass each other on the meridian at midnight going in opposite directions. Such an event would have been rather spectacular when occurring halfway through the night of the same day that the sun rose and set at its northernmost station of the year. It might also have been observed that on this day at noon the shadow of a vertical stick reached its shortest length of the year. Furthermore, a new season is now starting with its rains and budding vegetation.

The location of the sun on June 21, 2000 B.C., is shown in Fig. 9 by the usual symbol of the sun, a dot within a circle. At midnight the sun was 180° from Gamma Cygni, showing that both were on the same great circle. The meridian transit of each occurs 12 hours from the other; half-way in time between the successive midnight culminations of Gamma Cygni, the sun is on the meridian, and mid-way from one noon to the next Gamma Cygni crosses the meridian. If one wished to correlate solar and nocturnal events in order to begin a year count, the concurrent midnight meridian transits of the centerpoints of Cygnus and of Ursa Major, and the noon meridian transit of the sun on June 21 (the day it rose and set at its nothernmost point), would have had an obvious relationship, and thus would provide a convenient starting point for a year count. It might be noted that during those days of the year, the sun was "in" the sickle-shape of the constellation Leo; this constellation would not have been seen at all on that night, its midnight meridian transit occurring at the opposite time of year on the winter solstice, December 21. The midnight culmination of

Leo would have taken place half-way through the night of the day that the sun rose and set at its southernmost station; Leo would have had the same relationship to the winter solstice that Cygnus had to the summer solstice.

An observer anywhere in the northern hemisphere with a clear view of the sky at midnight on June 21, 2000 B.C., would have seen that Gamma Cygni reached the meridian at this moment. He would also be aware that almost due east, the Pleiades were rising above the horizon (Eta Tauri: $\alpha = 2^\circ.72$, $\delta = +5^\circ.23$). Almost due west, and directly opposite the Pleiades, the constellation Scorpio was setting on the horizon (Delta Scorpii: $\alpha = 185^\circ.98$, $\delta = -4^\circ.27$). The Pleiades would have been on the meridian approximately at midnight on September 22nd; the midnight culmination of Scorpio would have occurred March 21st. Thus Cygnus, the Pleiades, Leo, and Scorpio were four equidistant constellations whose midnight transits were concurrent with the summer solstice, autumnal equinox, winter solstice, and vernal equinox, respectively, each following the other by approximately 90° in right ascension. These facts are presented here for later reference, and also to note that these groups of stars had particular relationships to the path of the sun and to the seasons.

I think that the pattern of observations being made at La Venta at 1000 B.C. indicates that it must date back to a body of knowledge learned a millennium earlier, perhaps because agricultural activities in Mesoamerica demanded an accurate estimate of the length of a season. There is no evidence yet as to just where the earliest astronomical observations were being made, but the La Venta site and its art of 1000 B.C. seem to reflect a tradition based in large part on the meridian transits of stars occurring on the solstices and equinoxes around 2000 B.C. People living on elevated land which was not very distant from the sea would have been in a position to make these observations without any special apparatus. The main requirements would have been an interest in star movements leading to the comprehension that these conformed to an annual pattern. The obvious reason for developing a precise calendar, we assume, was to correlate dates and seasons with the advent or cessation of rainy periods, a knowledge which would have been very useful, perhaps indispensable, in slash-and-burn forest farming (Drucker and Heizer 1960; Heizer 1960). Wherever the earliest systematization of solar-stellar-calendrical-agricultural knowledge was effected, it was almost certainly not at La Venta which lies in an area of high canopy forest (for illustrations see West 1964: Fig. 3; Drucker, Heizer and Squier 1959: Pl. 2), possibly the Tuxtla Mountains were the scene of this early farming-calendar development (cf. Heizer 1968:24). When the Olmecs occupied La Venta the one thing they most needed was a vantage point of sufficient elevation to observe the true horizon, and here we seem to have the functional reason for the La Venta pyramid.

It has been noted that at 2000 B.C. the meridian transit of CP Ursae Majoris occurred approximately at midnight of June 21, and that it just grazed the horizon at the time of crossing. The picture a thousand years later was slightly different (compare Figs. 9 and 10). In 925 B.C., Beta and Gamma Ursae Majoris had exactly the same declinations (+68°.14), so that for more than a century before and after that date the "bottom" of the bowl of the Big Dipper would have been parallel to the horizon at the time it crossed the meridian. At La Venta, Beta and Gamma would have both set at an azimuth of 12° west of north, crossing the meridian below the horizon and lost to sight, then rising again 12° east of north. Alpha and Delta would have been continuously visible swinging across the sky just above the horizon line. Six hours before and after the meridian crossing, the bottom of the bowl of the Big Dipper would have been perpendicular to the horizon, due west and east of the celestial pole, respectively. In the millennium succeeding 2000 B.C., precession had caused right ascensions and declinations to shift, so that by 1000 B.C. CP Ursae Majoris made its meridian transit about an hour and a half after midnight ($\alpha = 116^\circ$). However, Alpha Ursae Majoris ($\chi = 98^\circ$), at the "edge" of the Dipper, reached the meridian going eastward only a half an hour after midnight, the same time that Gamma Cygni ($\alpha = 278^\circ$) also crossed it going westward. CP Ursae Majoris was now slightly further from the north celestial pole ($\delta = +71^\circ$), so that rather than just touching the horizon, it set into it at an azimuth of 8° west of north. I propose that the La Venta site complex was aligned to this setting azimuth of CP Ursae Majoris, because it had been learned around 2000 B.C. that its meridian transit and point of contact with the horizon occurred at midnight of the summer solstice, and in this way the solar year had been "keyed" to the sidereal year.

To sustain the theory, a few assumptions must be made. By the time of the construction of La Venta, the Olmecs must have had a fairly accurate knowledge of the length of the year, the solar and stellar movements, and the differences between solar, sidereal, and lunar counts. This must have included the ability to predict seasonal and nocturnal changes. Even without precise instruments and clocks, the cardinal points, for instance, could have been determined with accuracy, due east and west being the midpoint of the sun's journey north and south. "Midnight" would have been observed as the half-way point between the already known rising and setting points of a star along the eastern and western horizons, respectively. Similarly, "midday" was the midpoint of the sun's passage across the sky. Among virtually all the tribes examined in ethnographic studies of calendars of American Indians north of Mexico (Cope 1919:121-126; Spier 1955:16-30), the changing positions of the sun indicated the divisions of the day, while the movement of the major constellations and the morning and evening stars marked the night divisions. Apparently, because of certain ceremonials, it was often important to the Indians to recognize the divisions of the night. A relevant example is provided by the Californian Maidu, for in that tribe it was the role of the shaman to determine the period just before dawn, which he was able to discern by the position of the stars in the Dipper in reference to the north celestial pole. It seems likely that at La Venta the alignment to the setting point of Ursa Major was an expression of a cultural focus on that constellation via a long-practiced tradition of its being predominant and of prime importance in the night sky, even though at this date the meridian transit of the center no longer correlated exactly with the June solstice. Indeed, one can even imagine an important annual rite being performed in this connection, perhaps to celebrate or ensure success in the new season or year.

It is interesting to note that in the millennium between 2000 and 1000 B.C., precession had caused the declinations of the stars in Ursa Major first to rise and then to fall slightly. The figures listed below give the comparative declinations of Alpha, Beta, Gamma, and Delta Ursae Majoris between 2500 and 500 B.C.:

Years B.C.	Alpha	Beta	Gamma	Delta
2500	+71°.08	+67°.40	+70°.66	+75°.16
2000	+72°.48	+68°.32	+70°.55	+74°.99
1500	+73°.22	+68°.61	+69°.77	+74°.02
1000	+73°.22	+68°.25	+68°.39	+72°.42
500	+72°.47	+67°.26	+66°.52	+70°.32

It can be seen that the declinations of Alpha and Beta rise until 2000 B.C. and then become fairly stable for the next thousand years; in the 500 years following 1000 B.C., their declinations drop almost a whole degree. The declination of Gamma decreases throughout the time span, but the change is almost imperceptible until 1500 B.C.; then it falls by more than 3° between 1500 and 500 B.C. The pattern is similar for Delta, decreasing 1° in the first thousand years, and almost 4° in the succeeding thousand (1500 - 500 B.C.). Declinations of all four stars decrease twice as fast in the 500 years following 1000 B.C. as in the preceding thousand years (2000 - 1000 B.C.). Since the increase or decrease in the declinations of the four stars are not synchronized with each other, the declination of CP Ursae Majoris remains fairly stable, acting as a sort of pivot around which the four stars shift. Between 2000 and 1000 B.C. the declination of CP Ursae Majoris decreases only by one degree. However, after that date, since the declinations of Alpha, Beta, Gamma, and Delta decrease simultaneously, the declination of CP Ursae Majoris also begins to fall twice as fast as before, lowering by a whole degree in the next 500 years. By 500 B.C. even Delta Ursae Majoris would have been setting into the horizon at latitude 18° north. Alpha Ursae Majoris following suit by 300 B.C., with the result that by this time all four stars (the entire bowl of the Big Dipper) would have been briefly lost from view when it crossed the meridian in its lower transit.

Let us suppose that if early Mesoamerican peoples had begun to observe Ursa Major rather carefully, what must have appeared to be mysterious changes in its position in the sky were occurring just about the time at or immediately prior to the building of the Phase I structures at the La Venta site. Interestingly enough, the constellation would have appeared to sink lower and lower at an increasing rate after construction of the complex, and by 600 B.C., the estimated date of the abandonment of the site, Ursa Major was dipping much lower below the horizon than formerly, now having a setting azimuth of almost 10°. Due to precession, by 600 B.C. the midnight meridian transit of CP Ursae Majoris, or even of Alpha Ursae Majoris, would have been seriously out of step with the solstices. At that date Alpha Ursae Majoris had a right ascension of 109°.64, meaning that it would have crossed the meridian about an hour and 20 minutes after midnight; CP Ursae Majoris would have made its meridian transit two hours and 20 minutes after midnight. Furthermore, it will be recalled that at 1000 B.C. Alpha Ursae Majoris and Gamma Cygni crossed the meridian at the same moment (about a half an hour after midnight); by 600 B.C. Alpha Ursae Majoris preceded the culmination of Gamma Cygni by more than a half an hour.

The theory, then, suggests that the orientation of the La Venta site was based on a keen interest in Ursa Major and the implication is that the constellation was very important to the Olmecs, presumably for calendrical reasons. Although they probably had a good knowledge of the motion of the sun and stars and length of the year, they could hardly have understood the principle of precession, and might well have been curious, perhaps disturbed, about the shifting position of Ursa Major, both because, after having been comparatively stable for a thousand years, it appeared to be dropping lower in the sky, and also because its midnight culmination was changing in relation to the solstices; in addition, the time of meridian transits of CP Ursae Majoris and Gamma Cygni were occurring further and further apart. If such was the case, it would seem that by 600 B.C. (the calculated date of abandonment of La Venta) the site had accomplished the purpose for which it had been designed, and it is clear that the alignment was no longer so precisely oriented to the setting azimuth of CP Ursae Majoris as it had been 400 years earlier. The intention is not to argue the above as a cause of abandonment, but only to suggest it as a possible factor in the cessation of the site.

Further support for the astronomical basis of the orientation of La Venta appears to be offered by certain elements of the symbolism in Olmec art, which is expressed in carved stone in the form of "stelae," large "table-top altars," colossal human heads, small jade figurines, and plain and incised stone celts. A prominent motif in the iconography is that of the anthropomorphic jaguar which is most frequently portrayed as a conventionalized face with "snarling," exaggerated, squared upper lip and flattened head, often with a V-shaped cleft at the center (Figs. 15, 16, 23-26, and Fig. 39). The "altars" and "stelae" often have an open arch ("niche"), sometimes suggesting the open jaws of a jaguar, which contain seated or standing human figures; these frequently hold what appears to be a human infant whose face has some of the stylized jaguar features (Figs. 18, 19). Faces carved both in the round and incised on objects depict the conventionalized jaguar mask, or show human faces with feline attributes; they appear full-face as well as in profile, sometimes combining the two positions (Figs. 17, 22). Often the jaguar wears an X ("crossed bands") symbol on his head or chest (Figs. 14, 15, 20, 35 and Fig. 39a).

One does not have to stretch one's imagination very far to realize that the squared and exaggerated upper lip of the jaguar is very like the shape of the bowl of the Big Dipper. Furthermore, the lip may be represented as a carved or incised line connecting four drill holes placed in the positions of the four stars (see Fig. 35 and especially 37). The implication seems to be that this important constellation represented a jaguar deity which was possibly worshipped for his celestial and/or seasonal (agricultural) role. This suggestion is strengthened by the fact that among the historic Nahua of Mexico, Ursa Major was actually called "Ocelotl," which translates into "tiger" or "jaguar" (Brinton 1893:56; Förstemann 1904: 568). In the Annals of Cuautitlan, the nocturnal sky dotted with stars was conceived as a jaguar skin with spots (Brinton, loc. cit.). It may have been that anciently the jaguar stood for the night sky, the four stars of the Dipper forming his trapezoidal mouth. According to Thompson (1950:74), among the Aztecs the jaguar symbolized night, or night sun, and the interior of the earth (darkness); he believes this was the case for the Maya as well. The idea seems to be that as the sun determined the passing of days and the solar year, Ursa Major played an analogous role as the "night sun", measuring the sidereal year. For the Maya, the jaguar had a connotation of nobility or leadership with prestigious authority; one might guess that the association derives from its supreme role and dominant position in the sky.

It is interesting also to recall that in the Aztec myth of the Five Suns concerning the five creations and subsequent destructions of the world, the first creation is attributed to Tezcatlipoca who transformed himself into the sun. When Quetzalcoatl knocked him out of the sky, Tezcatlipoca in a fit of rage turned himself into a jaguar and destroyed the earth (Bray 1968: 153). The Annals of Cuautitlan give the name "Ocelotonatiuh" (Son of Jaguar) to the first creation (Armillas 1945:38-39). Among the Aztecs, Ursa Major mythically represented the god Tezcatlipoca deposed from his position as the sun god, falling into the sea (Brinton, loc. cit.). The idea is presented here as no more than a suggestion, but it all can be interpreted as a latter day recollection of the increasing distance between Ursa Major and the celestial pole in the first millennium B.C., when precession was causing the constellation to sink lower and lower into the horizon, and hence the jaguar was seen to "fall" from the sky into the sea.

If the stylized mouth and lip of the jaguar was seen as representing the bowl of the Big Dipper, it is further possible that the cleft in his head symbolized the meridian, since the cleft seems to mark the central axis of the figures, as the meridian divides the sky into two equal halves. CP Ursae Majoris seemed to have functioned as the "pointer" of the Dipper, its midnight meridian transit possibly serving as the starting point. The position of CP Ursae Majoris with respect to the meridian would have provided a useful measuring device, its journey again back to the midnight transit providing both a nightly and yearly "clock."

Since Ursa Major revolves about the celestial pole, the hour or season can be determined by its location in the sky (hour angle); this may explain the portrayal on some Olmec carvings of faces incised in profile and which either face east, west, or north,[7] superimposed on the full front view (Figs. 17, 22). That is to say, the direction to which the incised jaguar profile is turned may indicate where the constellation is in relation to the pole. If viewed at the same hour nightly throughout the year, particular positions would correlate with each season. It will be recalled that ca. 1000 B.C. at six hours before and after its meridian transit, the bottom of the bowl of the Dipper was perpendicular to the horizon, a fact which would relate quite well to the profile rendering of the jaguar face. That is to say, if the lower transit at midnight of CP Ursae Majoris was related to the summer solstice and the midnight upper transit to the winter solstice, then the halfway points, due east and west of the north celestial pole (where the Dipper would have been seen to lie "sideways,") would correlate with the equinoxes and the profile views of the jaguar face. Around midnight of September 22nd, Ursa Major would have been situated east of the pole, and on March 21st, it would have been west of it. Often these profile views show the cleft at right angles to the profile (Fig. 17), possibly to indicate that CP Ursae Majoris is 90° from its meridian transit.

A tentative note might be added here as an explanation for the frequent theme of a human figure holding an infant with feline attributes. Such a theme may carry the meaning of "beginning" or "birth" of a new year or season, or perhaps "new sky" in reference to starting the year count. It seems especially appropriate for the onset of the summer season with its accompanying rains which bring a renewal of life and growth. It is conceivable that the new season or year count was considered to have begun as the constellation emerged from the horizon on the night of the summer solstice.

An important motif appearing with the jaguar is the X, or "crossed bands," sometimes called a St. Andrew's Cross. It is often worn on his forehead, as a chest ornament, or at times in the eye (Figs. 14, 15, 20, 35). On the assumption that there is an astronomical basis for the symbol, we can suggest that the motif represents the constellation Cygnus. It can be seen in Fig. 5 that the constellation easily lends itself to the configuration of a cross, of which Gamma Cygni is the center. Even though Beta Cygni lies at a greater distance from Gamma than do Alpha, Delta, and Epsilon, the intersection of the two diagonal lines is a fixed point at Gamma. It was already pointed out that around 2000 B.C. Gamma Cygni was precisely on the meridian at midnight on June 21st. It is possible that Gamma Cygni was the object of focus on that night, and then the other brighter stars of Cygnus were seen in relation to it, Alpha, Beta, Delta, and Epsilon Cygni forming the crossed diagonal lines of which Gamma was the center; CP Ursae Majoris, north of Cygnus and on the meridian, was also conceived in terms of crossed diagonal lines drawn from the four stars forming its trapezium. The resulting pattern was to become fixed into a conception that endured for centuries. I think the evidence shows that the sky was organized into such a conceptual pattern by the Olmecs, and that therefore it was logical for them to orient their site to the centerpoint of the Dipper as it set on the horizon at 1000 B.C. (cf. p. 10, paragraph 2).

To lay aside the argument for a moment, one might speculate on how early Mesoamericans might have made their astronomical observations. Spinden (1924: Fig. 24) and Morley (1956:258) reproduce representations of simple observatories in the Mexican codices. The Codex Nuttall shows a pair of crossed sticks in the doorway of a temple; the head of a man is portrayed looking through the crossed sticks. In the Codex Selden, a pair of crossed sticks sppears in the temple doorway, with an eye in the notch. In the Bodleian Codex, an eye between two crossed sticks is shown, with a star descending into a notch and with two observers seated at either side. If the use of crossed sticks for making stellar observations was extremely ancient, it could account for the reason why Cygnus and Ursa Major were perceived in terms of crossed diagonal lines. If they were observing the meridian transit of Gamma Cygni, for example, it might easily occur to them that the other four stars lay approximately at the ends of their sticks when Gamma was centered between them.

The particular alignment, along a great circle, of Gamma Cygni, the north celestial pole, and the pole of the ecliptic in the first three millennia B.C., caused that star to display a remarkable stability (compare Figs. 11-13). Its declination between the year 3500 B.C. ($\delta = +34^\circ.51$) and the year 500 B.C. ($\delta = +34^\circ.53$) did not exceed by one degree the minimum value reached in 2000 B.C. ($\delta = +33^\circ.55$), due to its particular location in reference to the pole of the ecliptic. Gamma Cygni had an important relationship to the sun during the same time period: its midnight culmination coincided exactly with the summer solstice in 2000 B.C. ($\chi = 270^\circ$). These facts together indicate that Gamma Cygni makes an excellent candidate for a calendar star at that time. The evidence in Olmec iconography seems to confirm that those people observed Ursa Major throughout the night and year, but that the passage of Cygnus was an important signal within the perennial circuits of the Dipper.

The right ascension of Gamma Cygni in 1000 B.C. (278°) indicates that this constellation more accurately heralds the June solstice than does Ursa Major, since the former was still centered on the meridian fairly soon (about a half an hour) after midnight, whereas by this date CP Ursae Majoris does not make its transit until more than an hour and a half later ($\chi = 116^{\circ}$). Similarly, the evidence in Olmec art seems to indicate that the jaguar wears the crossed bands symbol in connotation of the summer solstice.

A problem arising here is differentiating the crossed bands symbol as referring to Cygnus, or to Ursa Major which also may be represented by the symbol. There does, however, appear to be a difference between the two. The distinction seems to be that when Ursa Major is represented, the crossed bands symbol is wider (i.e., flatter) than it is high. When the symbol is more equilateral or taller than it is wide, often in conjunction with a zig-zag motif, the meaning of Cygnus is conveyed. Both types appear in Fig. 20 on the chest of the figurine, Ursa Major beneath the chin, and Cygnus below it. The meaning in this case would seem to be that both constellations cross the meridian at midnight (or nearly so, having this relationship by tradition). An interesting point is that Fig. 20, a drawing of the infant held by the Las Limas figure (Fig. 40), recalls the idea presented earlier that the theme of holding forth an infant referred to the summer solstice. Note also the four stylized profiles (Fig. 21) incised on the shoulders and knees of the main Las Limas figure. What may be represented are the four "aspects" of the jaguar deity, or night sky (more specifically Ursa Major in the night sky), each relating to one of the four seasons or quarters of the year. On the night of the summer solstice, the count of the year begins, the infant conveying the association of "new" or "beginning."

Fig. 14 and Fig. 39a also show the crossed bands of Cygnus, similar in shape to the same element worn by the infant in the Las Limas sculpture; all three cases are accompanied by the zig-zag motif. Fig. 18 (La Venta Altar 4) shows a flattened cross within the mouth of the jaguar, and in this case the reference seems to be to Ursa Major. The zig-zag motif is not present, and the figure in the niche does not offer an infant. The seated personage in the niche on La Venta Altar 5 (Fig. 19) holds an infant in his arms; the man wears a headdress which has on the lower rim the equilateral crossed bands (Cygnus) placed to either side of a jaguar face. The interpretation in this case would be that Cygnus goes from one side of the sky to the other, passing Ursa Major; it is the night of the June solstice; the infant is present.

It is not as clear which constellation is meant by the crossed bands worn by Fig. 15. The shape is more like the symbol when used for Ursa Major; however, he wears the same type of ornament over his ears as the Las Limas infant. The M-shaped motif (noted hereafter as "M-Element") on his headdress is seen again in Figs. 28, 32 and on the celts in Fig. 33. A similar type of representation is seen on Fig. 16. A guess is that the central cleft in these figures denotes the meridian, and that the M-Element to either side of it depicts the location on the horizon (perhaps sighted over a marker) where CP Ursae Majoris dips into it and then emerges after crossing the meridian. The theme is re-emphasized on the rim of the headdress on Fig. 15 where on the left a line slants down to the center (meridian); on the right a line slants upward from it. Fig. 32 and also the celts in Fig. 33 show the same idea; a cleft and center line with the M-Element to either side. The four dots in these cases may represent Alpha, Beta, Gamma, and Delta Ursae Majoris, the whole signifying the meridian transit of the constellation.

Not to be overlooked are the two mosaic "jaguar masks" found at La Venta (Fig. 31). These were buried in deep pits beneath two rectangular brickwork platforms, one on either side of the centerline of the main complex, north of the great pyramid (Drucker, Heizer, and Squier 1959). Each mask is identical to the other, and both were made at the same time. Each consists of serpentine blocks arranged in a 15 by 20 foot rectangle. The whole is once again a development on the theme of matching units bisected by a centerline, above which is shown a bar with three protruberances, possibly a modification of the M-Element. The masks themselves flank a central line, the main north-south axis of the complex. Further north, centered on the main axis, lies a third buried mask, which has the same pattern as the other two, but is formed in the reverse method; the serpentine blocks compose the M-Elements on the blank space of the main rectangle. Note the pattern as it would have been observed from the pyramid. The four stars forming the trapezium of Ursa Major descend from the west to dip into the horizon, cross the meridian, then rise above the horizon again an equal distance on the other side; these three steps comprise the meridian transit of the constellation. The two platforms covering the jaguar masks, and bordering the main axis from the pyramid, repeat the pattern of centerline and rectangle (analogous to the trapezium of Ursa Major) to either side of it. Each mask itself reflects an axial arrangement, the cleft at the centerline dividing the matching halves, each containing two smaller rectangular units. The M-Element re-emphasizes the pattern of a centrally divided motif, and each of the four units below once again reiterates the theme, being themselves designed as small M-Elements. The development and variation-on-a-theme was conveyed by the La Venta artist from the main object of focus from the pyramid, the setting of Ursa Major, to the smallest detail of the masks below it which seem to be a geometrical idealization of the spectacle. The four "tassels" at the base of the masks may have represented the four seasons, or quarters of the year.[8]

Incised Olmec celts from the La Venta site and from unspecified sites show no signs of utilitarian use as work-axes or common cutting instruments. We can assume they served primarily for ceremonial functions. It is tempting to think that perhaps they were used as some sort of sighting devices or as markers used for astronomical purposes, and that the designs incised on them related to their observations. Other celts are more elaborate than those shown in Fig. 33, some appearing to bear a "text." In Fig. 35 the four circles representing Ursa Major frame his mouth. In the center of the mouth is a square notch, marking the meridian. The crossed band motif at the center of the headband refers to Cygnus on the meridian, the three "droplets" above perhaps indicating the rains associated with the summer solstice. Each eye has the "flame" eyebrow in which a square notch can be discerned, and this may represent the location or mark on the landscape where Ursa Major dips into and out of the horizon on either side of the centerline. The square notch at the mouth and above each eye is therefore analogous to the M-Element. In the left eye appears the crossed diagonals of CP Ursae Majoris, the right eye contains an irregular line. Conceivably, what is meant is that Ursa Major is setting as Cygnus crosses the meridian, the right eye showing the horizon east of the meridian where Ursa Major is not yet apparent. Such would have been the case in the first millennium B.C. when Cygnus culminated on June 21. It seems significant, and cleverly rendered, that the artist has here combined several concepts relating to "eye": the eye of the observer, the object of his attention (i.e., a point on the horizon), both expressed within the eye of this stylized face. The four cleft elements on the headdress may refer to the four seasons, meaning that CP Ursae Majoris (the "pointer" of the Dipper) had four different positions with reference to the meridian at the time of the solstices and equinoxes. The design on this celt is reminiscent of the buried mosaic masks at La Venta: both contain references to the setting of CP Ursae Majoris expressed by the M-Element concept, and each also contains an association with a line of four repeated units, presumably indicating the four seasons, the four critical times or stations in the year count.

It might be noted at this point that the incised design (Fig. 22) on the face of the Las Limas figure also contains a line of four cleft elements on the forehead. A face in profile can be discerned on either cheek, perhaps to indicate the position of Ursa Major at the equinoxes. At the base of the chin a cleft rectangle is shown, the cleft being at the left side of it. Another cleft appears immediately above the rectangle at the center of the chin. To the left of this cleft is shown what may be a closed eye (upside down); to the right of the cleft there appears to be an open eye (right side up). The meaning would seem to be that CP Ursae Majoris sets into the horizon coming down from the west ("upside down") and cannot be seen; the right eye shows that it rises again (becoming "right side up") and is visible again. Hence the face seems to reveal the circumpolar route of Ursa Major, strengthening the idea proposed earlier (p. 18) that the figure carries the meaning of the night sky, holding the infant in connotation of the summer solstice. The two circles on the upper lip and the two drill holes at the corners of the mouth portray the stars comprising the bowl of the Dipper. The line of four cleft units on the forehead, each containing the M-Element, probably convey, as in the previous examples, the meaning of "four times a year," or the four seasons. These four units can also be discerned on either side of the face (two on each side) in conjunction with the profiles. The cleft profiles on the shoulders and knees of the Las Limas figure (Fig. 21) may be the personified versions of the sky in the four seasons, as has already been mentioned.

Before continuing with the subject of Olmec celts, it is necessary to discuss another theme that frequently appears in Olmec art, that of a figure with the conventionalized down-turned mouth holding a crescent in one hand, and a torch-shaped object in the other (Figs. 25, 26, 29, 30). The "torch" in Figs. 26, 30 resembles a bud, or budding vegetation. The crescent held by Fig. 26 seems rather like the shape of a sickle; it appears in like manner in Figs. 25, 29 and also Figs. 23, 24 where the person holds this object (often termed "knuckle duster") in each hand. It seems possible that the budding vegetation conveys the meaning of June and the advent of the rainy season. The corresponding object held by Fig. 25 does not resemble vegetation, but looks, instead, like the M-Element described above and proposed as signifying the setting point on the horizon of CP Ursae Majoris. Thus the object conveys the same meaning that budding vegetation does, i.e., the summer solstice.

Since the torch-shaped object seems to be shown in opposition to the crescent-shaped object (for the two are repeatedly shown as a pair), it seems logical that the crescent must carry the meaning of something either equal to, or opposed in concept to, the summer solstice; this would be the winter solstice. It can be seen in Fig. 9 that 180° from Cygnus (in 2000 B.C.), and at approximately the same declination, is located the "sickle" of the constellation Leo. It was pointed out earlier that this constellation would not have been visible on the night of June 21; likewise Cygnus would not have been seen in the night sky of December 21. On that night in the era between 2000 and 1000 B.C., the sickle of Leo would have culminated at midnight. Thus it is clear that Leo in winter was counterpart of Cygnus in summer. One might surmise that in Figs. 23, 24, and 34, where a crescent is held in each hand, the portrayal is to be understood as the winter solstice when Leo moves an equal distance from east to west, crossing the meridian at midnight.

To conclude this partial and selective iconographic interpretation of Olmec art, three more celts will be discussed. The proveniences of two of them are not known, but both contain undoubted Olmec elements. The first of these, known as the Humboldt Celt, was presented early in the 19th century to Baron Alexander von Humboldt by Sr. Andres del Rio, Professor of Mineralogy at the School of Mines in Mexico. Humboldt deposited it in the royal cabinet of the King of Prussia in Berlin, from whence it was transferred to the Königliches Museum für Völkerkunde, Berlin. In 1904 a cast of the celt (with the tip now broken off) was deposited in the Smithsonian Institution in Washington, D.C. Since World War II (presumably as a result of aerial bombardment) the original specimen in Germany has disappeared, but a drawing taken from Humboldt's notes is given by Penafiel (1890: Pl. 119). Combining this drawing with the reproduction of the broken cast, a complete reconstruction of it can be made (Fig. 36).

The Humboldt Celt is important to this analysis, because if the theory presented here is correct, i.e., that Olmec iconography contains elements reflecting the pattern of the night sky ca. 2000 B.C., the text of the celt can be "read." The interpretation (following the numbers in the diagram) is as follows:

1. Crescent, representing the constellation Leo. It is very similar to the crescent held by Fig. 30. If the observer were facing the northern horizon, his eye moving southward along the meridian, the bright star Antares would be seen at the "top" of the crescent, as the large circle appears at the top of the crescent here. Below, two hands are pointing. The first one points to the west (to the right side of the page). The meaning is that Leo is "over there," i.e., has already set in the west. An interesting thing about this celt is that it presents a "mirror-image" of the sky, either by holding it upright so that the design faces the northern horizon, or by laying it on a flat surface so that the lower end points toward the north. Hence the right of the celt (as viewed by the reader) coincides with the west, and left of it with the east. The base of the celt correlates with the horizon line, the top of it with a point close to zenith.

2. The Pleiades, here represented as a cluster. The second arm and hand beneath (pointing to the left side of the page) indicates that the Pleiades are in the east. Ethnographic evidence indicates that one of the Aztec names for this constellation was "miec," meaning "heap," and that they attached ceremonial importance to the zenith passage of the Pleiades at the end of a 52-year cycle (Seler 1904:357). This may indicate an ancient tradition of watching for it, which then became ritualized and which persisted after its appearance no longer correlated with the seasons. Bishop Landa (Tozzer 1941:132-133) states that the Pleiades was one of the constellations used by the Maya of Yucatan as a "guide by night, so as to know the hour."

3. An eye, the Pleiades, and a hand pointing to the left. The meaning is: "The Pleiades become visible in the east." The "comb" elements surrounding the eye may be related to the Maya "count" symbol. According to Thompson (1950:44), in Maya hieroglyphic writing the comb form of the "count" affix can be replaced by the head of the mythological <u>xoc</u> fish; both correspond to the Maya word <u>xoc</u>, "count" or "sum." He also argues that there is an obvious connection between the two forms of the "count" glyph and water.

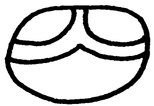
4. The crossed bands of Cygnus. The X is higher than it is wide, and is flanked by the three "droplets" on either side which also occur in connection with the crossed bands on the celt in Fig. 35, and also on the headdress of the figure holding the infant on La Venta Altar 5 (Fig. 19). It was noted that the droplets may refer to the advent of the rainy season in connection with the midnight culmination of Gamma Cygni on June 21.

5. Conjoined index finger pointing east and west, indicating that Gamma Cygni is at the center, on the meridian, traveling the length of the sky during the course of the night. The element immediately above No. 5 appears to be the zig-zag element that occurs elsewhere in conjunction with the crossed bands symbol. The meaning of the zig-zag is not clear, but seems to be definitely associated with Cygnus. It may be affiliated with the zig-zag motif appearing on the "budding vegetation" held

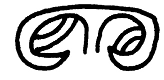
by Figs. 26 and 30, and if so, the association would be with the summer solstice and new growth, perhaps "beginning" of the count of the year.

6. An element which may mean something like "the year divided into four quarters (seasons)," namely, the solar year. The sign, known in Maya epigraphy as the Kan cross, is also worn by Fig. 30 as ear ornaments. The four small round circles at the exterior of each quarter of the Kan cross on the Humboldt Celt may represent the sun during each season, a period of time determined by its course north and south. This solar year sign appears directly below Cygnus which is centered on the meridian at midnight, associating the year with the summer solstice and the onset of the rains.

To the right of the year sign is a unit which I believe is meant to represent the autumnal equinox. A motif appears here which resembles vegetation (perhaps "blossoming" or "in fruit"). The association may be with the harvest, or middle of the rainy season; September 22nd comes in the heart of the wet season which generally continues from June to February. Part of this symbol appears again on the next celt to be discussed, and it will be argued that it represents September in that case as well. It will be remembered that this side of the celt denotes west, the side where the sun sets. On the autumnal equinox, Cygnus would have been on the meridian at sunset.

Below the year symbol, the element  appears superimposed on the crossed bands. This element is very like the Maya glyph Akbal, meaning darkness. In December, at the time of the winter solstice, Cygnus is not visible during the night, therefore it may indicate that Cygnus is "dark."

To the left of the Kan cross, or solar year symbol, is shown the element:  It seems to be superimposed on the lower or upper half of the crossed bands symbol; since this unnamed symbol looks like the upper half of the Akbal sign, it might be possible to say that the upper half of Cygnus is meant. This is the east side of the celt, where the sun rises. On the vernal equinox (March 21), Cygnus is on the meridian at sunrise, having risen sometime before midnight. Thus Cygnus is visible for half of the night, the symbol telling us "Cygnus half visible, on the meridian when the sun rises," indicating that it will be seen during the "upper" (later) half of the night, towards morning.

All four of the seasons rest on the symbol:  Here the meaning is even less certain, but the half-circles at each side of the main element seem to be similar to the circle at the top of the crescent which was interpreted as the bright star Antares. It may be that the symbol carries the meaning of stars rising and setting, i.e., the night sky. The two concentric circles may mean even more specifically "bright" star. The symbol will be referred to again on the next celt, but note that the Pleiades cluster does not show the concentric circles, each circle having only the single outline. The Pleiades, though a conspicuous cluster, is made of small, faint stars. Note also that above the first hand that points to the west, in reference to Leo, the curved element above the finger does not contain the concentric circles. The intention may be to show that the stars of Leo will not rise and set on the night in question (June 21). The small plain circles around the Kan cross would not be confused with stars, because that symbol refers only to the sun and the solar year.

7. The meaning of this design is the least clear of all. A tentative suggestion is that it is a representation of the sighting line from the observer to the meridian. The lines leading directly to the central axis would seem to mean that the center of the sky (meridian or north-south axis) is the focus. Another interpretation is possible. If the celt is not meant to present a mirror-image of the sky, but to illustrate the sky as one faced south holding and reading the celt in front of him, this particular sign may then indicate something like "turn (invert) celt" or "turn celt around (and face north)." Nos. 8 and 9 below would then still be correctly read to identify the constellation on the northern horizon.

8. A shape representing the bowl of the Big Dipper.

9. The horizon line, showing by the notches that the Dipper sets and then rises again on either side of the meridian, similar to the concept of the M-Element. It seems likely that the celt tells of the sky ca. 1000 B.C., that "midnight" is only an approximation, when the Dipper would have

set into the horizon very briefly at or near latitude 18° north. "Sunset" and "sunrise" are also only approximate, for there is a duration of an hour or so when the sky is gradually getting darker or lighter.

10. Digging stick. The left side of the celt is associated with east, sunrise, and the vernal equinox, with the accompanying dry season. The soil is cultivated at this time and planting occurs in April or early May (Morley 1956:134; Long 1948:215), to coincide with the first rains.

11. Some type of cutting implement. This side of the celt is associated with west, sunset, the autumnal equinox, and the accompanying rainy season. The cutting of the brush (to be burned in the dry season) is done at the height of the wet season (Morley 1956:130). This tool has been interpreted as an "atlatl," (Beyer 1969:422), but the resemblance is not convincing. Its appearance is much more like that of a cutting implement.

The Humboldt Celt is an interesting combination of Olmec and what seem to be Maya elements and contrasts to the other celts discussed here in this respect. Its context appears to be a star map which is surprisingly similar to that shown in Fig. 9, the objective of which seems to be to record the correlation of the solar year with the sidereal year. The subject matter deals with a pattern in the night sky (keyed to the rising of the Pleiades and the meridian transit of Gamma Cygni) and the hour it would have been seen at four distinctive times in the year measured according to the path of the sun, the correlation being most accurate between 2000 B.C. and 1000 B.C. One supposes (in default of any information whatsoever as to its provenience and age) that it was a copy of something which had been learned and perhaps inscribed in a simple way at a much earlier date. The main emphasis is on Cygnus, or more precisely, Gamma Cygni, which has already been shown to have been very stable and well-qualified as a calendar star. It can only be guessed as to why it presents a mirror-image of the sky; certainly the reversal of east and west with respect to north must have had some ceremonial or astronomically-related use. That is to say, the celt must have functioned in some way so that its position rendered the directions pointed to in the design capable of showing where the sun rose and set.

The discussion of the celt in Fig. 37 will also follow the numbers on the diagram:

1. Cleft elements, pointing to north, east and west. They probably refer to CP Ursae Majoris functioning as a pointer in relation to its position in reference to the meridian in each of the four seasons of the year. East and west do not seem to be reversed on this celt, and it does not present a mirror-image of the sky.

2. Cygnus, with Gamma Cygni at the center on the meridian.

3. The four stars of the Dipper, framing the mouth of the stylized jaguar in profile view. It will be recalled that six hours (90°) before and after its meridian transit the Dipper was perpendicular to the horizon, and therefore it was postulated that the profile view was related to the position of Ursa Major at the equinoxes. The stars forming the mouth are represented by concentric circles, perhaps to indicate that they are bright stars; Gamma Cygni, which is a small, faint star, is shown as a single circle.

4. This is an element similar to that on the Humboldt Celt (Fig. 36) on the right side of the Kan cross (No. 6) and interpreted as the autumnal equinox.

5. Vegetation symbol, similar to that held by Fig. 26. Note the zigzag motif which seems to correspond to the budding aspect, or new growth connected with the summer solstice.

6. Crescent, similar in general outline to that on the Humboldt Celt (Fig. 36, No. 1) and also held by Fig. 30. The object is related to the sickle of the constellation Leo, and represents the winter solstice.

7. Hand, pointing to the east. At the base of the hand is shown an eye on the horizon. The hand may relate to the cleft "pointers" at the top of the celt, in which case the direction would be read as "CP Ursae Majoris, east." The bowl of the Dipper will be observed to rise above the horizon and will remain east of the meridian throughout the night, being perpendicular to the horizon midway in its journey. Cygnus will be on the meridian

after sunset, moving east during the night. The season is halfway between the summer and winter solstices, indicated by the budding vegetation on the left (west, or setting side), and the crescent of Leo on the right (east, or rising side). A tentative suggestion for the design on the hand is that it shows a doorway or platform over which the Dipper will be seen to rise.

If this analysis has any basis in fact, it is significant that the two celts deal with the same subject, the seasonal locations of Ursa Major and Cygnus; one deals with all four seasons focusing on Cygnus, the other primarily with the autumnal equinox emphasizing Ursa Major. They seem to refer to the sky around 1000 B.C., but reflect meridian transits coinciding more accurately with the solstices and equinoxes around 2000 B.C. It may be that they represent copies of earlier examples (perhaps inscribed on wood) from which stellar change was measured, and by which calendrical computations were made. In this way the actual difference in the length of the sidereal year, as compared with the solar year, could have been estimated. By the time the Maya were erecting stelae early in the first millennium of the Christian Era, knowledge of this sort was very accurate. The engraved celts referred to here may also have been "textbooks" or pictorial teaching devices recording astronomical data in symbolic form, i.e., glyphs. Astronomer priests could have employed them in communicating their special knowledge; at least they would have been highly suitable for such a purpose.

The third celt (Fig. 38) also deals with the same subject matter as those above, but in a slightly different manner. It is especially significant because it was actually part of a cache deposit at La Venta which was recovered by controlled excavation (Drucker, Heizer, and Squier 1959:135-146). Thus its provenience and approximate age are clearly relatable to the Olmec at the time of their occupation of La Venta. The interpretation (following the numbered motifs) is:

1. The crossed bands of Cygnus, the X being higher than it is wide. The center corresponds to Gamma Cygni on the meridian.

2. The Kan cross, or solar year with its four seasons. Both the Kan cross and the crossed bands of Cygnus are present on the Humboldt Celt

(Fig. 36, nos. 6 and 4, respectively). Here the superposition of the one over the other may be intended to convey the idea of a simultaneous correlation of the solar year and its seasons, with the sidereal year measured by the meridian transits of Gamma Cygni.

3. Ursa Major, identified by the cleft which indicates that CP Ursae Majoris is the object of focus in the constellation. CP Ursae Majoris descends from the west, dips into the horizon, and crosses the meridian (the central axis of the celt, in line with the center of the crossed bands). The fact that west is on the left of the celt, east on the right, shows that the design does not present a mirror-image of the sky as with the Humboldt Celt.

4. The M-Element, already argued as relating to the setting of CP Ursae Majoris on the horizon. Ursa Major is shown partially superimposed on it.

5. Possibly this element represents Gamma Cygni moving to the west. Note that the vertical line from which it is drawn is continued above Ursa Major to the top of the celt, and this line is to one side of the central axis of the celt, or meridian. This may be done deliberately to indicate that Gamma Cygni and CP Ursae Majoris did not pass each other while crossing the meridian, as they did in 2000 B.C. If this is the case, the implication is that the celt was designed at the time of the occupation of La Venta (ca. 1000 B.C.), a supposition which seems probable in any case. At this time Gamma Cygni and CP Ursae Majoris pass each other well after midnight; however, Alpha Ursae Majoris, at the "edge" of the Dipper, and Gamma Cygni reached the meridian at the same time, shortly after midnight. The front edge of the cleft element (3), denoting the edge of the Dipper, is in line with the center of the crossed bands, the central axis of the celt. Probably the Olmec astronomers knew that at an earlier date CP Ursae Majoris and Gamma Cygni had crossed the meridian simultaneously at midnight of the summer solstice. It was now apparent that Alpha Ursae Majoris and Gamma Cygni culminated at the same time; it cannot be stated with certainty whether or not they were aware that this culmination was no longer precisely halfway through the night of June 21 (occurring only about a half

an hour after midnight in 1000 B.C.). It seems possible that they might have still considered the midnight meridian transit of Gamma Cygni to herald accurately the summer solstice but that it was quite obviously no longer the case for CP Ursae Majoris. The design of the celt seems to indicate their interest in the difference in time between the two transits which they were observing at that time and perhaps measuring.

6. This seems to be an eye, and the entire design on the upper half of the celt may represent a highly conventionalized face in profile. A rather similar type of stylized profile was seen on the celt in Fig. 37. An implication may also be that the eye of the observer is directed toward the setting of CP Ursae Majoris on the horizon; this connection with the eye on a face has been seen earlier on the celt in Fig. 35.

In summation, all the celts seem to deal with the same subject: the pattern of the night sky with emphasis on the constellations Ursa Major and Cygnus in their relationship with the seasonal path of the sun. It seems valid to assign them a function as sky charts, and perhaps as actual instruments for making astronomical observations.

Before concluding the analysis, and having dared to go to the lengths I have in suggesting a body of astronomical knowledge and its application by the Olmecs, I ought perhaps, to call attention to the recently published contour map of the La Venta pyramid. It can be seen (Figs, 2 and 3) that there is a systematic pattern of lobes and ridges which emanate from the apex. Although some erosion has obviously occurred, there is no appreciable depositional delta or fan at the bottom of the valleys. It therefore seems a fairly safe assumption that the shape of the cone has not drastically altered from its original form, and that its ridges and valleys were part of the original design. As has been explained, there is reason to believe that the main north-south axis of the La Venta site complex was oriented ca. 1000 B.C. to CP Ursae Majoris which set on the horizon 8° west of north. It seems to be, therefore, more than coincidence that the small mound at the northwest "corner" of the pyramid, between the 120° and 130° line on the map (V3 on Fig. 3), is located precisely at the setting azimuth of Gamma Cygni which was 126° at La Venta (Gamma Cygni: $\delta = +33.98$ at 1000 B.C.; see Azimuth

Chart p. 39). Since Gamma Cygni was a star of remarkably stable declination, it would have maintained an unchanging rising and setting azimuth as viewed anywhere in the northern hemisphere during the three millennia prior to 500 B.C. Although the mound at the opposite "corner" northeast of the pyramid does not lie at 126° but approximately at the 147° line instead (V9 on Fig. 3), it does not necessarily weaken the argument. If the objective of astronomical sightings were a year count, it would only have been required to count the elapsed number of days from the setting of a star at one day and hour of the year to the following year at the same time. That is to say, it would not have been necessary to observe both the rising and setting times of a particular star. The attention of La Ventans seems to have been mainly directed to the setting points and this may have included the setting sun as well. Above and beyond this, it makes a logical scheme that here are two definite points of alignment from the pyramid which are oriented to the setting azimuths of the centerpoints of two constellations which were analogous in many ways, as has already been discussed.

It may also be significant that the rising azimuth of the Pleiades in 1000 B.C. (Eta Tauri: $\delta = +10^\circ.77$) would have been approximately at 101°. This location is just about 90° from the main north-south axis of alignment and it can be seen that there is a deep channel at the 100° east line (V8 in Fig. 3). It has already been seen that the Pleiades rose as Cygnus crossed the meridian, a coincidence which we believe was inscribed on the Humboldt Celt. Opposite this line, at 80° west, (and at right angles to the main north-south axis), there is another deep channel (V4 in Fig. 3). In 1000 B.C., Delta Scorpii ($\delta = -9^\circ.79$) would have set at an azimuth of 80° at the same time that Eta Tauri was rising (the right ascensions of the two stars being different by 183°). A distinct channel also appears at 70° east (V7 in Fig. 3), and it is worth noting that the rising azimuth of Sirius ($\delta = -17^\circ.18$) was 72° at the time in question. Sirius is the brightest star in the sky, and would have risen about the time that Cygnus was setting.

The ridges and valleys of the La Venta pyramid and their possible function as sighting angles is a subject which is presented very tenuously; more study is necessary to make firm statements. Obviously, to show that one of the small mounds at the outer pyramidal edge was lined to the setting azimuth of a particular star implies the need to explain the functions of others that also are built around it. Furthermore, the factor of some erosional alteration of the pyramid's surface may weaken any sort of analysis about the precise function of the ridges and valleys of the pyramid. However, since there is presumably more than chance in the fact that five of the deepest channels are in direct line with the rising or setting azimuths of important stars and constellations, it seems worth mentioning. It may be significant that these channels we have determined as having been oriented to the setting azimuths of certain stars or constellations (CP Ursae Majoris, Gamma Cygni, Delta Scorpii) are stars whose declinations were increasing, and therefore were "falling" or appearing progressively lower in the sky. Those valleys oriented to the rising azimuths of stars (Eta Tauri, Sirius) were stars whose declinations were decreasing, and would have appeared to be "rising" in the sky.

The archaeological evidence (Berger, Graham, and Heizer 1967) suggests that the site of La Venta was abandoned about 600 B.C. The reason for the abandonment of the site will probably never be known and a dozen possibilities could be offered. Perhaps significant in view of the hypothesis presented in this paper, is the circumstance that by 500 B.C. the setting azimuth of CP Ursae Majoris would have been two degrees away from the alignment of the site, and the center of the Big Dipper was now setting at an azimuth of 10° west of north. Ursa Major was almost completely below the horizon as it crossed the meridian at its lower transit. Gamma Cygni would have culminated almost an hour after midnight; it would have made this transit 40 minutes before Alpha Ursae Majoris reached the meridian, so there would have been little relationship between the two meridian crossings of these constellations. The whole pattern, as celebrated in Olmec iconography and relating the constellations and stars with the solar and sidereal years was, by 500 B.C., seriously out of step with apparent events. Although hardly sufficient cause for the total abandonment of a site, it seems possible that these factors may have had some influence.

The Mesoamerican cosmological myth holds that the jaguar sun was deposed from his supreme role in the night sky, and there are some grounds for believing the occurrence may have had a factual basis, and that a conceptual change did occur. Certainly by the time the next great civilization becomes apparent in Mesoamerica, that of the Maya, the cultural emphasis is on a celestial serpent rather than the jaguar, alghough the latter is still recognized. What the relationship is between Maya and Olmec cultures is not yet clear but there are hints that the Olmecs and the Maya were sharing some knowledge of calendrical glyphs and numeration as early as the first century B.C. At what earlier time these two peoples may have been in contact and exchanged such knowledge we do not know, but that time could have been as long ago as the early centuries of the first millennium B.C. An interesting artifact in this respect is the cylinder seal from Tlatilco (Fig. 27) portraying three separate glyphs. On the left is the familiar profile we have analyzed as the Ursa Major-related jaguar deity. At the center is the cleft design containing the M-Element above the four units divided by a center line. According to our analysis, the two glyphs relate to the setting of CP Ursae Majoris into the horizon as it crosses the meridian. It seems possible that the third glyph, on the right, is a symbol for the sun, since it resembles very much the Maya kin sign meaning "sun." Here again the subject matter (in this case employed only as a design without implication of utilitarian function) appears to relate to the night and day skies, the sidereal and solar years, and the relationship of the position of Ursa Major with respect to the meridian at the various seasons. It is intriguing that on this seal the typically Olmec designs are shown in the same context with what later appears as a Maya glyph. We are of the opinion that the Olmecs used glyphs, and base this on the evidence of the inscription on the Humboldt Celt and other inscribed pieces such as the celt shown here in Fig. 38 which was excavated in 1955 at La Venta (Drucker, Heizer, and Squier 1959:140-141) in Offering No. 2 assignable to Phase III and dating from some time, perhaps a couple of centuries, earlier than 600 B.C. (Berger, Graham, and Heizer 1967). The engraved celts excavated in 1955 at La Venta are particularly important pieces because they stand alone among the much larger corpus of Olmec-attributed finely-engraved art in being unquestionably part of Olmec culture, something we cannot prove, unfortunately, for the Humboldt Celt.

With respect to the symbol for nought or completion, it is possible that the year count was considered to be completed at the time of the summer solstice; we have argued that the presentation of the infant in Olmec art is associated with the new year beginning June 21. The superimposition of the Cygnus crossed bands on the Kan cross (as shown on Fig. 38) may have become a symbol to convey the meaning for "completion." In Maya epigraphy, crossed diagonal lines superimposed on a four-petaled motif is suggested as a design related to what is known as a completion symbol (Thompson 1950:fig. 44, 1, 2; 45, 3). Although we are not arguing that the Maya symbol is the same as that found in Olmec art, it could be that the basic concepts of the two symbols are related.

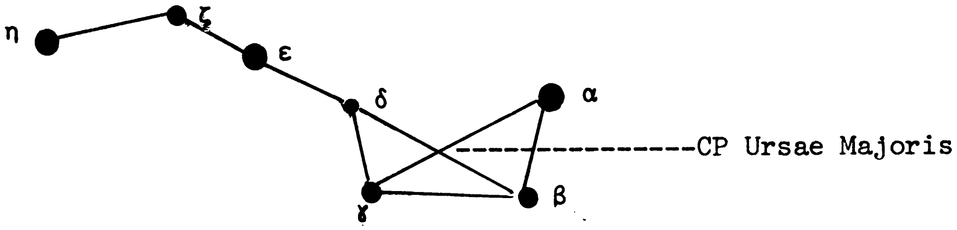
This paper has set forth an hypothesis proposing an astronomical basis for the alignment of the La Venta site. The argument seems to be supported by certain elements of Olmec iconography. Few unequivocal interpretations are possible at this time regarding Olmec glyphs, but the consistency and obvious patterning of many of these (especially certain series inscribed on celts and held here to be "star maps") appear to make them more than simple decorative expressions. Put another way, it is hardly probable that embellishment of the sort found on the Humboldt Celt and the La Venta Offering No. 2 Celt (Fig. 38) could be purely decorative or artistic and at the same time be amenable to a consistent and reasonably complete reading in terms of astronomical symbolism.

There are many areas of the subject yet to be explored, and there are details presented here which will have to be modified as more information is supplied. Yet we believe we have established two features of the La Venta period Olmec culture. The first is that they possessed an organized practical astronomy whose central function was calendrical. The second is that a certain portion of Olmec symbolism can be interpreted as glyphic records of astronomical phenomena such as meridian transits in connection with solstices.

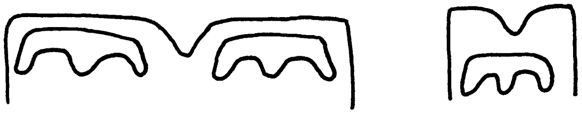
Notes

1. For the reader's convenience, certain abbreviations used in this paper are listed here for easy reference:

> χ: right ascension. A co-ordinate in the equator system measured from the vernal equinox eastward to the point where the hour circle of a star intersects the celestial equator.
>
> δ: declination. The co-ordinate in the equator system which is the measure of the angular distance of a body from the celestial equator.
>
> CP Ursae Majoris. Centerpoint of the "bowl" of the "Dipper" of Ursae Majoris, determined by the point of intersection of the Alpha-Gamma and Beta-Delta diagonal lines of that constellation.



> M-Element: A design that usually looks like an "M" on either side of a cleft or central axis. Alternatively the whole unit itself will compose the "M" with a central axis dividing it.



2. Drucker, Heizer and Squier (1959:15) earlier wrote: "Whatever the specific reason which impelled the builders of La Venta to orient the centerline along 8° west of true north, we feel that it is significant that the majority of Mesoamerican sites are built on north-south alignments, and from this conclude that the La Venta Olmec were early participants in this widespread practice. This whole problem is one in urgent need of exploration".

3. I wish to thank Dr. Alexander Pogo of the Carnegie Institution of Washington for his kind and generous assistance on the astronomical parts

of this paper, since this aid has been of major importance in enabling the present analysis to be realized. Professors John A. Graham and Robert F. Heizer at Berkeley have been kind enough to help me with reference materials and to read this report. My graduate student colleagues, Thomas R. Hester who has made the drawings, and C. William Clewlow, Jr. who has helped me locate some of the illustrations also have my thanks for their assistance.

4. Astronomical data of the diagrams and azimuth table, as well as values for right ascensions and declinations of stars during the millennia before the present are taken from Paul Victor Neugebauer's Tafeln zur Astronomischen Chronologie, vols. I-III, Leipzig 1912-1925.

5. We first examined the idea that the site complex at La Venta may have been oriented to Alpha Draconis by tradition of its having been the ancient Polestar, but calculations showed this idea to be untenable. The radiocarbon evidence from the La Venta site places the age of Phase I at approximately 1000 B.C. (Berger, Graham, and Heizer 1967), at which time Alpha Draconis was about 10° from the pole, a deviation dignificantly greater than the orientation of the site centerline. Further investigation led to the conclusion that the site was aligned to the constellation Ursa Major (the Big Dipper).

6. Planting time seems to have been weather-determined rather than strictly calendrical, according to the estimated onset of the first rains. Standard planting dates in Mesoamerica vary from April 11th (Long 1948:216), to the end of May just following the first rains (Morley 1956:134), to the first two weeks of June (Heizer, personal communication). This is because the rain pattern is different in the various parts of the lowlands. Differences in terrain may also affect the time of planting.

7. Faces do not seem to be shown facing south. The "south" position (lower transit) of the Dipper is usually shown by the M-Element, indicating that it sets into the horizon. Possibly, the profile is not shown at that position because it is not visible at that time in its circumpolar journey.

8. There may be additional astronomy-related features in these large filled pits. One could suggest here the possibility of a lunar count recorded in the 28 layers of serpentine which underly the mosaic masks (Drucker, Heizer and Squier 1959:102).

AZIMUTHS for $\phi = 18°$

δ	W_3+W_1	δ	W_3+W_1	δ	W_3-W_1	δ	W_3-W_1
+72°	180°						
71	175.6						
+70°	172°4	+30°	121°8	-1°	89°1	-41°	46°7
69	170.0	29	120.8	2	88.1	42	45.6
68	168.0	28	119.8	3	87.0	43	44.5
67	166.2	27	118.7	4	86.0	44	43.4
66	164.5	26	117.6	5	85.0	45	42.4
+65°	163.0	+25°	116.5	-6°	83.9	46°	41.3
64	161.5	24	115.4	7	82.8	47	40.2
63	160.1	23	114.4	8	81.8	48	39.0
62	158.7	22	113.3	9	80.7	49	37.8
61	157.4	21	112.2	10	79.7	50	36.6
+60°	156.1	+20°	111.2	-11°	78.7	-51°	35.5
59	154.7	19	110.2	12	77.6	52	34.4
58	153.5	18	109.1	13	76.6	53	33.3
57	152.3	17	108.1	14	75.5	54	32.1
56	151.1	16	107.1	15	74.4	55	30.9
+55°	149.9	+15°	106.0	-16°	73.3	-56°	29.7
54	148.7	14	104.9	17	72.3	57	28.5
53	147.5	13	103.8	18	71.3	58	27.3
52	146.2	12	102.8	19	70.2	59	26.1
51	145.1	11	101.7	20	69.2	60	24.9
+50°	144.0	+10°	100.7	-21°	68.2	-61°	23.6
49	142.8	9	99.7	22	67.1	62	22.3
48	141.6	8	98.6	23	66.0	63	21.1
47	140.4	7	97.4	24	65.0	64	19.7
46	139.3	6	96.5	25	63.9	65	18.2
+45°	138.2	+5°	95.4	-26°	62.8	-66°	16.9
44	137.2	4	94.4	27	61.7	67	15.4
43	136.1	3	93.4	28	60.6	68	13.8
42	135.0	2	92.3	29	59.6	69	12.0
41	133.9	1	91.3	30	58.6	70	10.2
+40°	132.8	0°	90°2	-31°	57.5	-71°	8.0
39	131.7			32	56.4	-72	0°
38	130.5			33	55.4		
37	129.4			34	54.3		
36	128.3			35	53.2		
+35°	127.2			-36°	52.1		
34	126.1			37	51.2		
33	125.0			38	50.1		
32	124.0			39	48.9		
31	122.9			40	47.8		

For stars rising: azimuths counted from S over East to N

For stars setting: azimuths counted from S over West to N

Addenda to Table 16 (P. 46) and to Table 18 (p. 48) in vol. III of P.V. Neugebauer's TAFELN ZUR ASTRONOMISCHEN CHRONOLOGIE Leipzig 1925

Values of W_1
for
$\phi = 18°$

δ	W_1	δ	W_1	δ	W_1	δ	W_1
0°	0°						
1	1.1	21°	22°0	41°	43°6	61°	66°9
2	2.1	22	23.1	42	44.7	62	68.2
3	3.2	23	24.2	43	45.8	63	69.5
4	4.2	24	25.2	44	46.9	64	70.9
5	5.2	25	26.3	45	47.9	65	72.4
6	6.3	26	27.4	46	49.0	66	73.8
7	7.4	27	28.5	47	50.1	67	75.4
8	8.4	28	29.6	48	51.3	68	77.1
9	9.5	29	30.6	49	52.5	69	79.0
10	10.5	30	31.6	50	53.7	70	81.1
11	11.5	31	32.7	51	54.8	71	83.8
12	12.6	32	33.8	52	55.9		
13	13.6	33	34.8	53	57.1		
14	14.7	34	35.9	54	58.3		
15	15.8	35	37.0	55	59.5		
16	16.9	36	38.1	56	60.7		
17	17.9	37	39.1	57	61.9		
18	18.9	38	40.2	58	63.1		
19	20.0	39	41.4	59	64.3		
20	21.0	40	42.5	60	65.6		

Values of W_3
for
$\phi = 18°$

δ	W_3	δ	W_3
0° - 36°	90°2	66°	90°7
37 - 52	90.3	67	90.8
53 - 59	90.4	68	90.9
60 - 62	90.5	69	91.0
63 - 65	90.6	70	91.3
		71	91.8

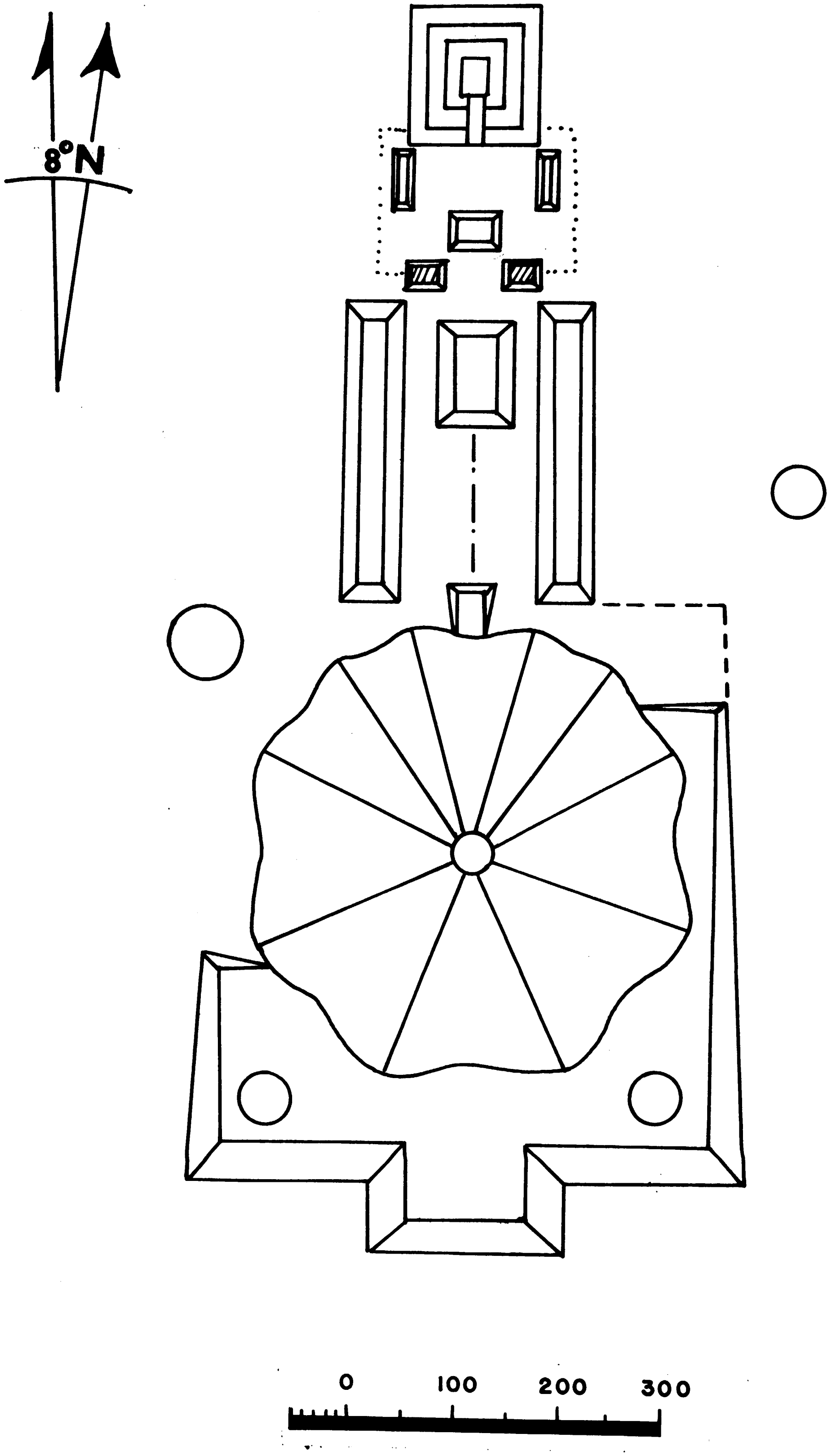


Fig. 1. La Venta, Tabasco, Mexico. Site plan. The two hachured rectangles show location of the two mosiac masks.

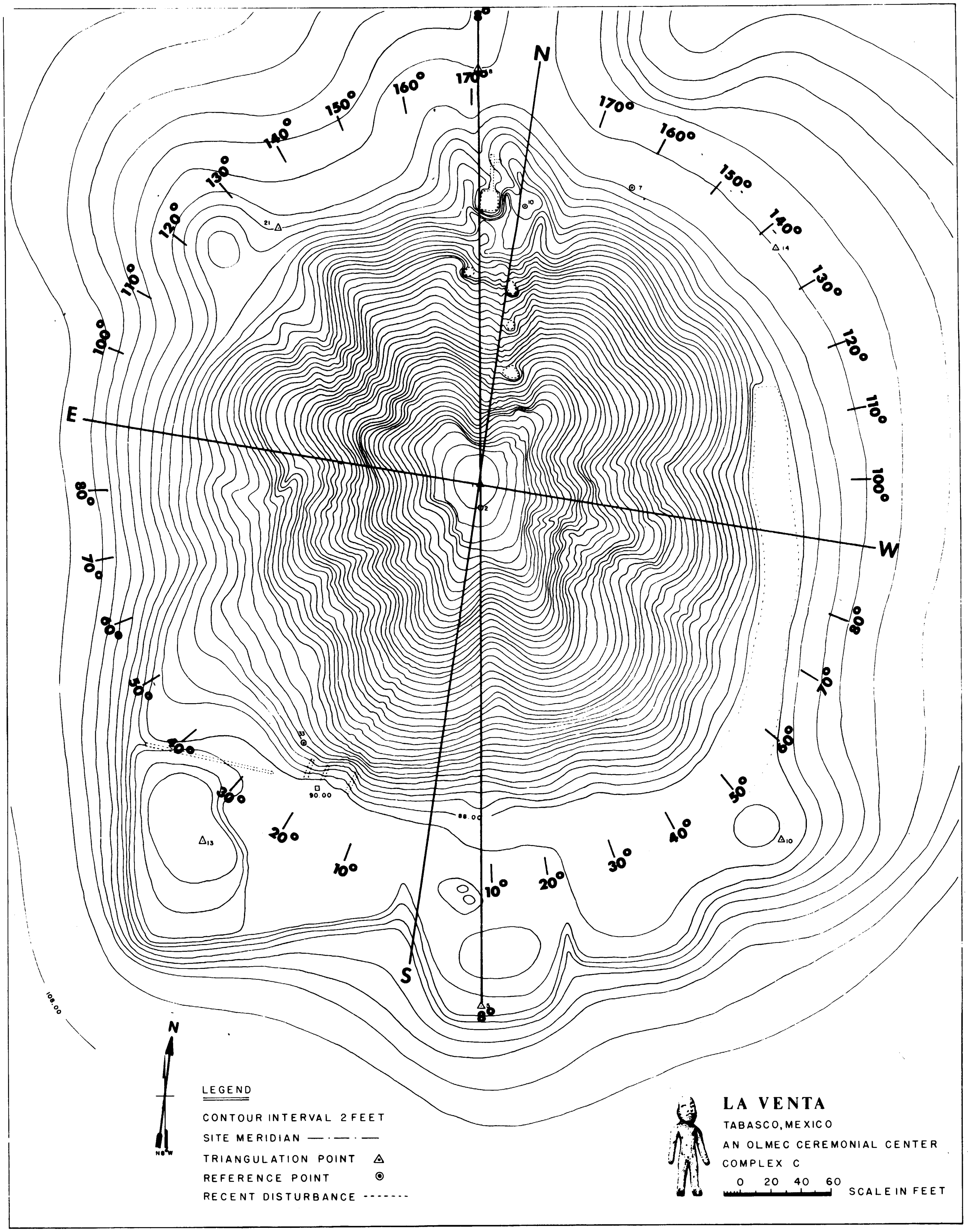


Fig. 2. Contour map of the Pyramid at La Venta Site.

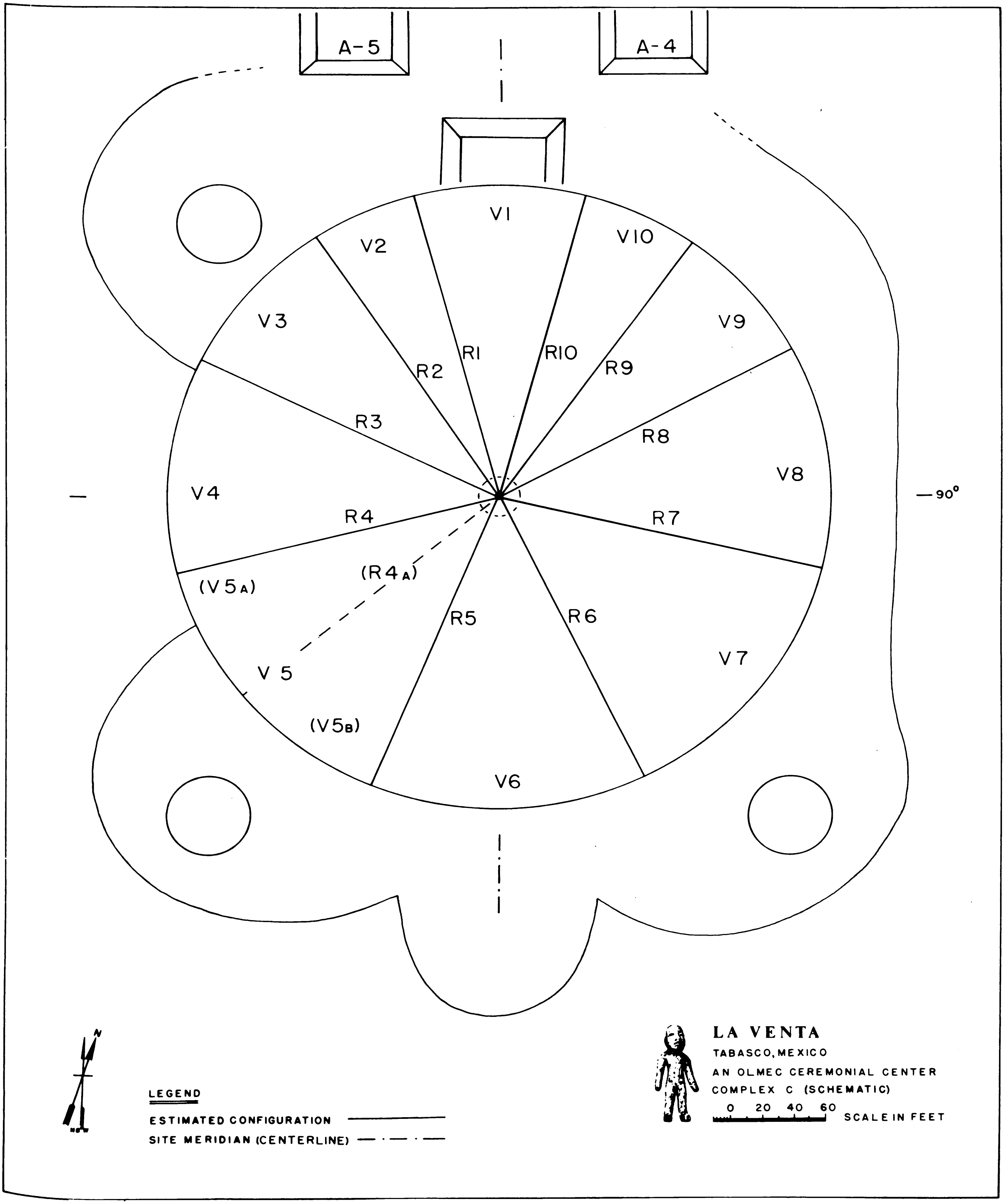


Fig. 3. Schematic representation of the ridges of the La Venta pyramid.

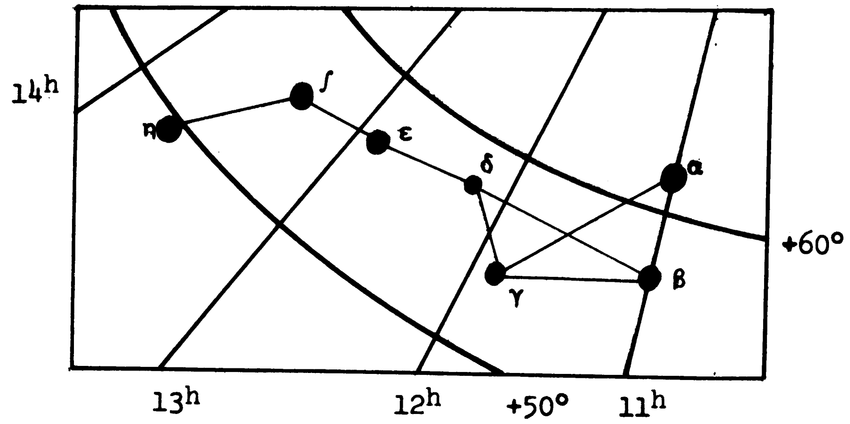


Fig. 4. The Big Dipper (Ursa Major)

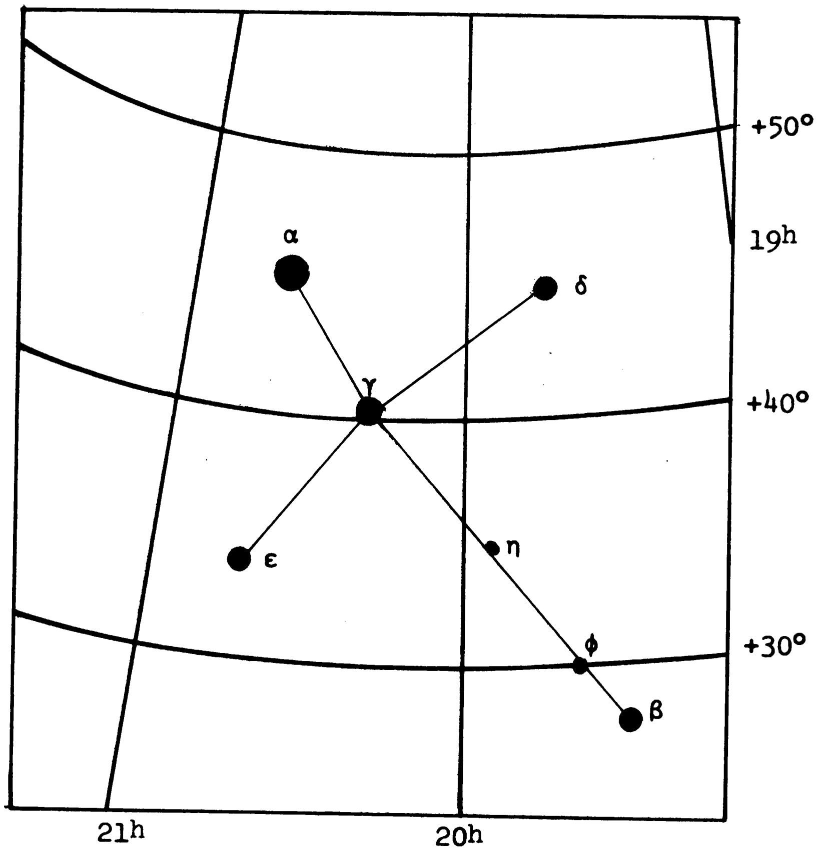


Fig. 5. Cygnus

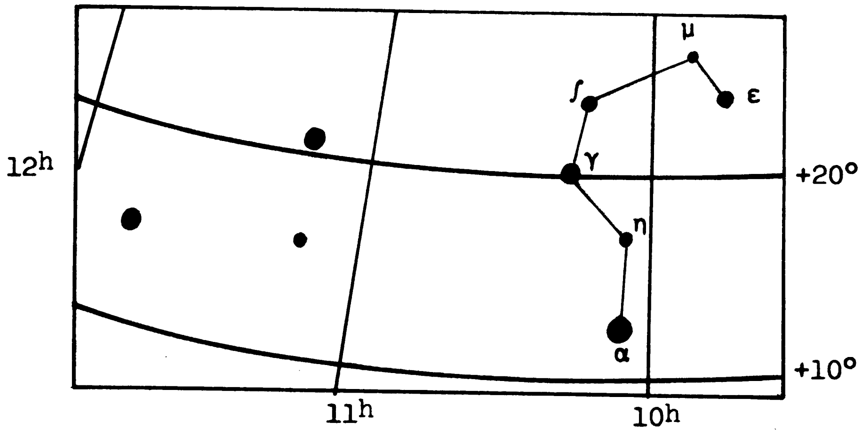


Fig. 6. The Constellation Leo

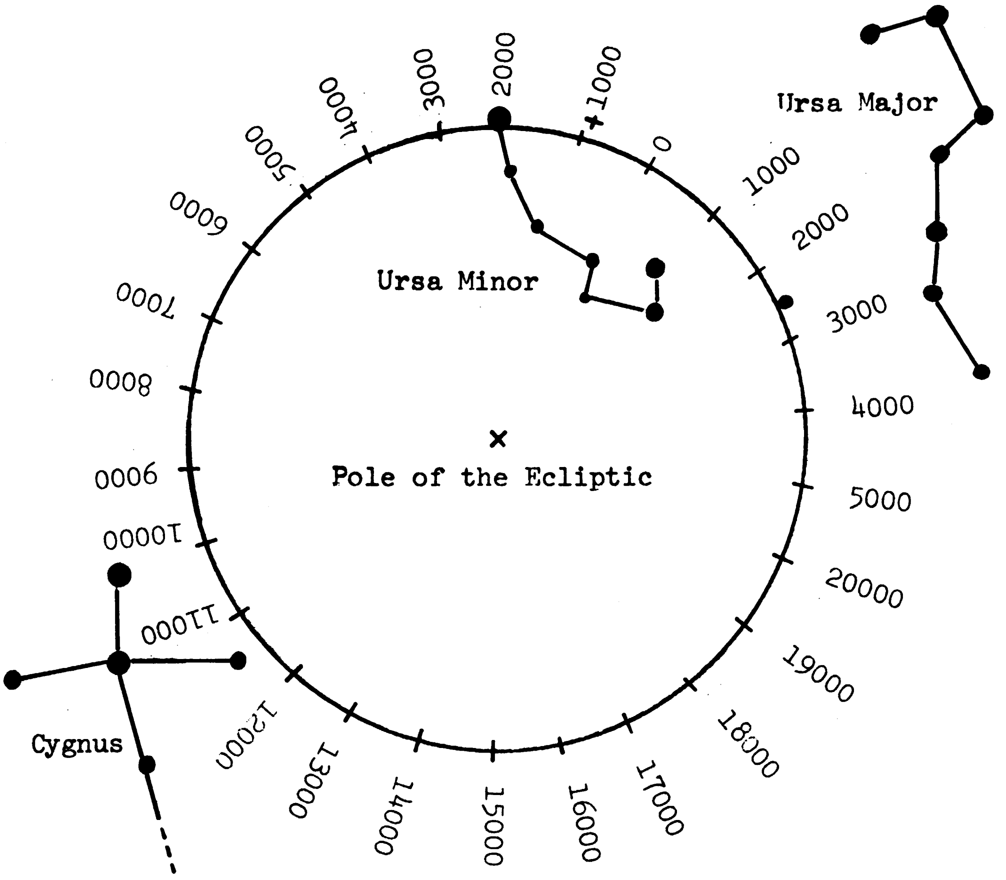


Fig. 7. Precessional path of the North celestial pole. The celestial pole describes a circle of 23 1/2° radius around the ecliptic pole.

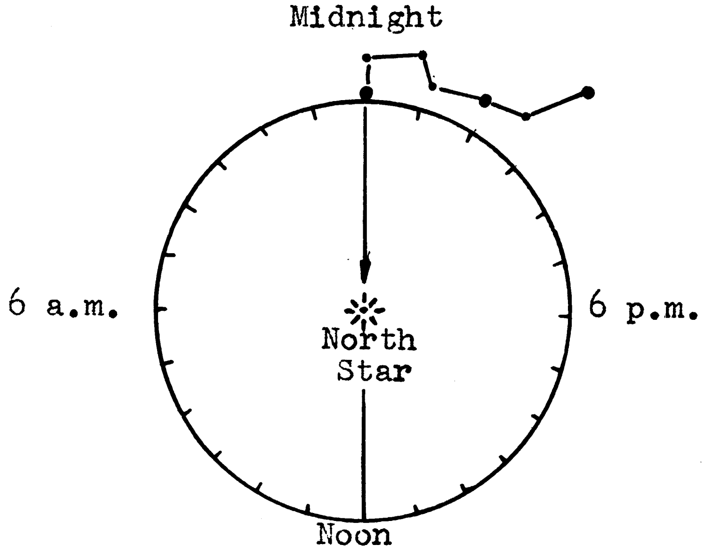


Fig. 8. Big Dipper clock for night of March 5. At midnight the pointers are directly above the North Star. They move west (left) 15 degrees each hour.

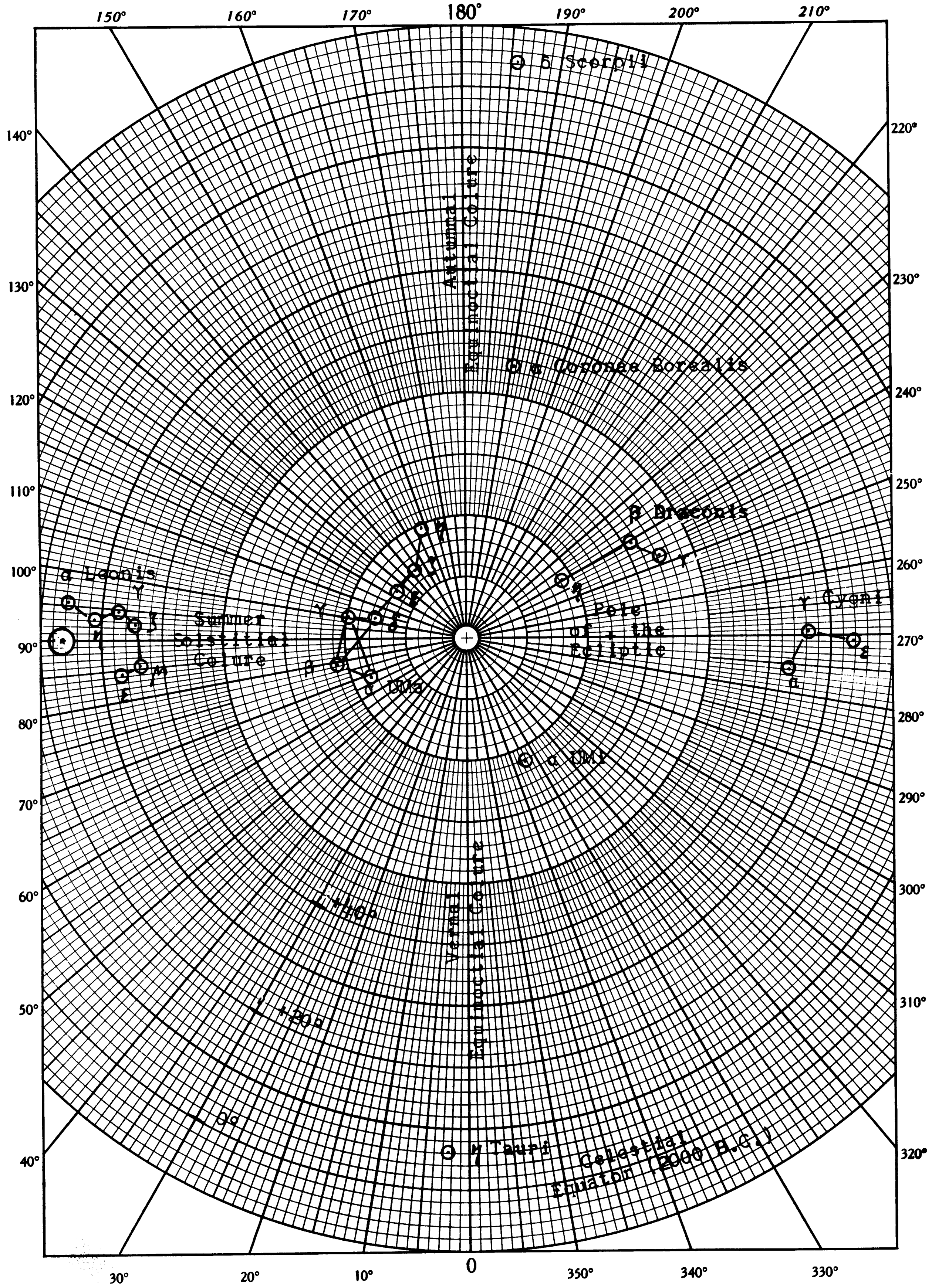


Fig. 9. Polar diagram of right ascensions and declinations, for 2000 B.C., of selected stars. Center of the diagram: North celestial pole.

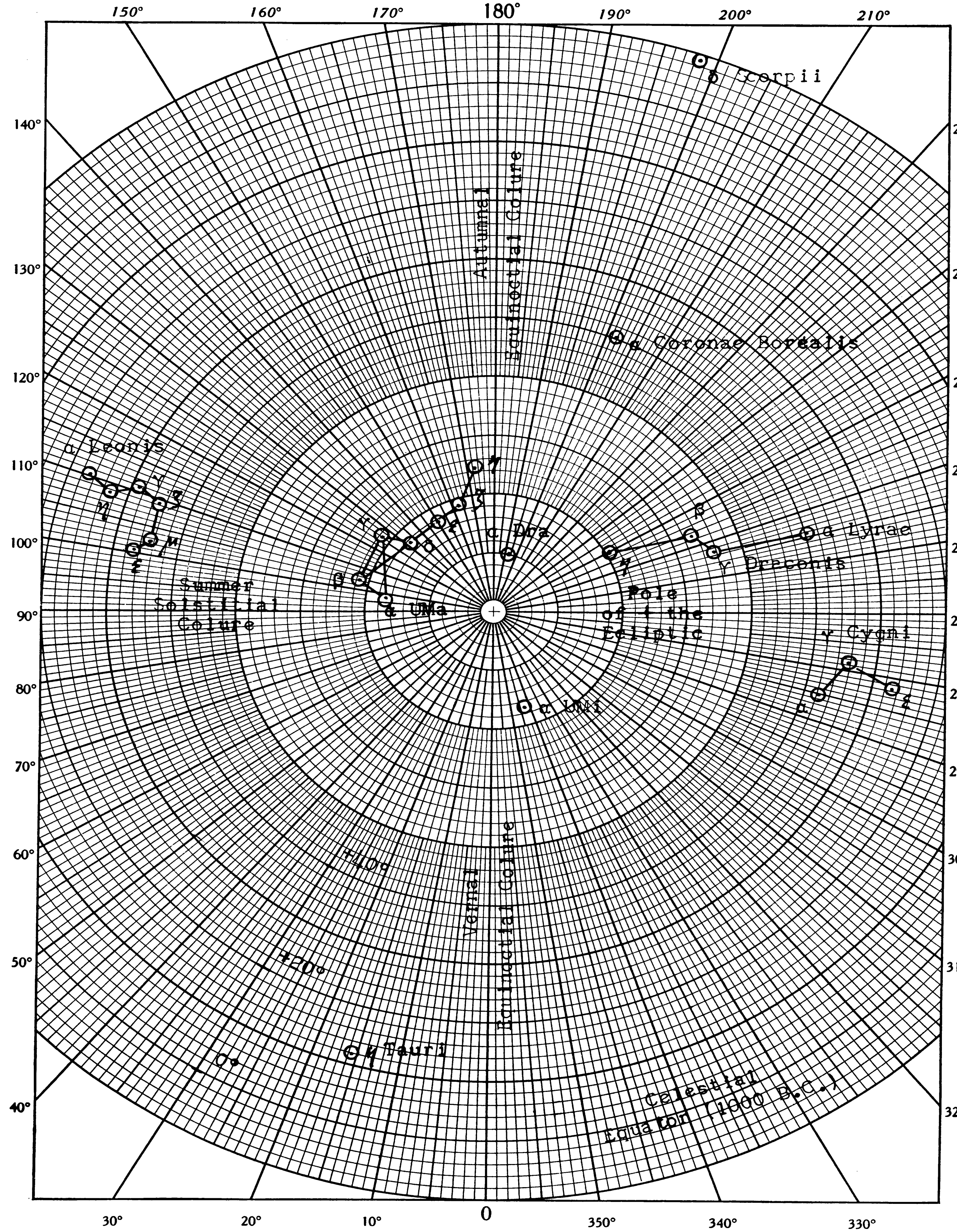


Fig. 10. Polar diagram of right ascensions and declinations, for 1000 B.C., of selected stars. Center of the diagram: North celestial pole.

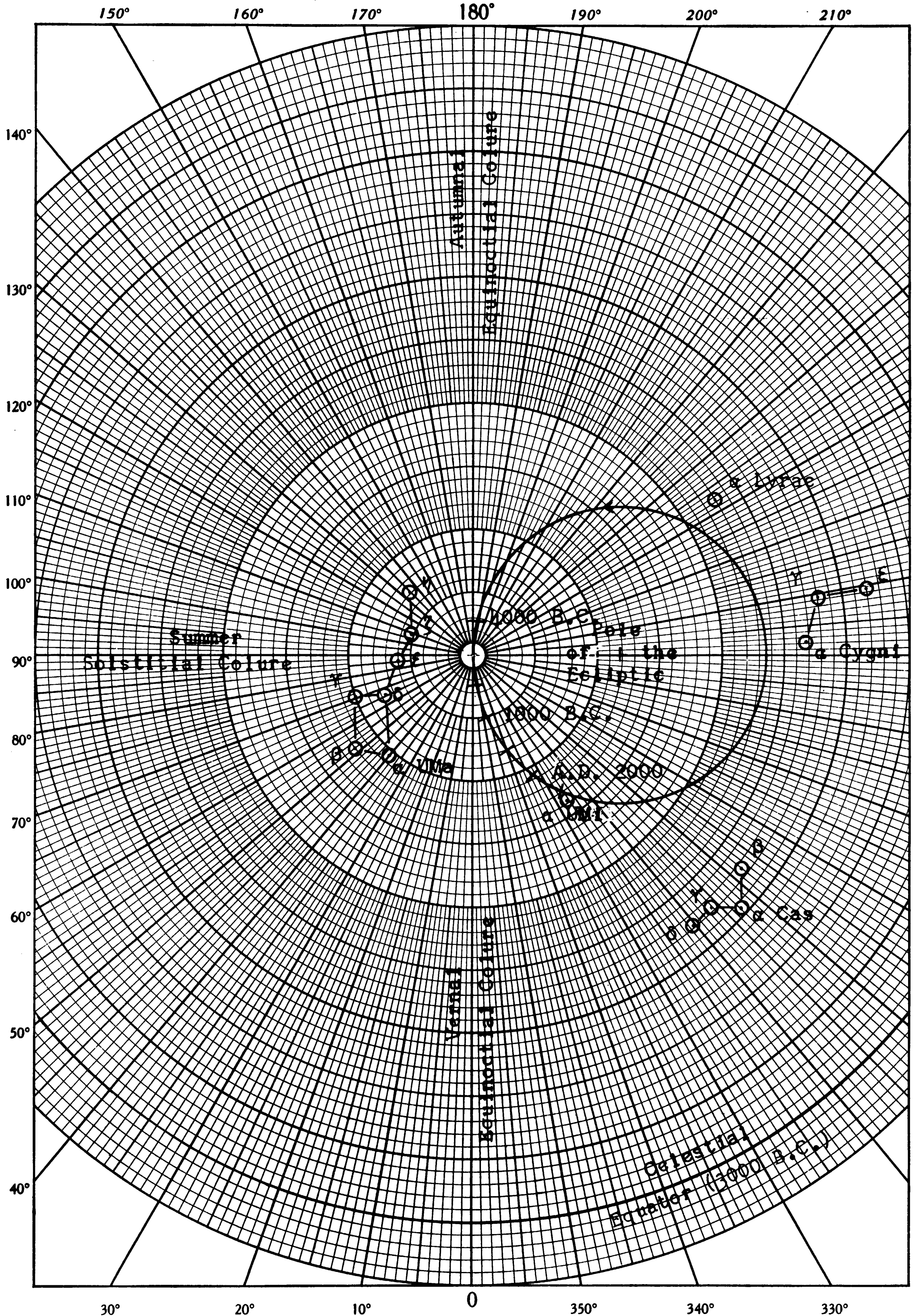


Fig. 11. Polar diagram of right ascensions and declinations, for 3000 B.C., of selected stars. The path of the North celestial pole around the North pole of the ecliptic is shown.

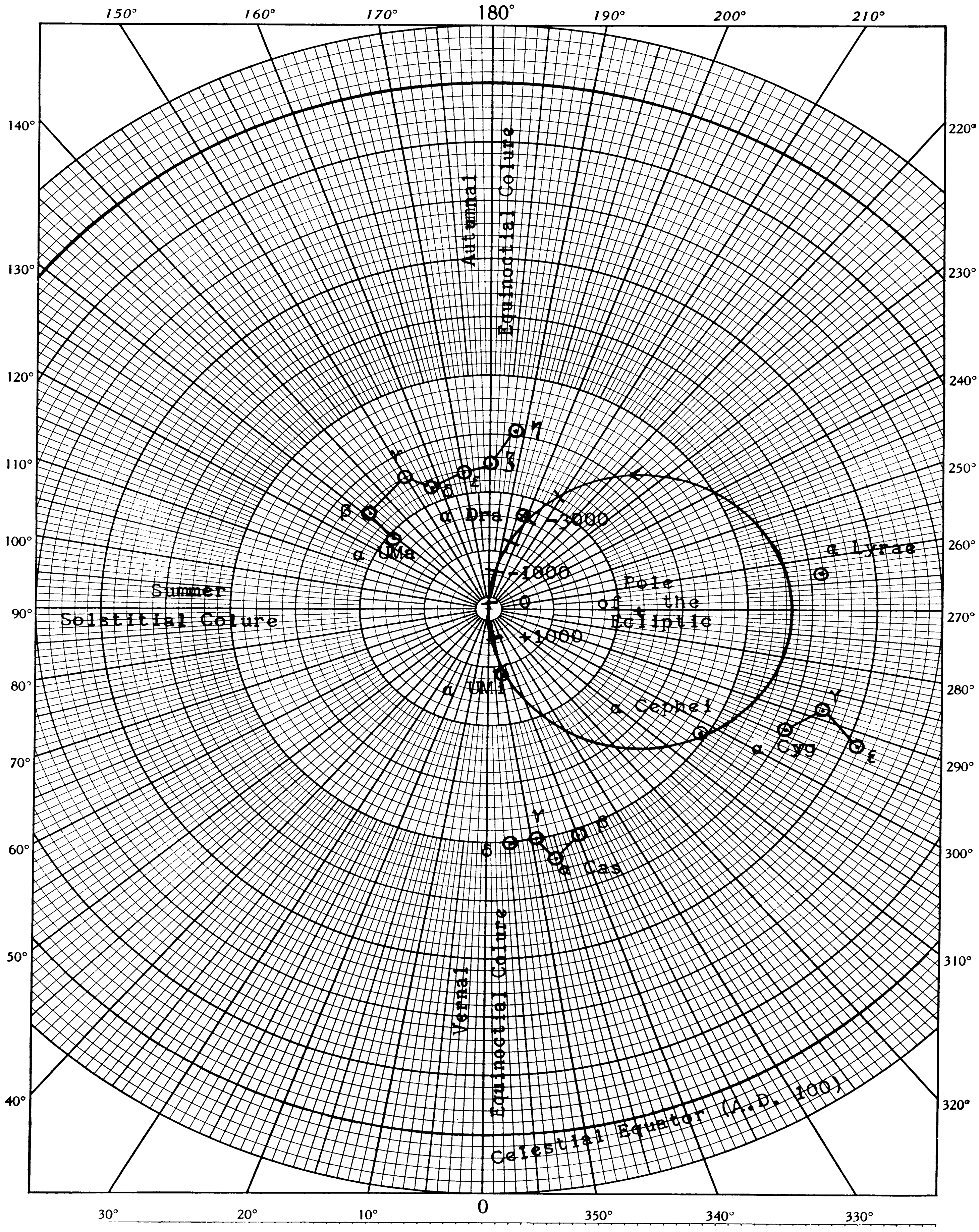


Fig. 12. Polar diagram of right ascensions and declinations, for A.D. 100, of selected stars. Center of the diagram: North celestial pole. The path of the North celestial pole around the North pole of the ecliptic is shown.

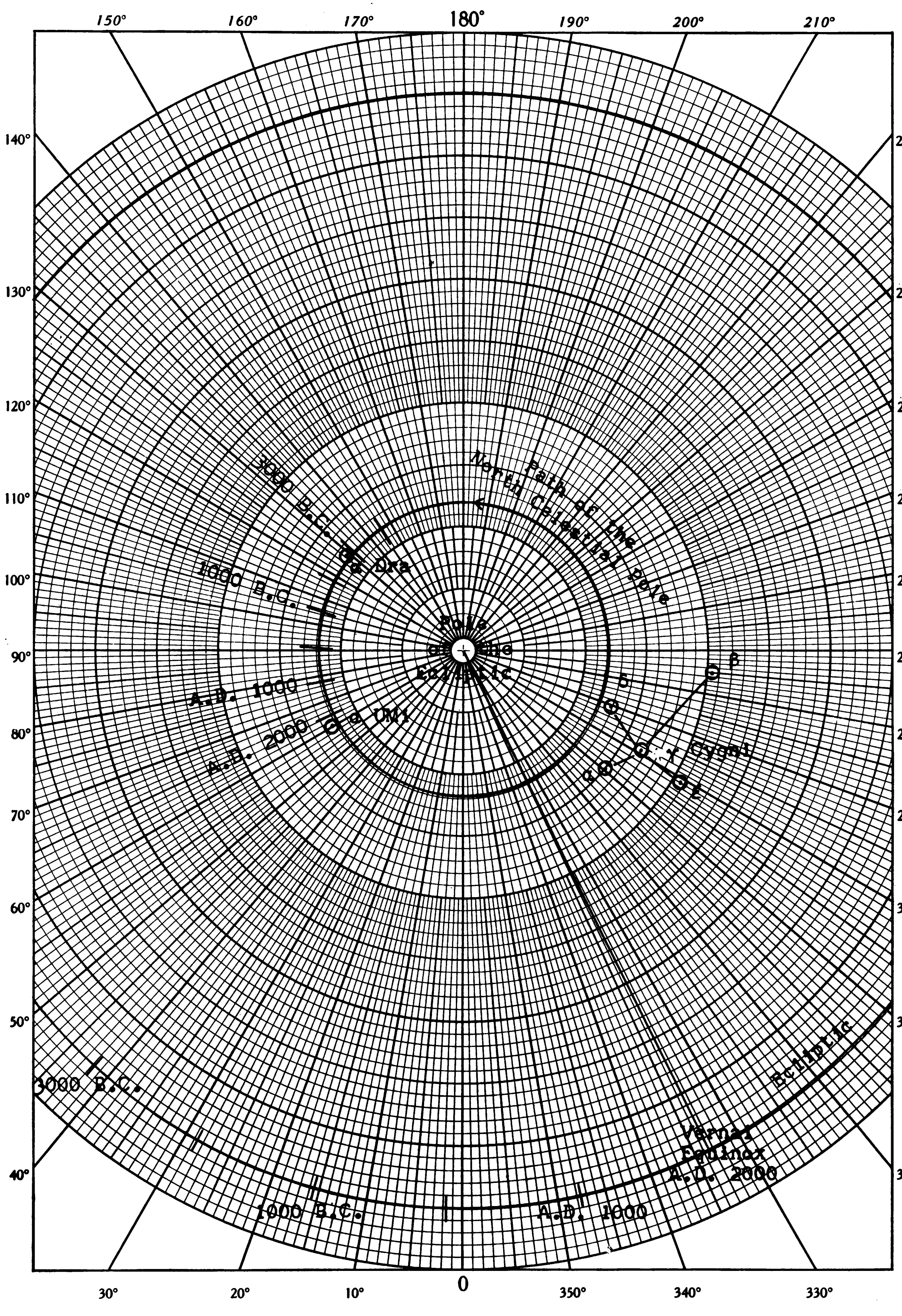


Fig. 13. Polar diagram of longitudes and latitudes, for A.D. 100, of selected stars. Center of the diagram: North pole of the ecliptic. The path of the North celestial pole around the North pole of the ecliptic is shown.

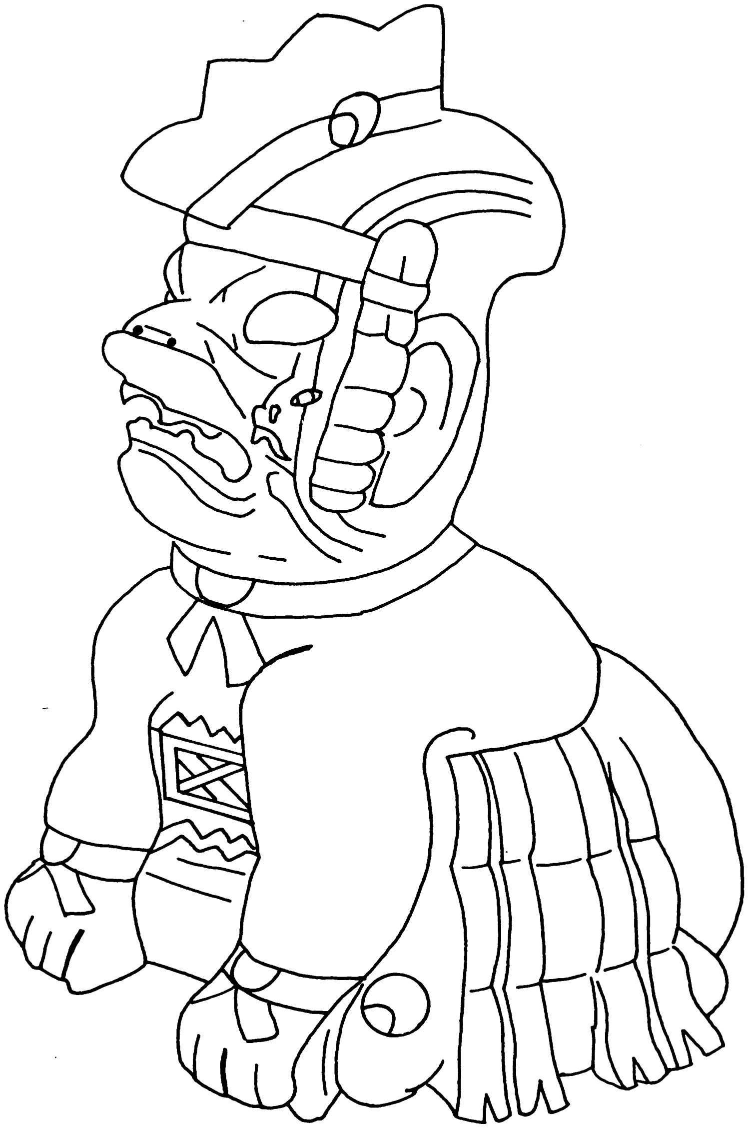


Fig. 14. Blue-green jadeite figure from Necaxa, Puebla, Mexico. (After Covarrubias 1957, facing p. 78, left).

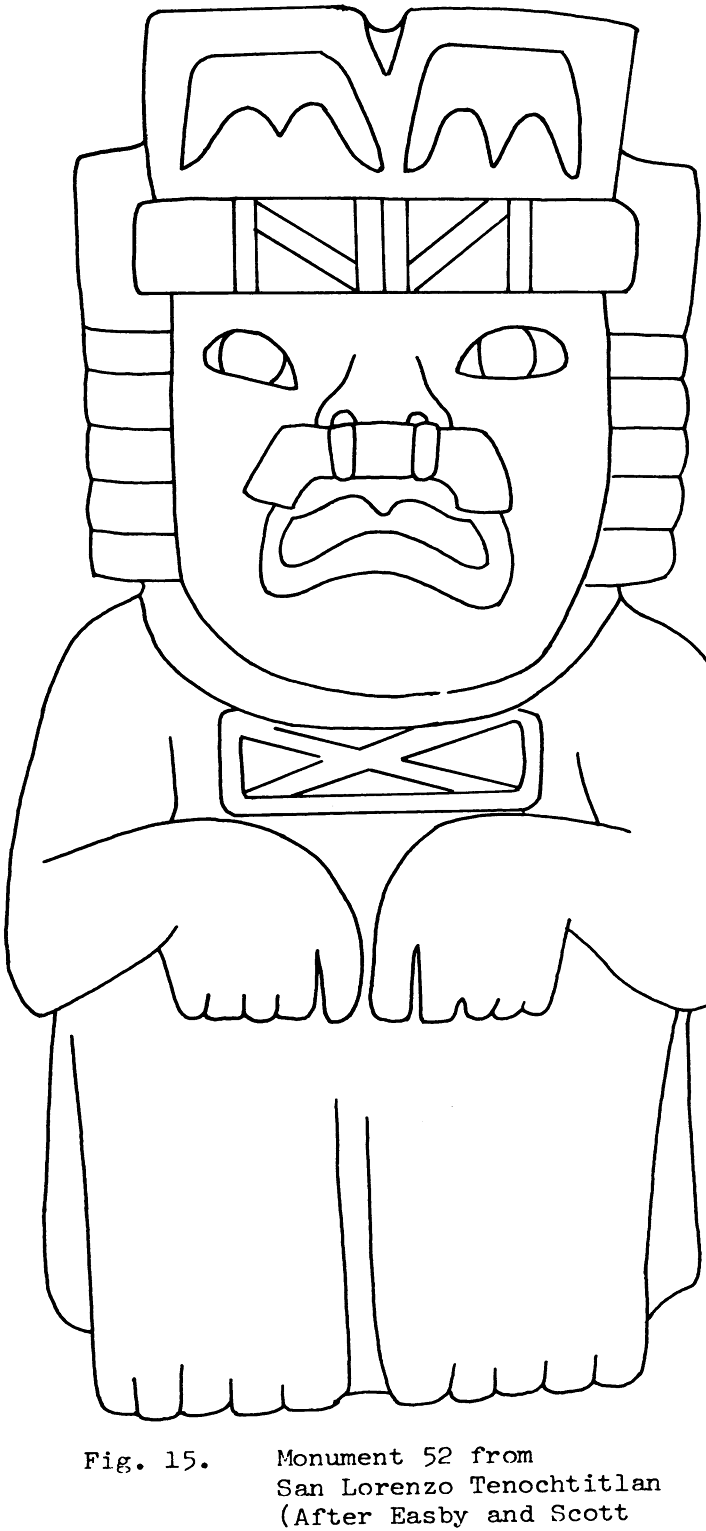


Fig. 15. Monument 52 from San Lorenzo Tenochtitlan (After Easby and Scott 1970, No. 34).

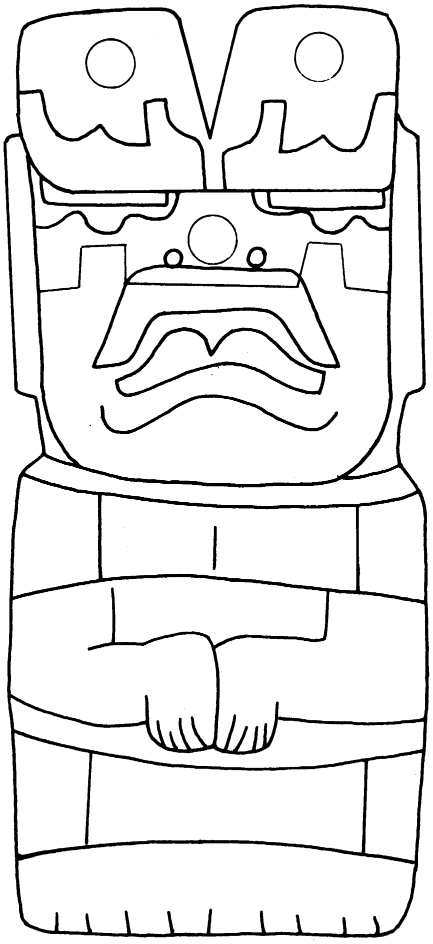


Fig. 16. Stone effigy axe, probably from Oaxaca. (After Coe, 1965, Fig. 28).

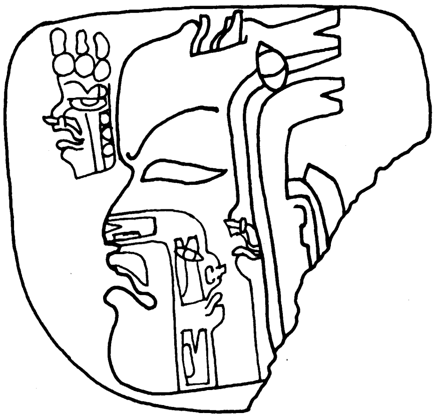


Fig. 17. Jade plaque, provenience unknown. (After Covarrubias, 1957, Fig. 35 top left).

Fig. 19. La Venta Altar 5. (After Stirling 1965, Fig. 20, top)

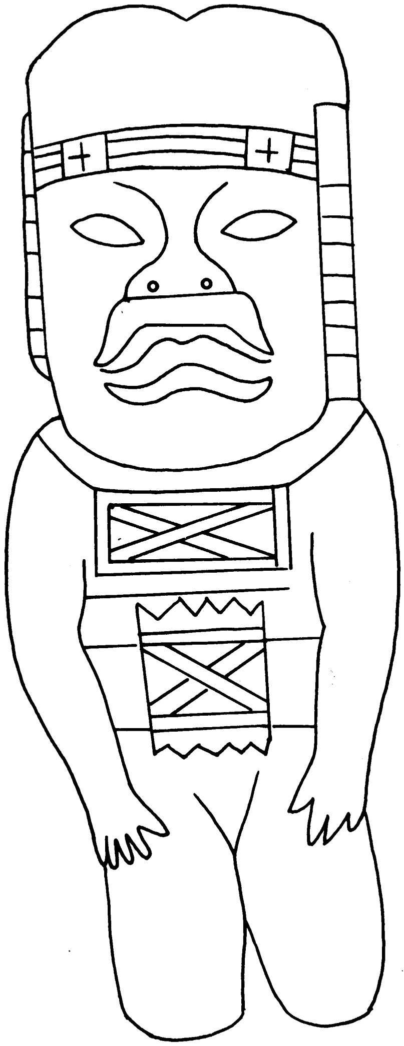


Fig. 20. Infant held in arms of Las Limas Figure shown in Fig. 40).

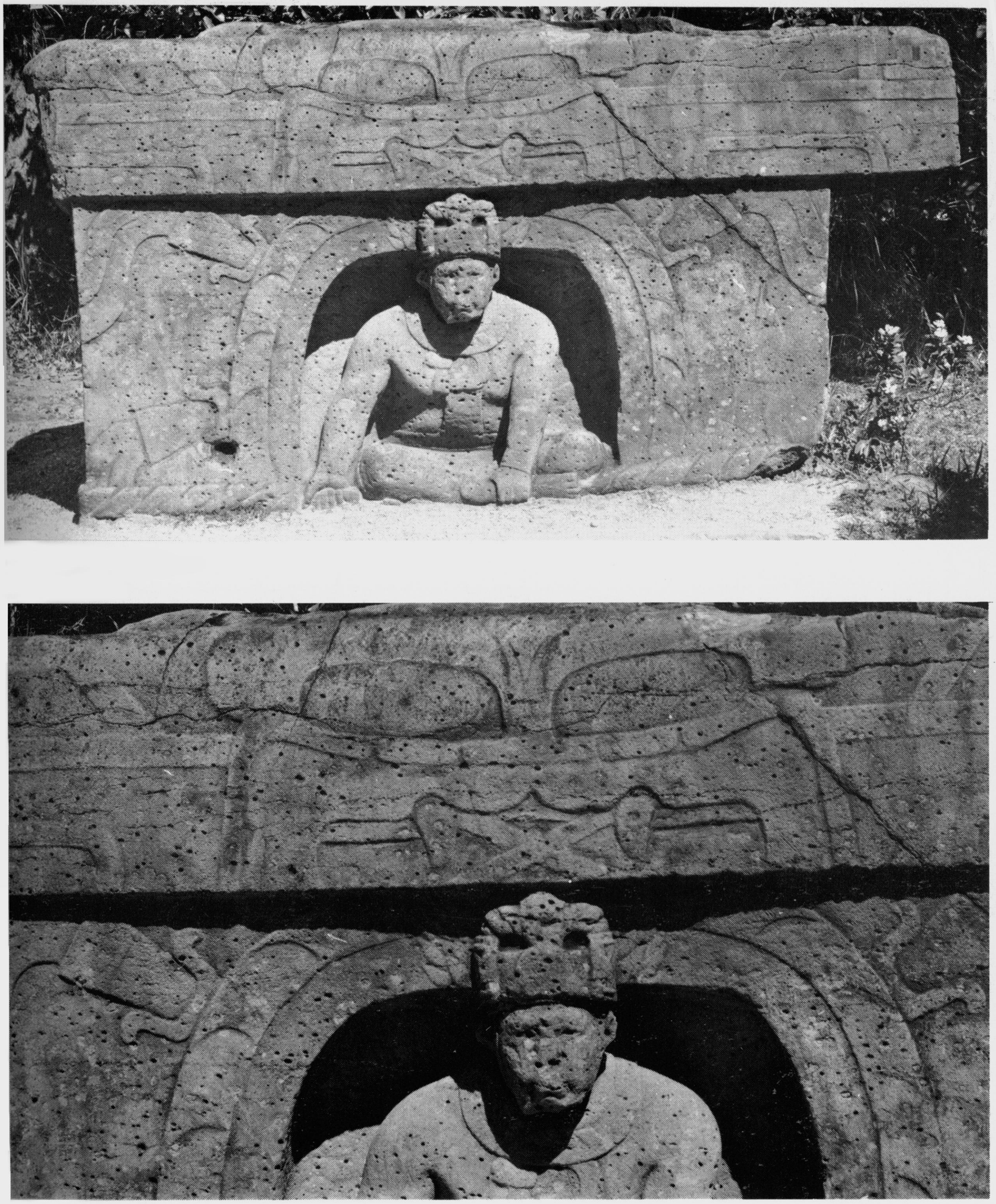


Fig. 18. La Venta Altar 4.

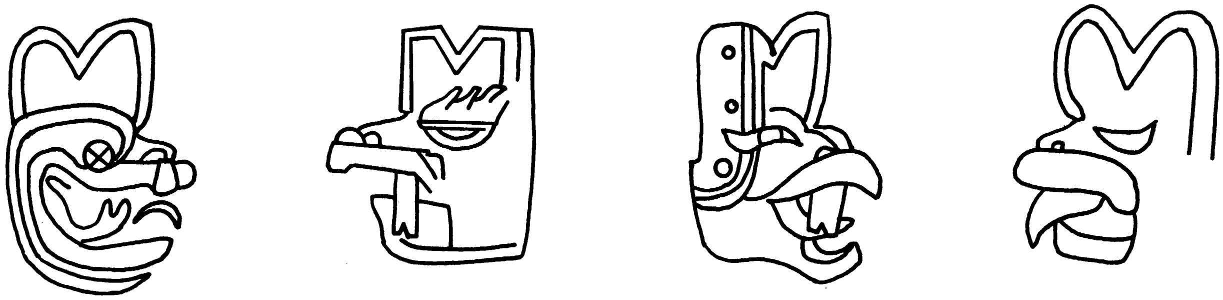


Fig. 21. Profile faces incised on shoulders and knees of Las Limas Figure.

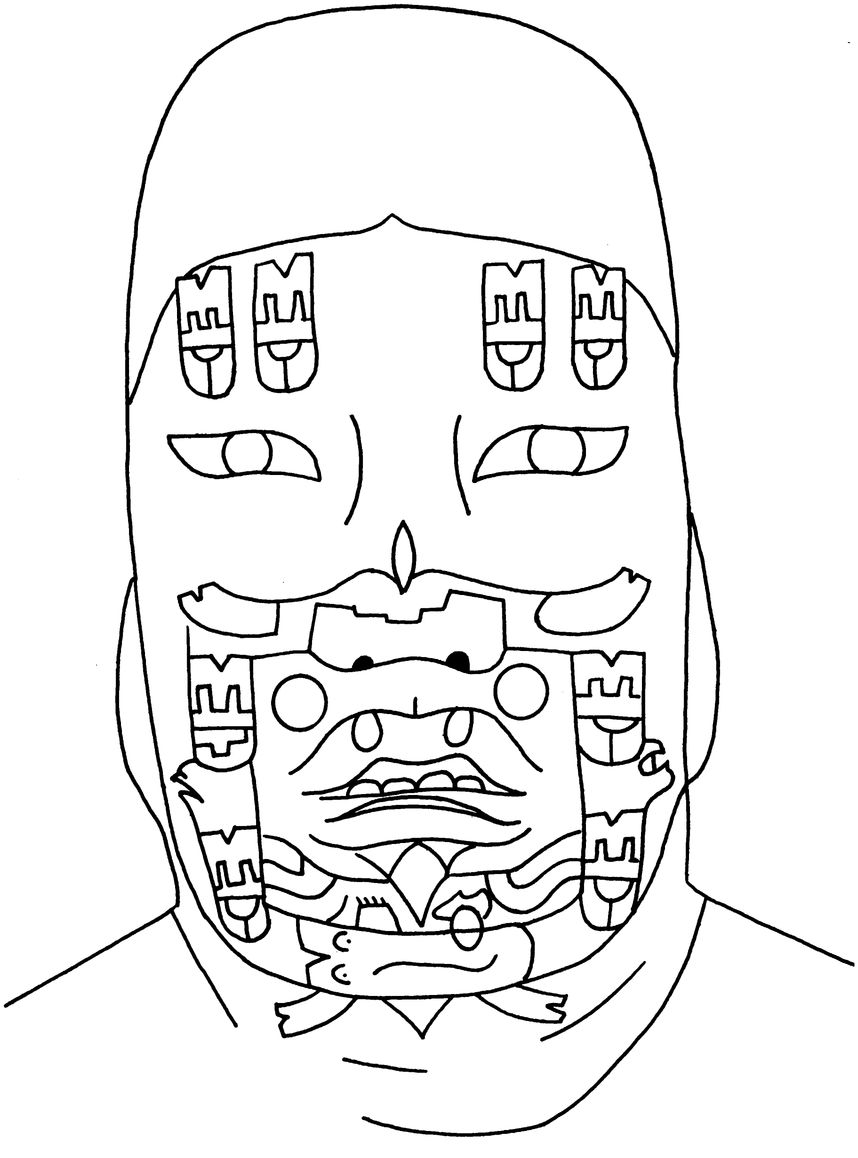


Fig. 22. Design incised on face of Las Limas Figure (see Fig. 40).

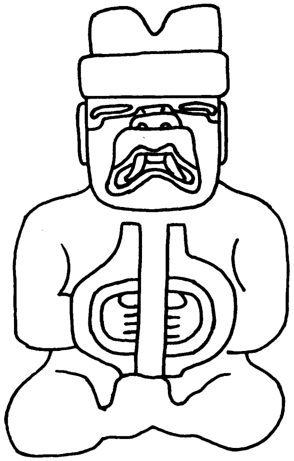


Fig. 23. Monument 10 from San Lorenzo Tenochtitlan. (After Covarrubias, 1957)

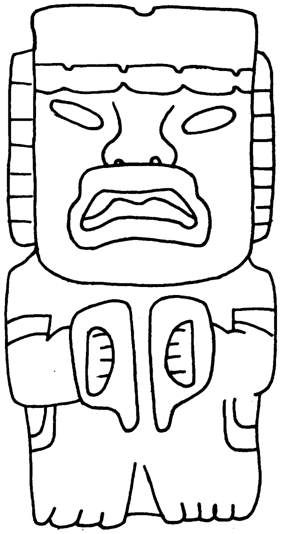


Fig. 24. Jade figurine from Pichualco, Chiapas, Mexico. (After Cervantes 1969, Fig. 14)

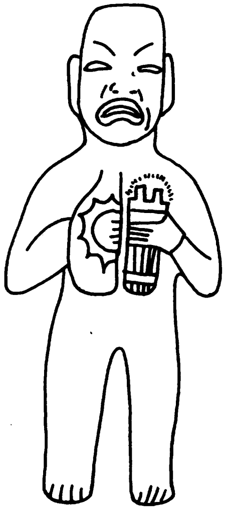


Fig. 25. Jade figurine from San Cristobal, Tepatlaxco, Puebla, Mexico. (After Coe 1965, Fig. 8).

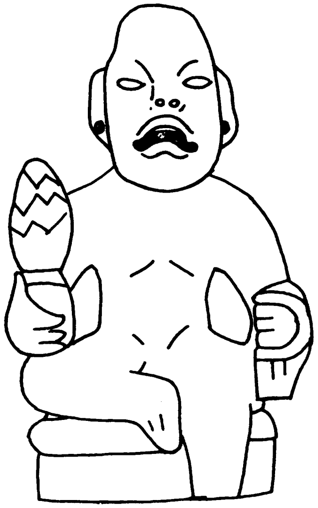


Fig. 26. Jade figurine, provenience unknown. (After Coe 1965, Fig. 12).

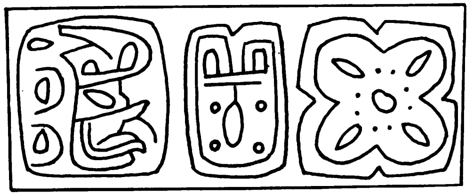


Fig. 27. Glyphs on a roller stamp found at Tlatilco, Mexico. (After Coe 1965, Fig. 47).

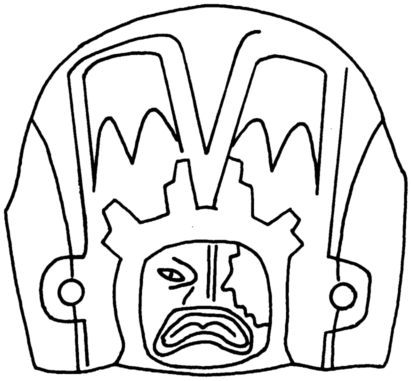


Fig. 28. Yuguito from Tlacotepec, Guerrero, Mexico. (After Coe 1965, Fig. 4).

Fig. 29. Engraved celt, provenience unknown. (After Coe 1965, Fig. 52).

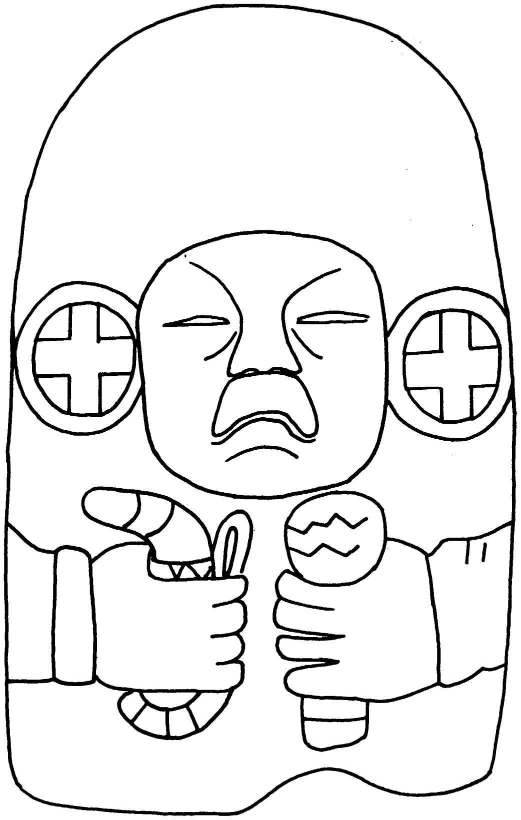


Fig. 30. Figure of deep green serpentine, provenience unknown. (After Easby and Scott 1970, No. 37).

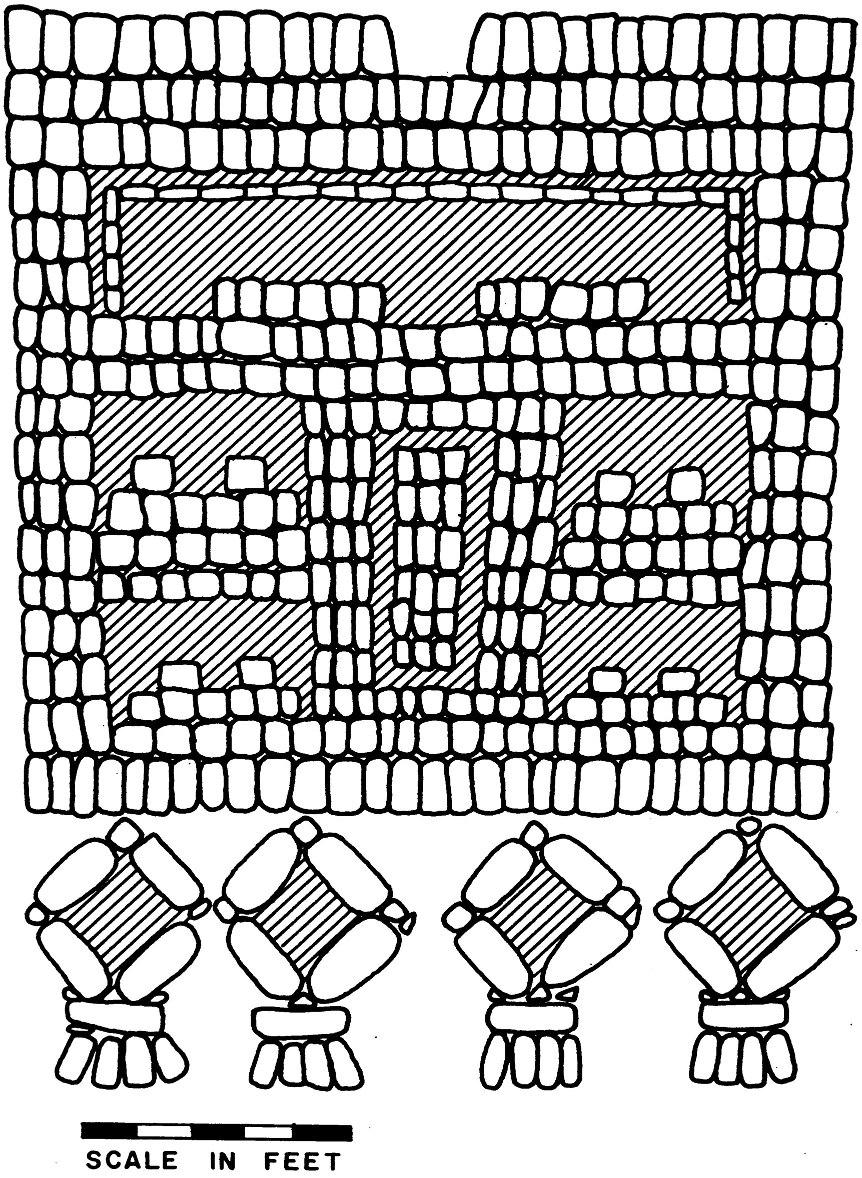


Fig. 31. Mosaic mask in Southwest Platform, La Venta site (After Drucker, Heizer and Squier, Fig. 28). Hachured areas are unfilled; open areas are stone blocks.

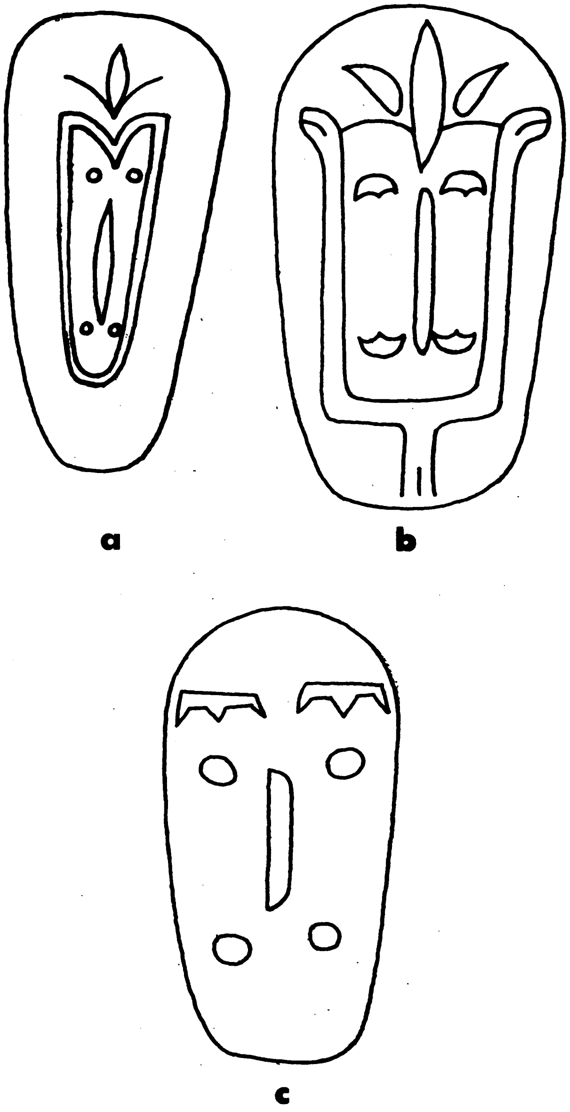


Fig. 33. Celts from La Venta site (a and b after Drucker 1952, Fig. 47; c after Drucker, Heizer and Squier 1955, Fig. 35c.)

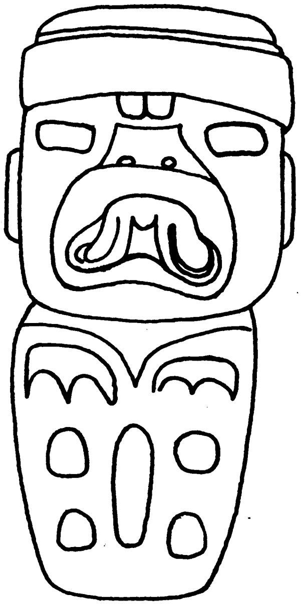


Fig. 32. "Votive axe," unknown provenience. (After Covarrubias 1957, Fig. 32, lower right).

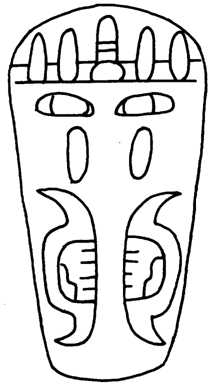


Fig. 34. Celt from La Venta. (After Covarrubias 1957, Fig. 34, center).

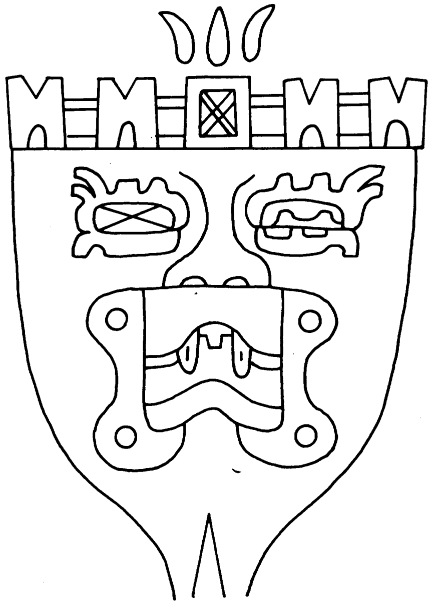


Fig. 35. Celt from Los Tuxtlas, Veracruz, Mexico. (After Piña Chan 1964, Fig. 1).

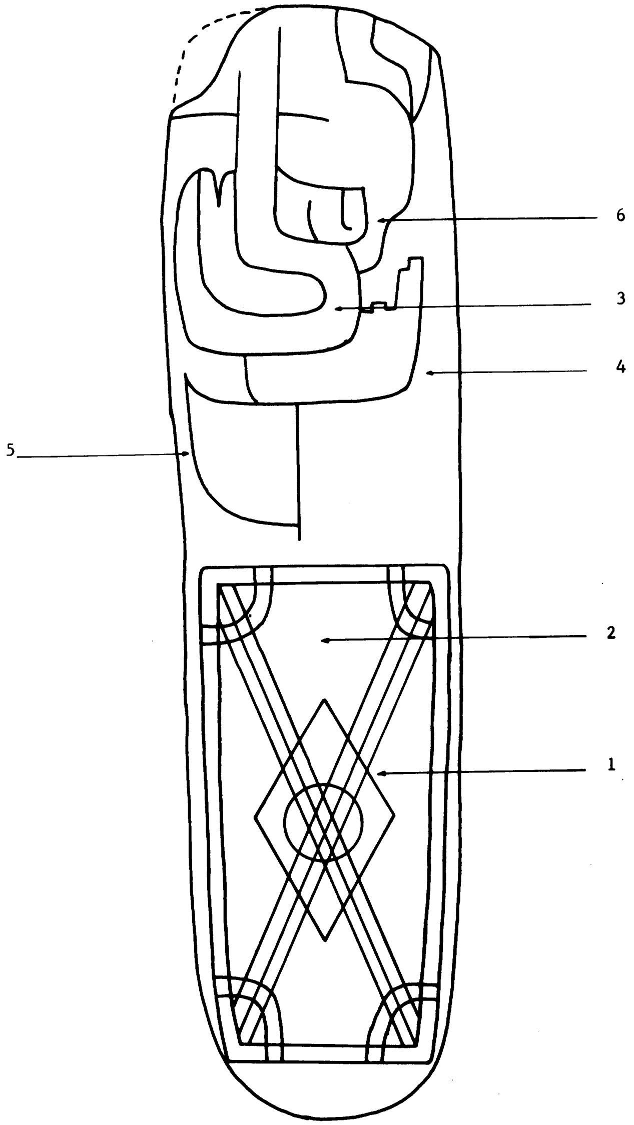


Fig. 38. Serpentine celt from Offering No. 2, La Venta. (From Drucker, Heizer and Squier 1955, Pl. 24).

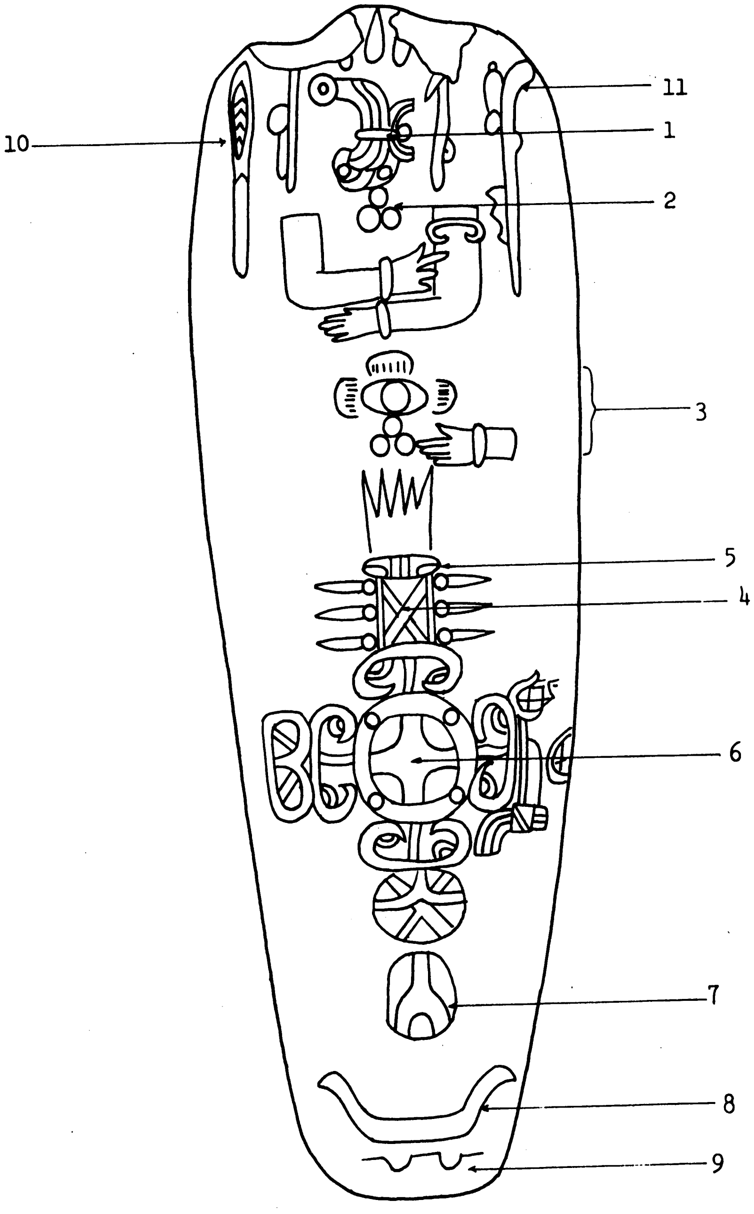


Fig. 36. The Humboldt Celt, provenience unknown. (After Penafiel 1890, pl. 119).

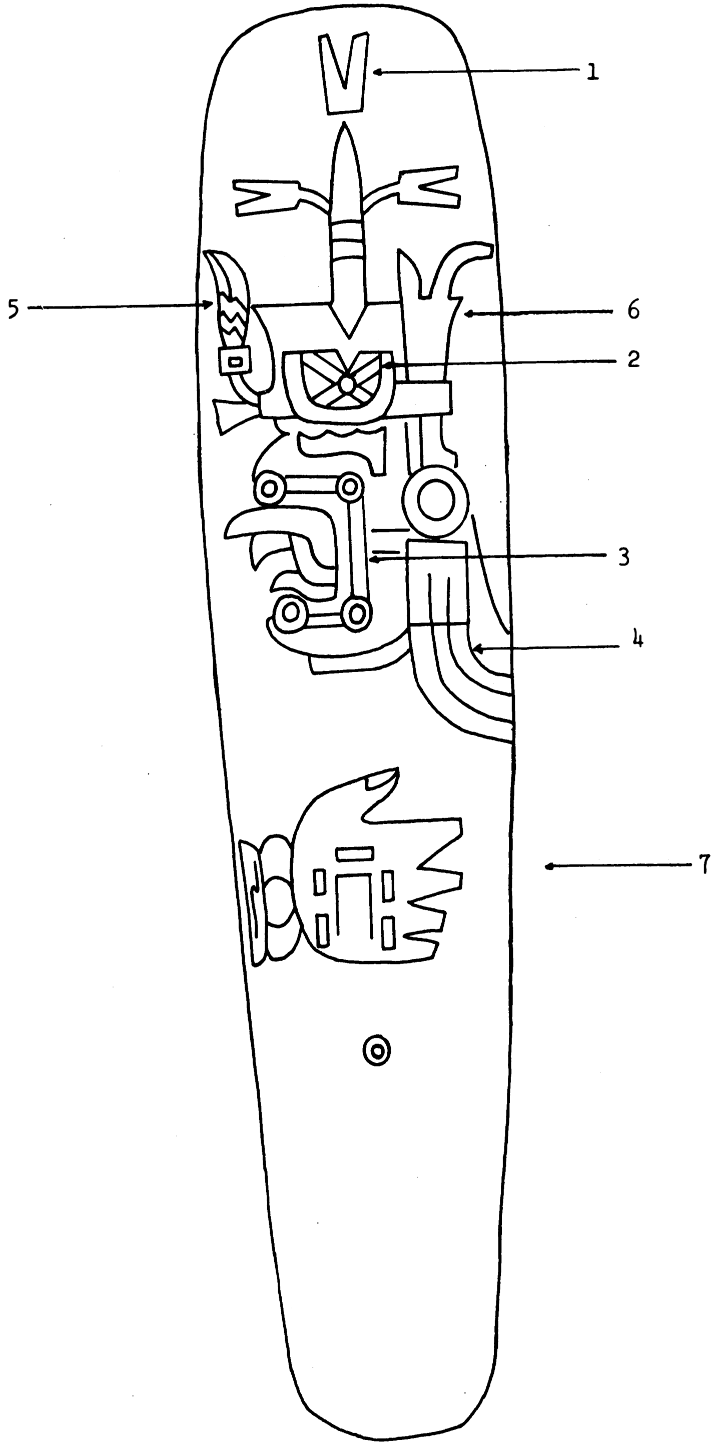


Fig. 37. Jade celt, provenience unknown. (After Covarrubias 1957, Fig. 33, right).

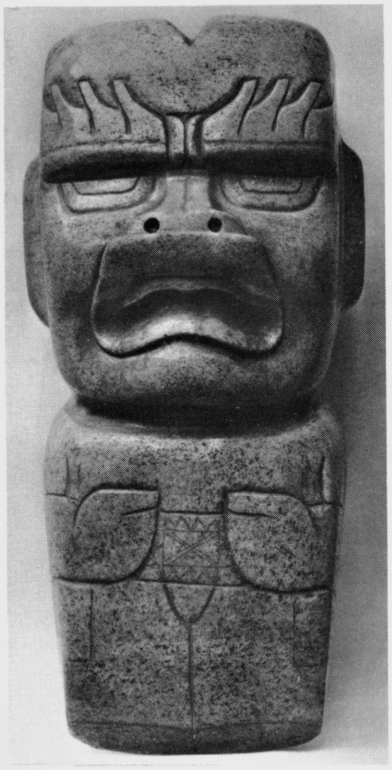


Fig. 39a. Ceremonial jade "axe" from Veracruz, Mexico. (British Museum).

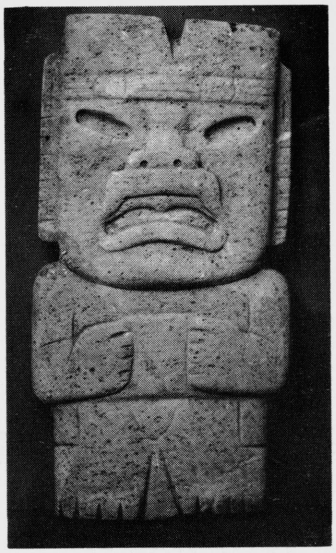


Fig. 39b. Sculptured "axe" from Sanches Magallanes, Tab. In Museo del Estado, Villahermosa, Tab.

Fig. 40a. Sculptured figure from Las Limas, Veracruz, Mexico.

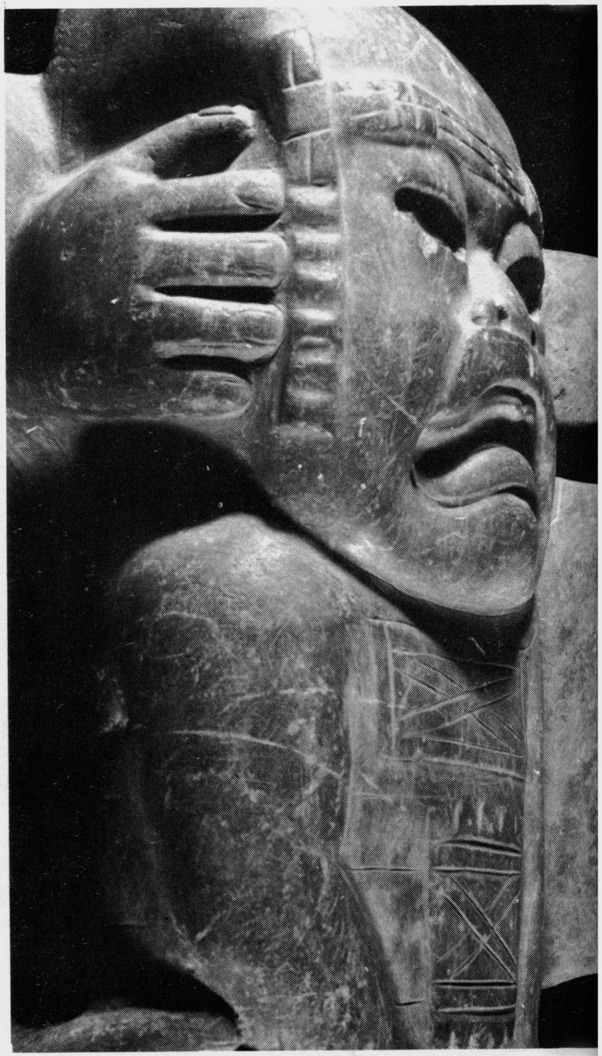


Fig. 40b. Close-up of infant held in (a). Photos by C. W. Clewlow, Jr.

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

Thomas R. Hester, Robert N. Jack and Robert F. Heizer

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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* Financial support for this research was provided by a grant (No. 1-403820-08613) from Chancellor's Patent Fund for Graduate Student Research, University of California at Berkeley. A grant from the National Science Foundation (GA-11735) contributed to the X-ray fluorescence analytical facilities.

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

Cores with Scratched Platforms

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. <u>Widths of Medial and Distal Blade Fragments</u>. 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.

Flake Fragments

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

Lunate Objects

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. Correlation of Artifacts and Obsidian Chemical Types at Tres Zapotes.

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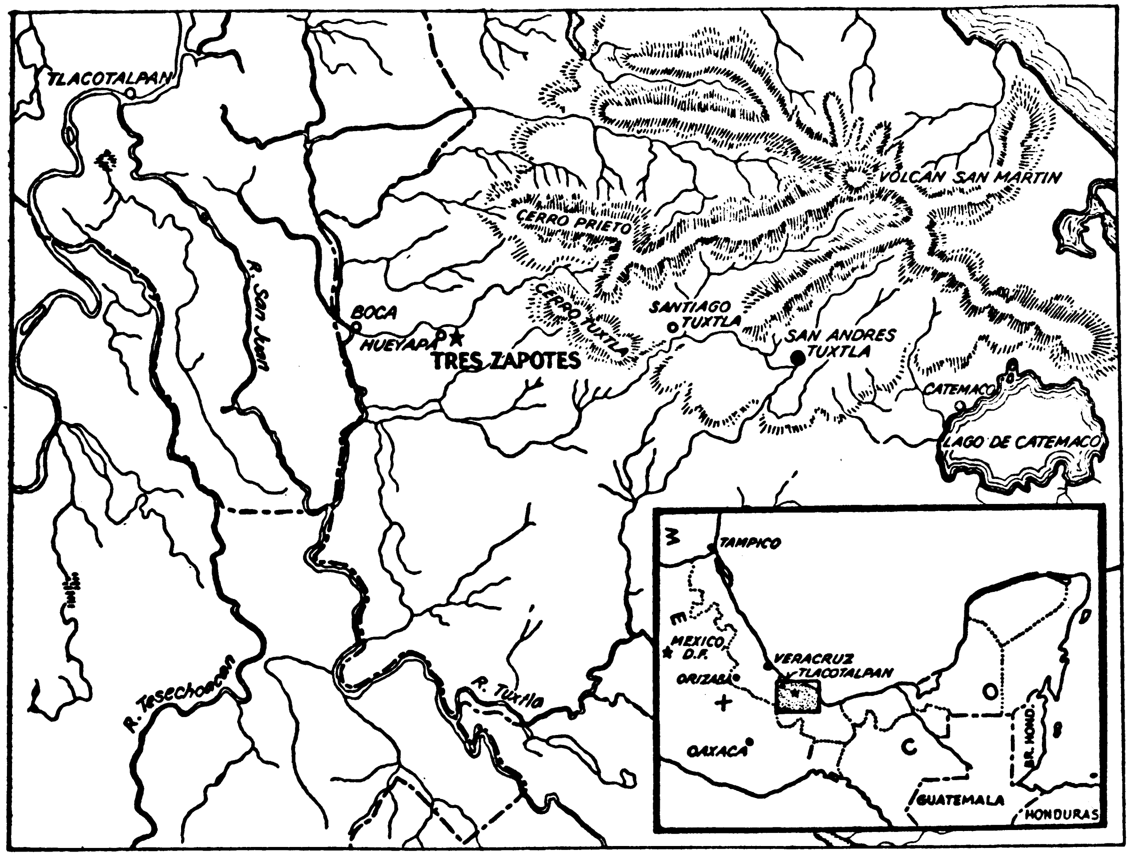
* [Sartorius published a book _Mexico, Landscapes and Popular Sketches_ (Darmstadt, London, New York, 1858) which was reprinted by F.A. Brockhaus, Stuttgart, in 1961 under the title _Mexico About 1850_. This work does not contain any reference to the information attributed to him by Berendt.]

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.

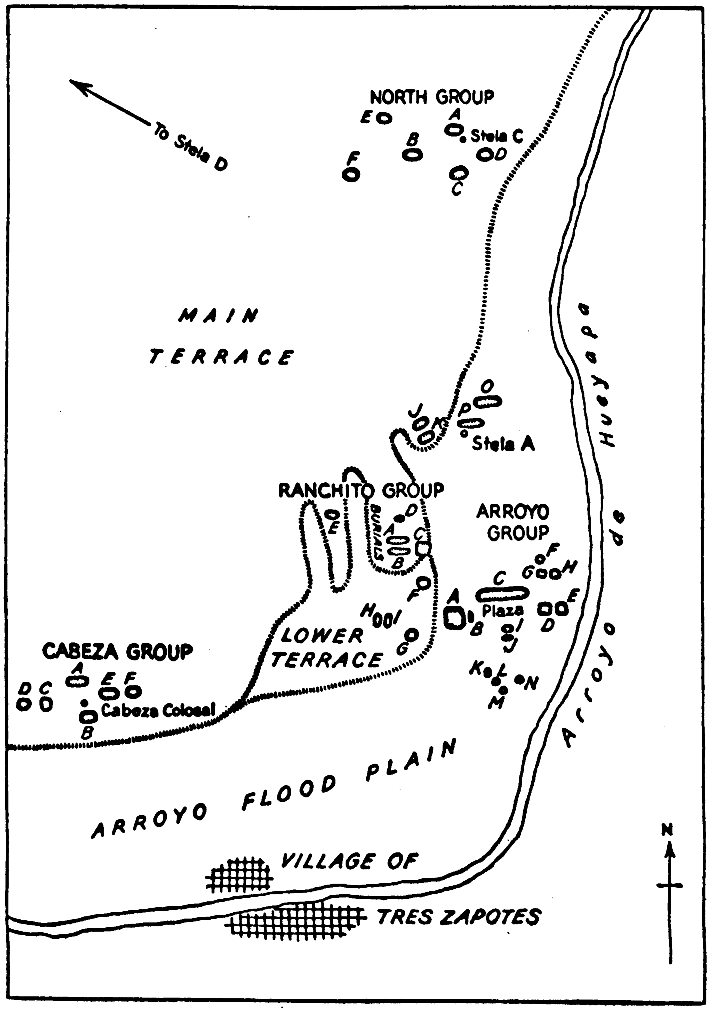
"Mr. Sartorius mentioned another place, likewise in the State of Vera Cruz, where obsidian formerly was quarried. This place is situated in the chain of mountains extending from the Pico de Orizaba to the Cofre de Perote. One of the intervening mountains, called Xalistac, is distinguished by a white 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."

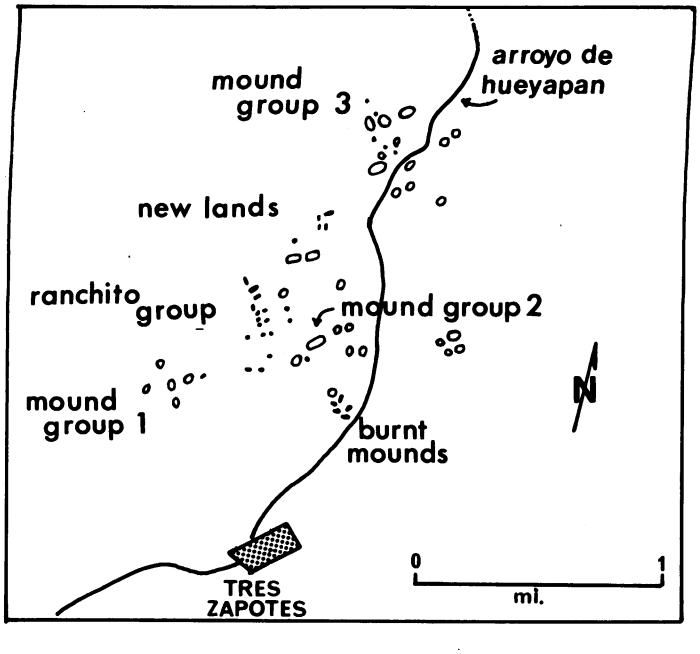
ILLUSTRATION CREDITS

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.



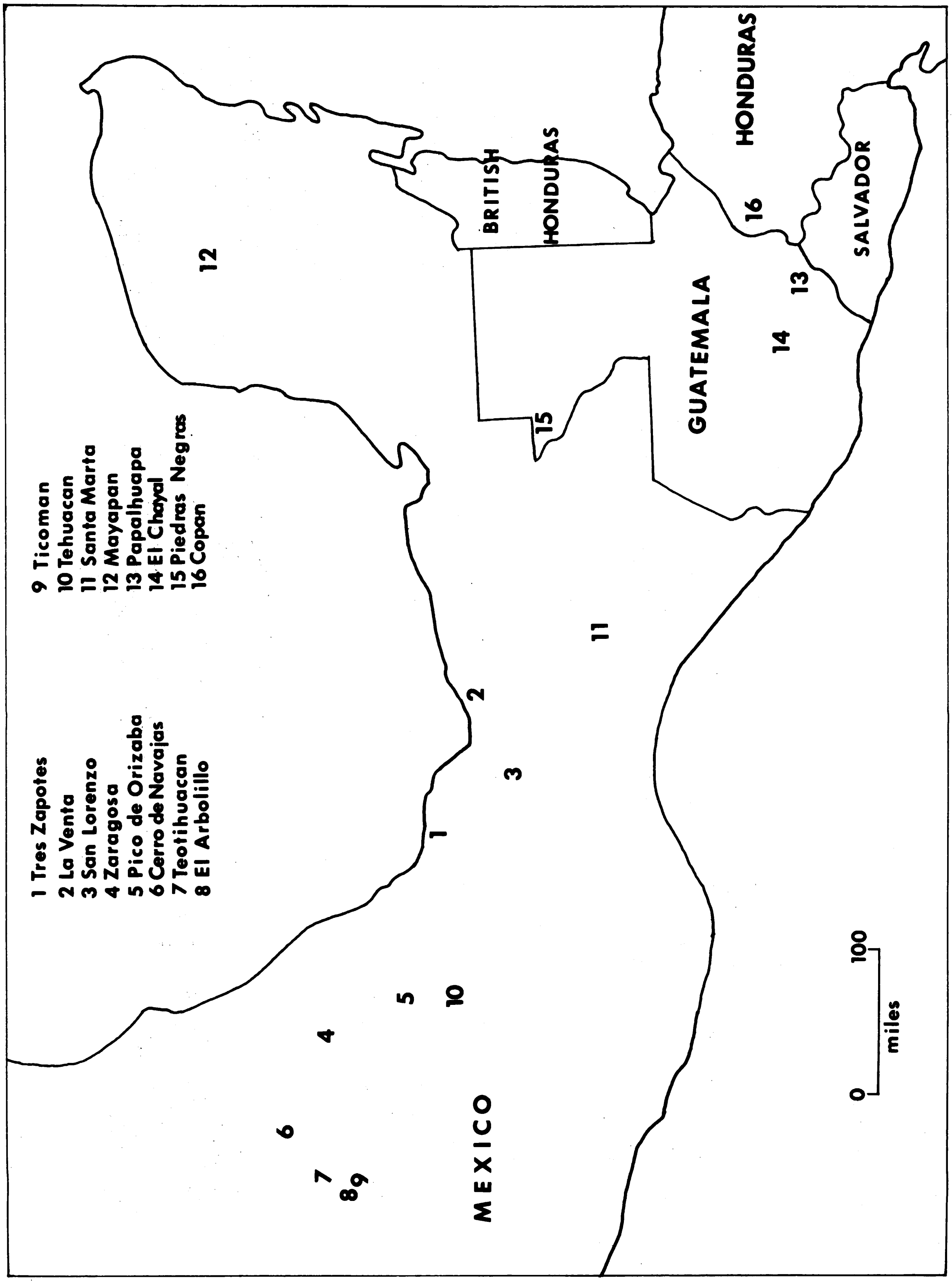
Map 1. Location of Tres Zapotes. (from Drucker 1943)





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.

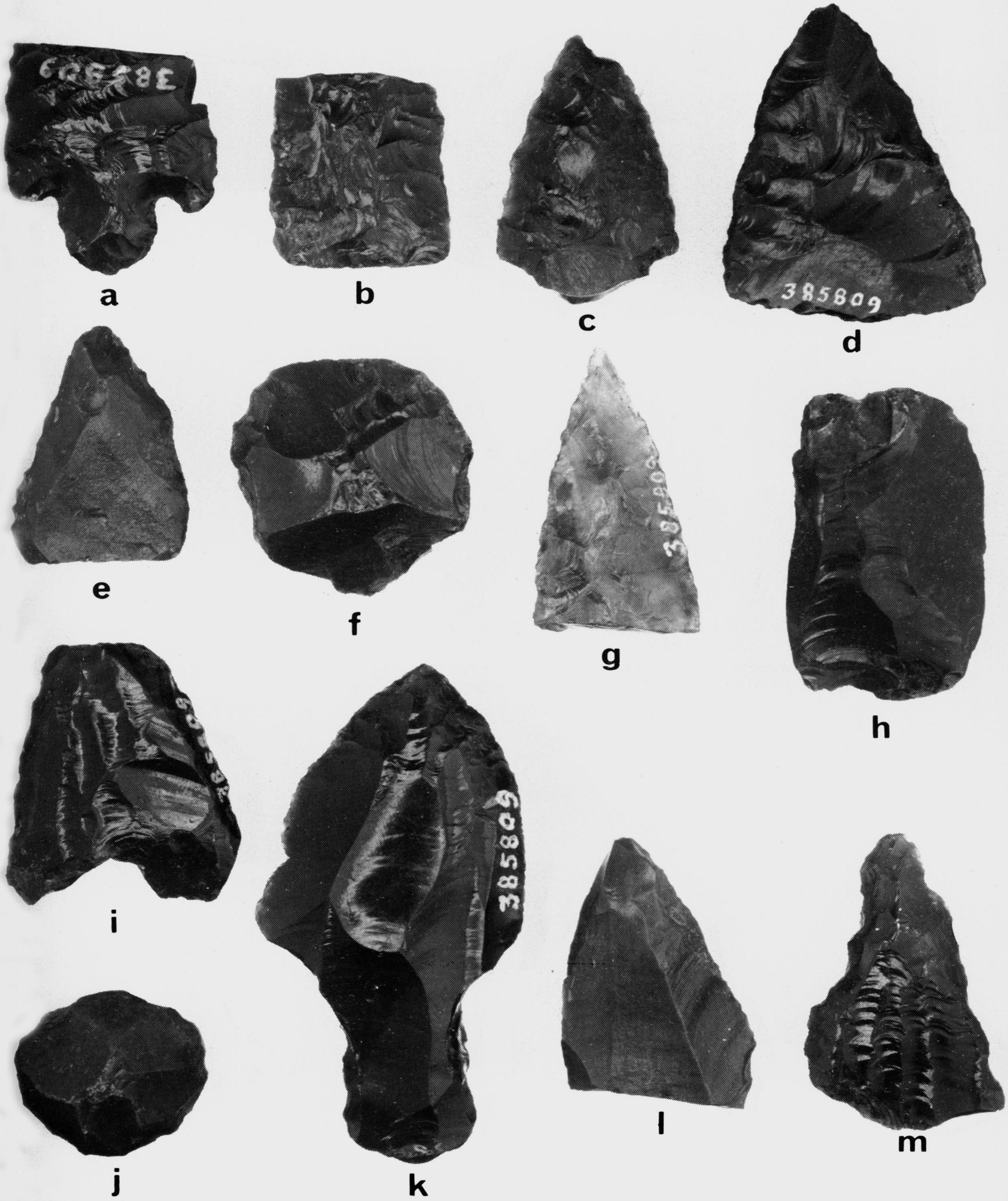


Plate 1. a, projectile point; b-h, miscellaneous bifaces; i-m, miscellaneous unifaces.
(illustrated actual size)

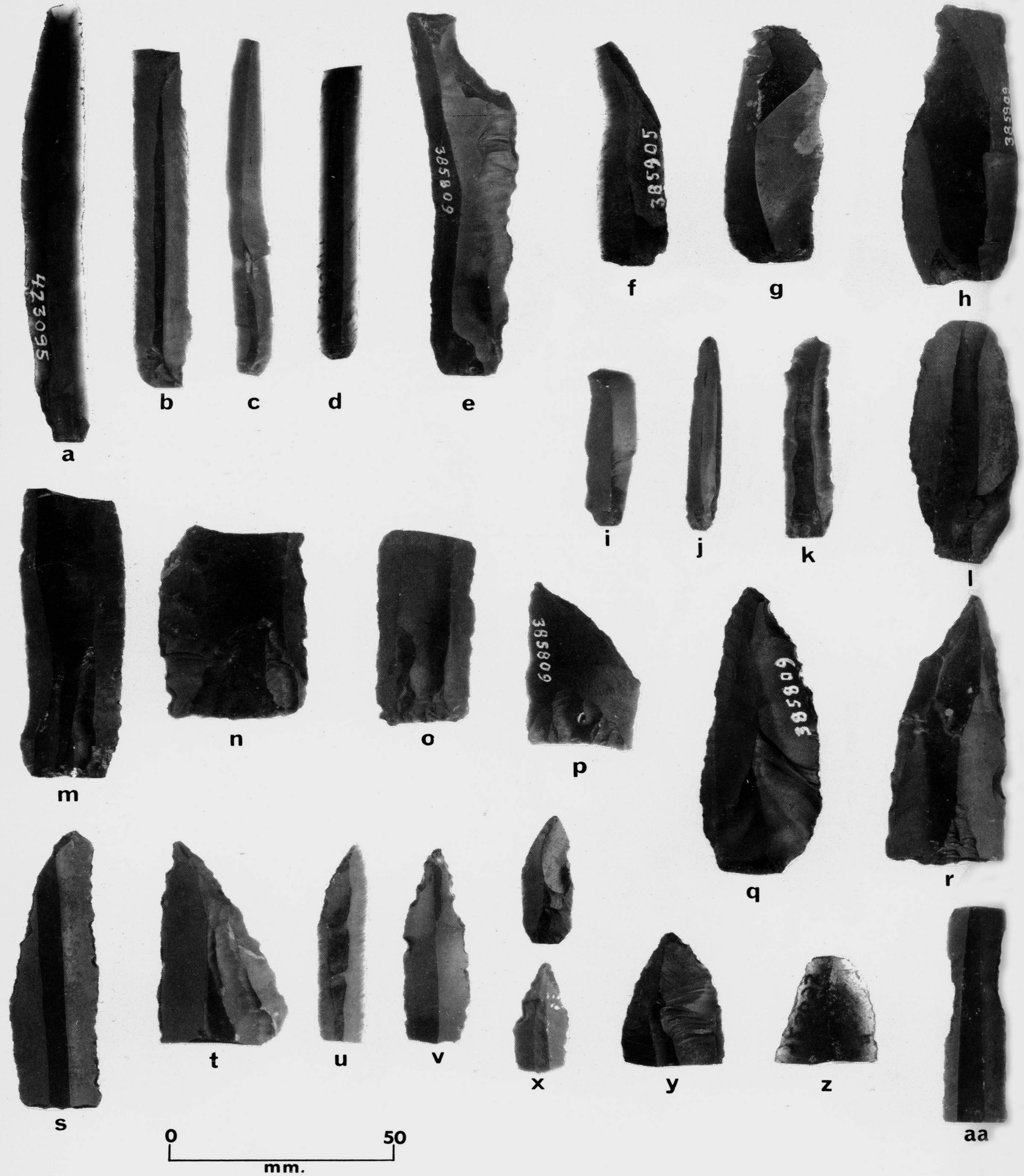


Plate 2. a-l, complete blades (all oriented with bulbs of percussion down); m-p, thinned blades; q-z, trimmed blades (dashes indicate dulling on z); aa, notched blade.

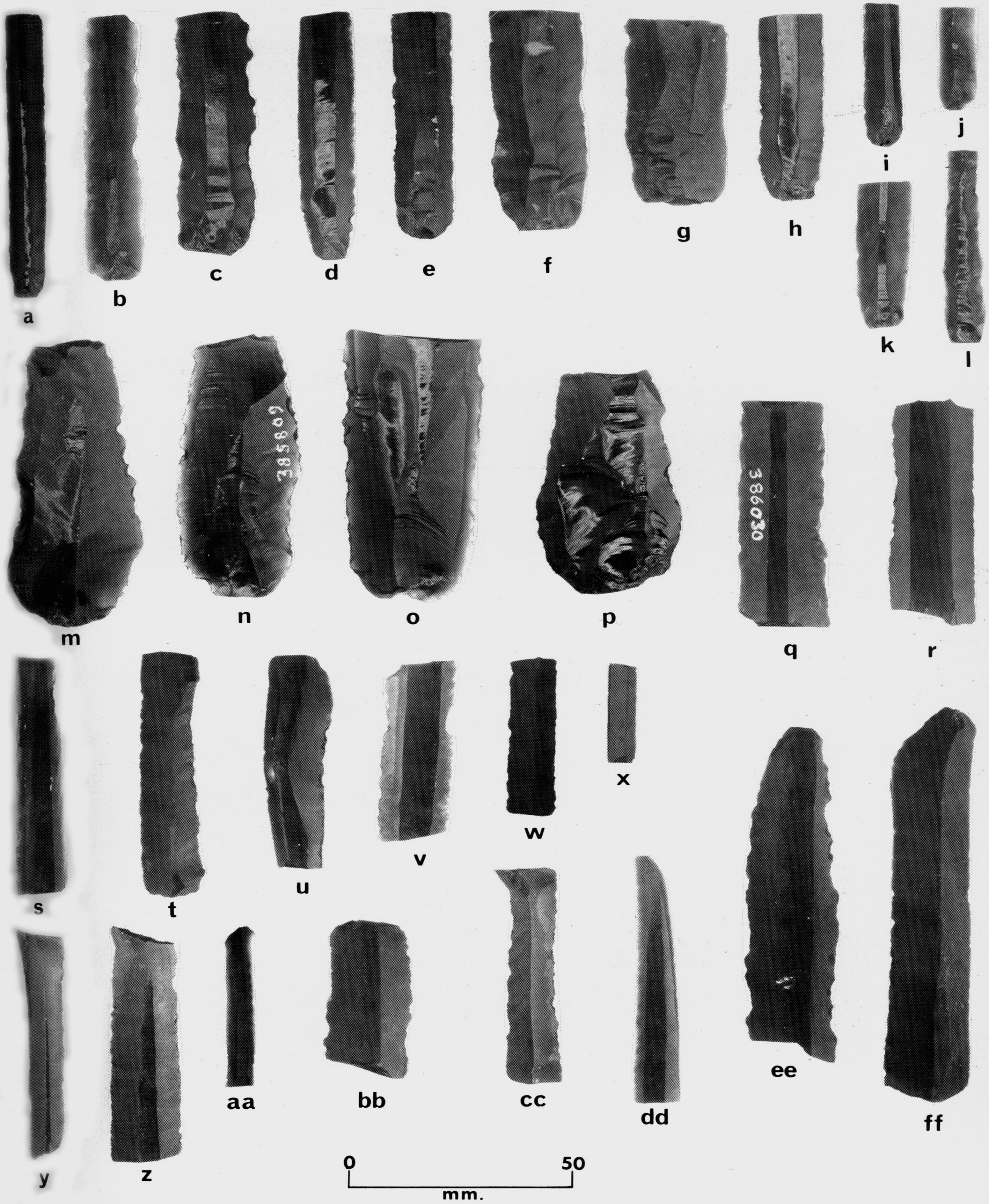


Plate 3. Blade Fragments. a-p, proximal; q-x, medial; y-ff, distal.

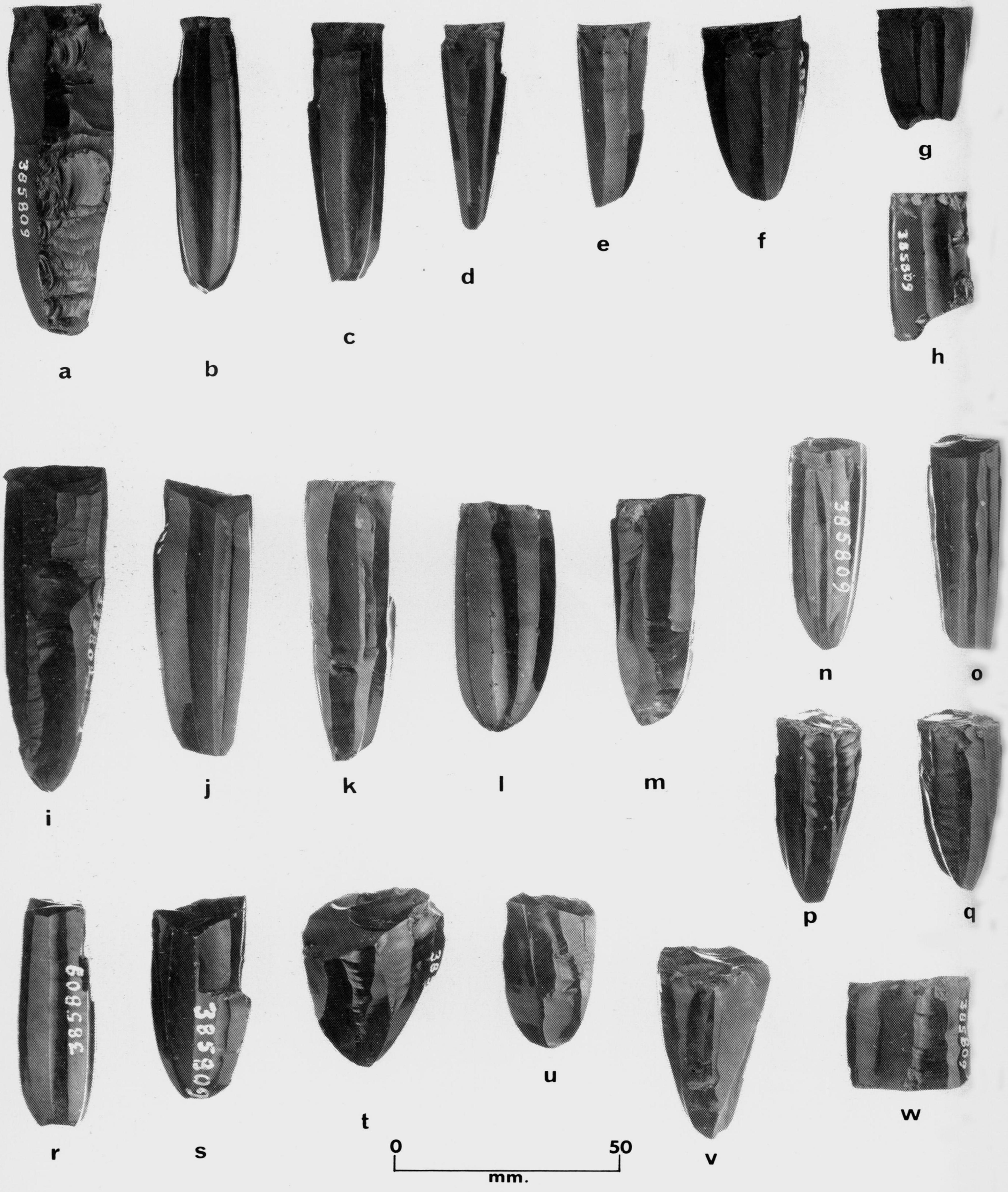
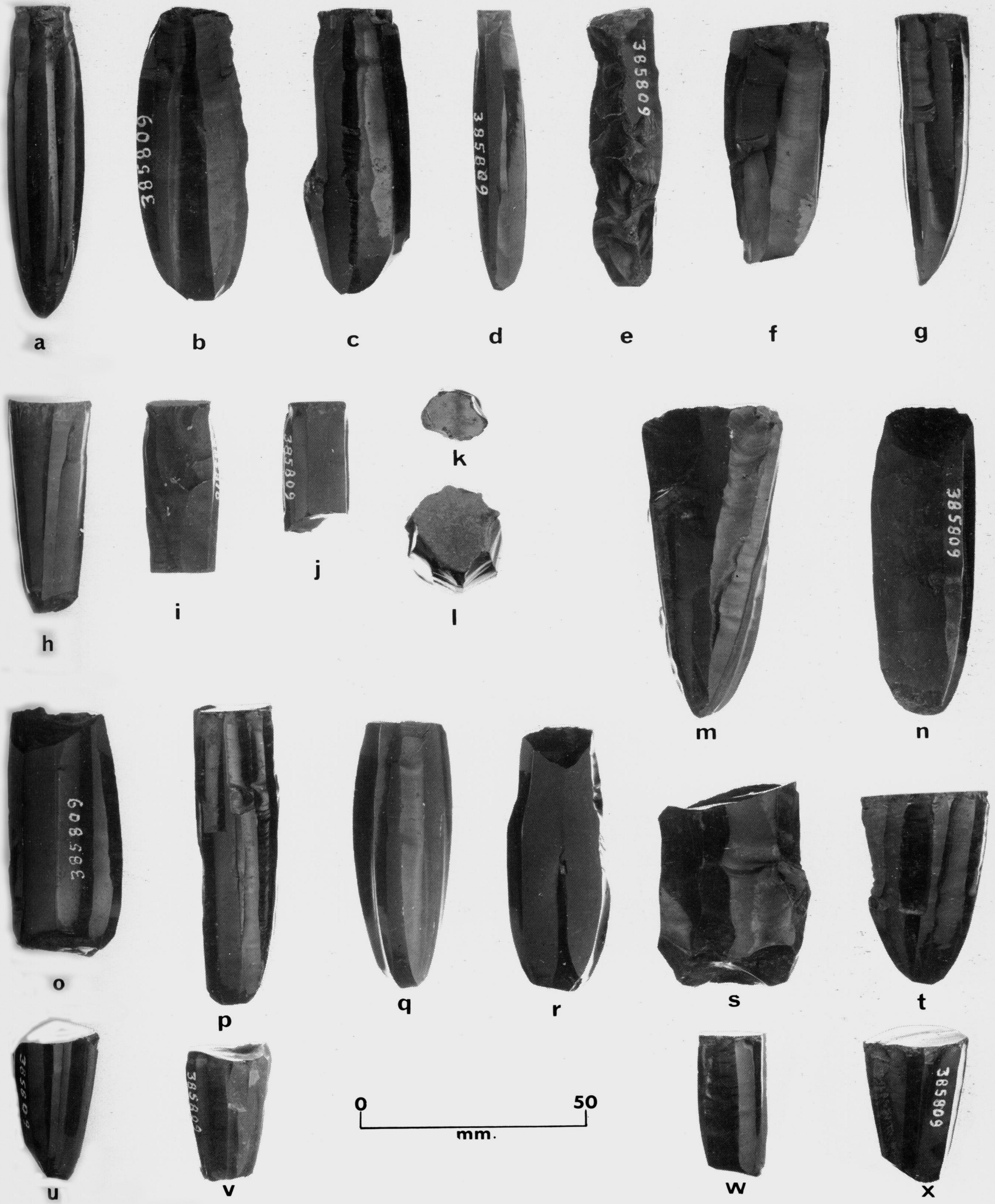


Plate 4. a-j, single facet platform cores; i-w, multifaceted platform cores. Note ridge flake preparation on a.



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

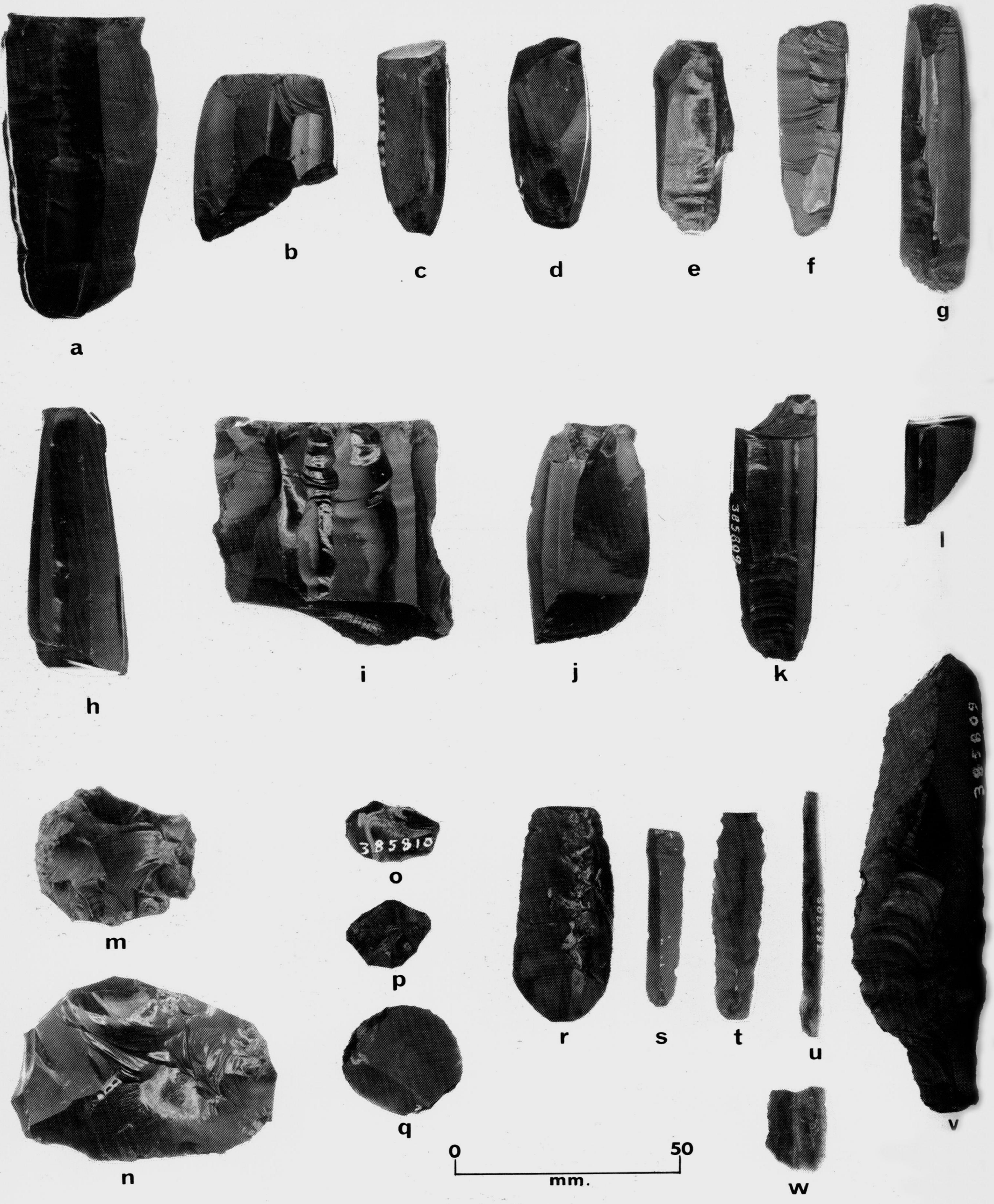


Plate 6. a-d, scratched platform cores; e-g, splintered platform cores; h, distally-truncated core; i-l, core fragments; m-q, core tablets; r-v, ridge flakes; w, transverse modification flake.

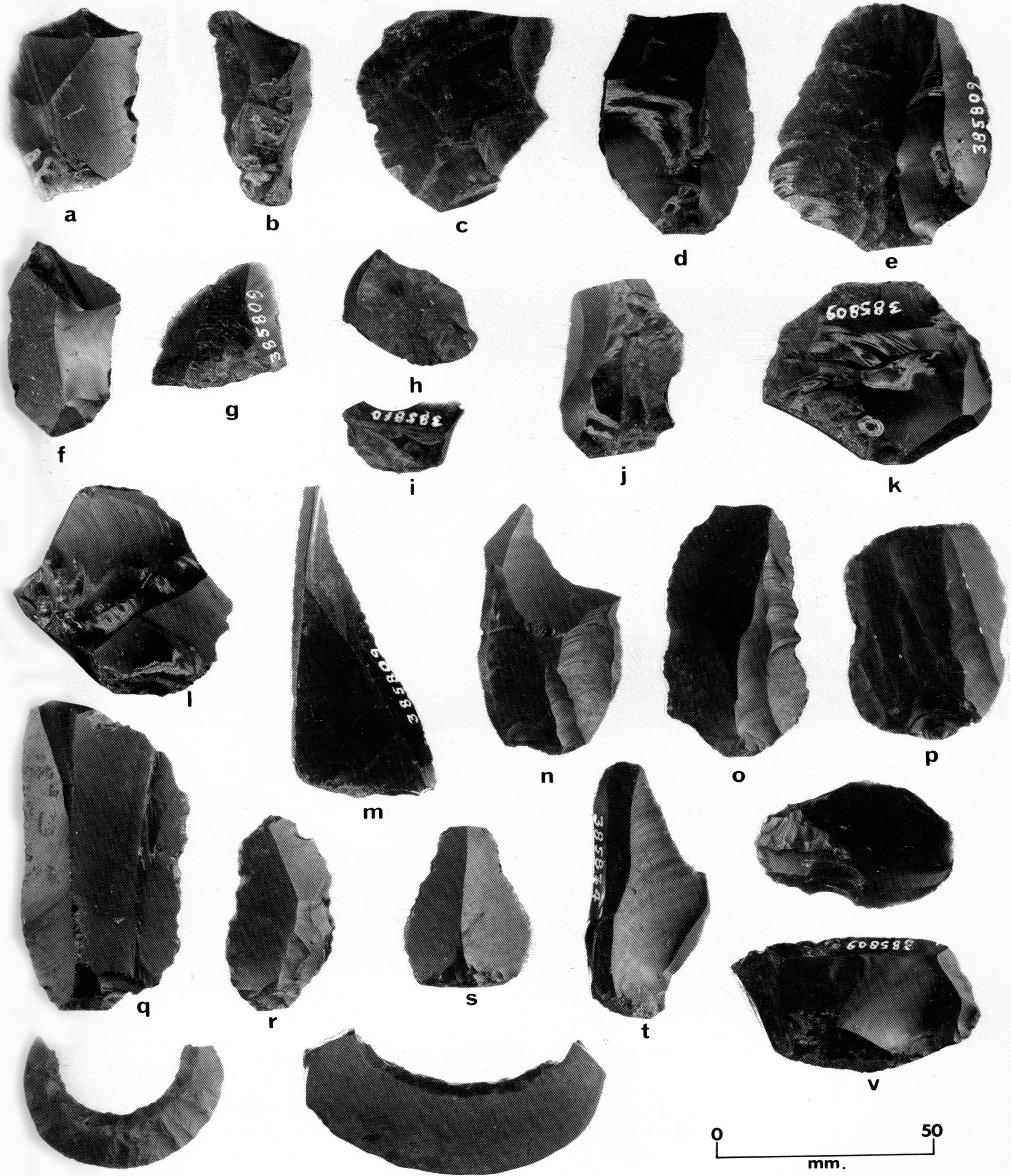


Plate 7. a-l, waste flakes; m-v, retouched flakes; w-x, lunate objects.

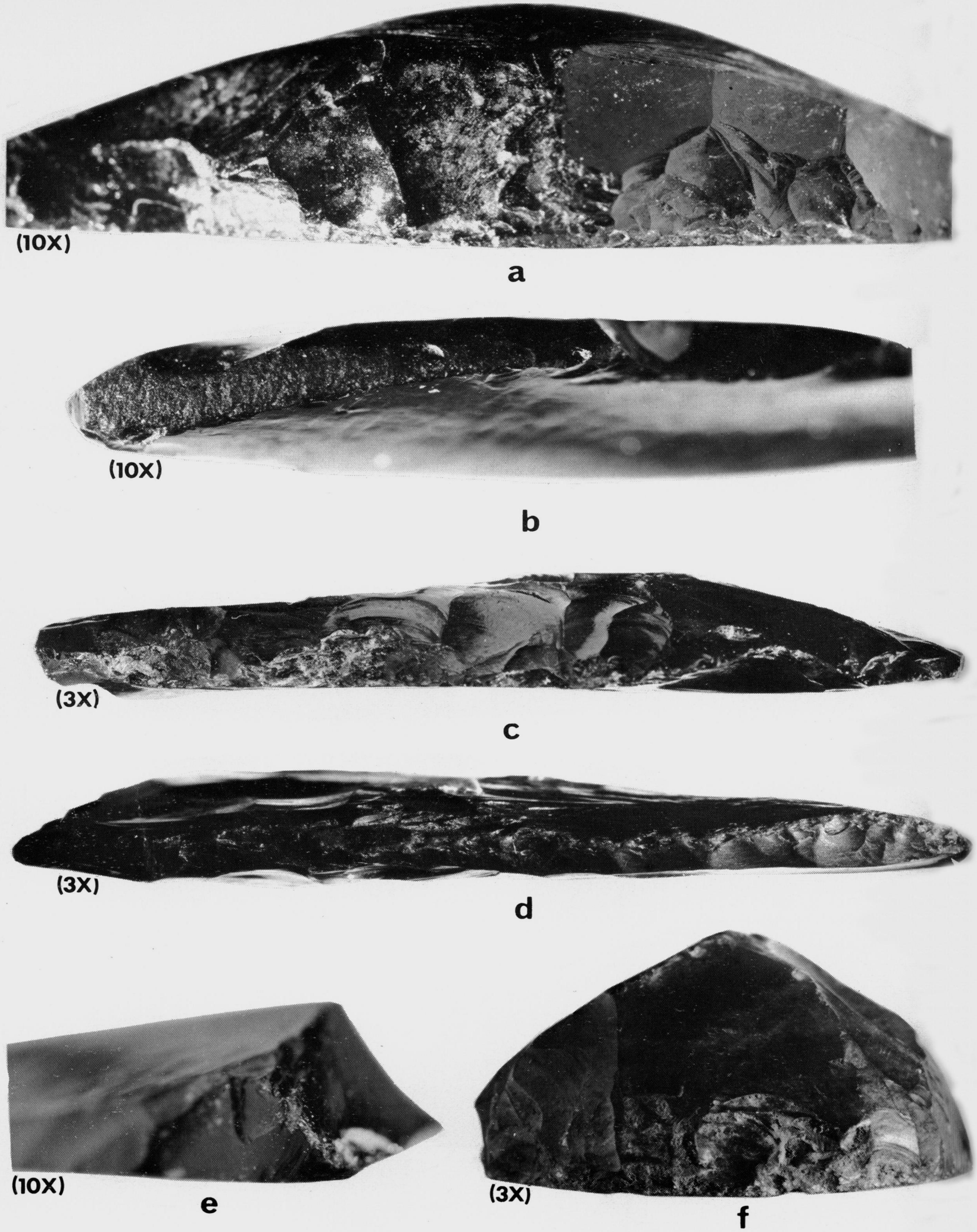


Plate 8. Use-Wear. a,b, and e, enlarged 10 times; c,d,f, enlarged 3 times. a, platform view of scraper rejuvenation flake (see Fig. 2, i); b, dulled blade edge; c, crushing and nibbling on uniface edges (see Pl. 1, m); d, dulling along biface edge (see Pl. 1,d); e, crushing on burin tip (see Fig. 2,h);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

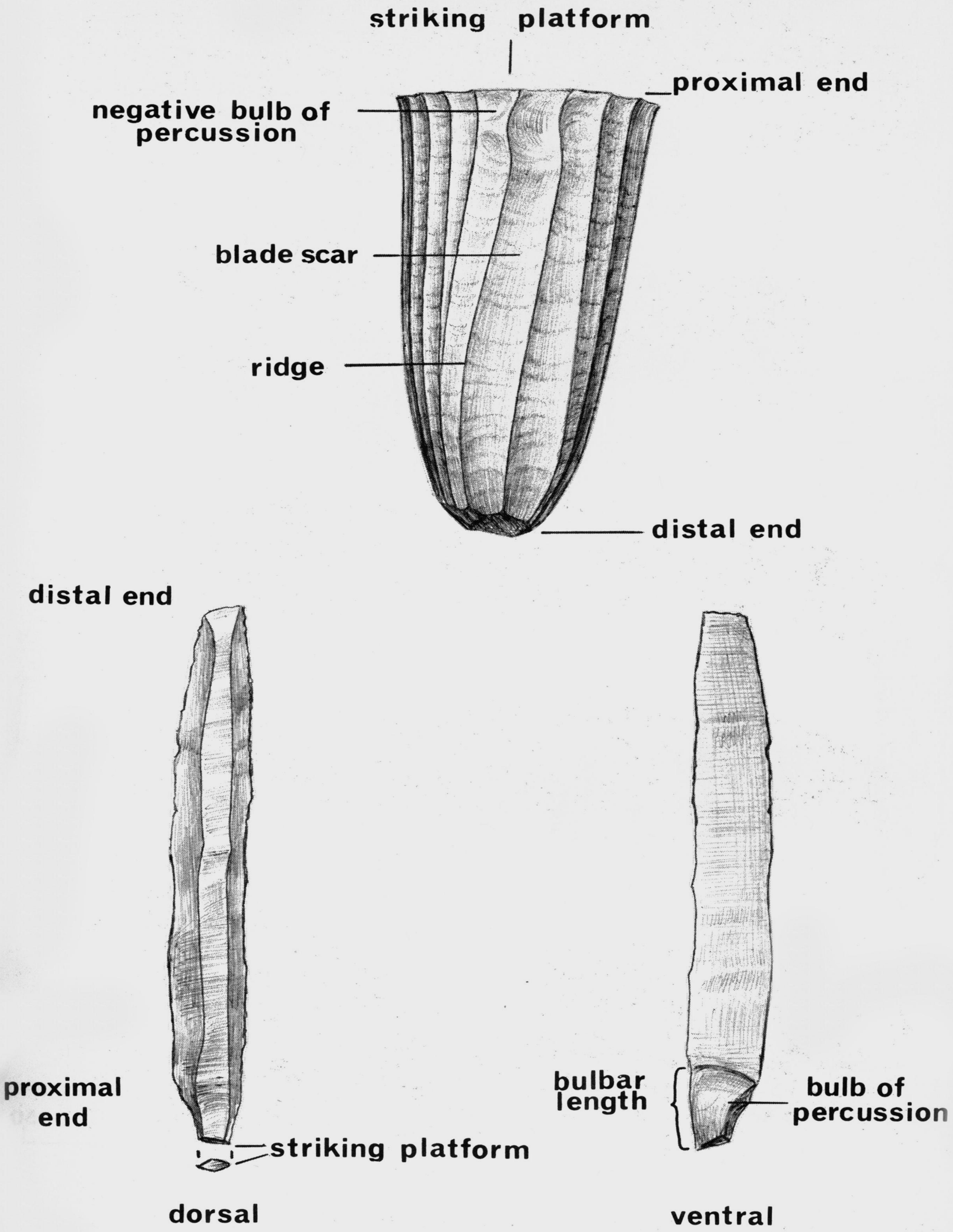


Fig. 1. Upper, Core Terminology;
Lower, Blade Terminology.

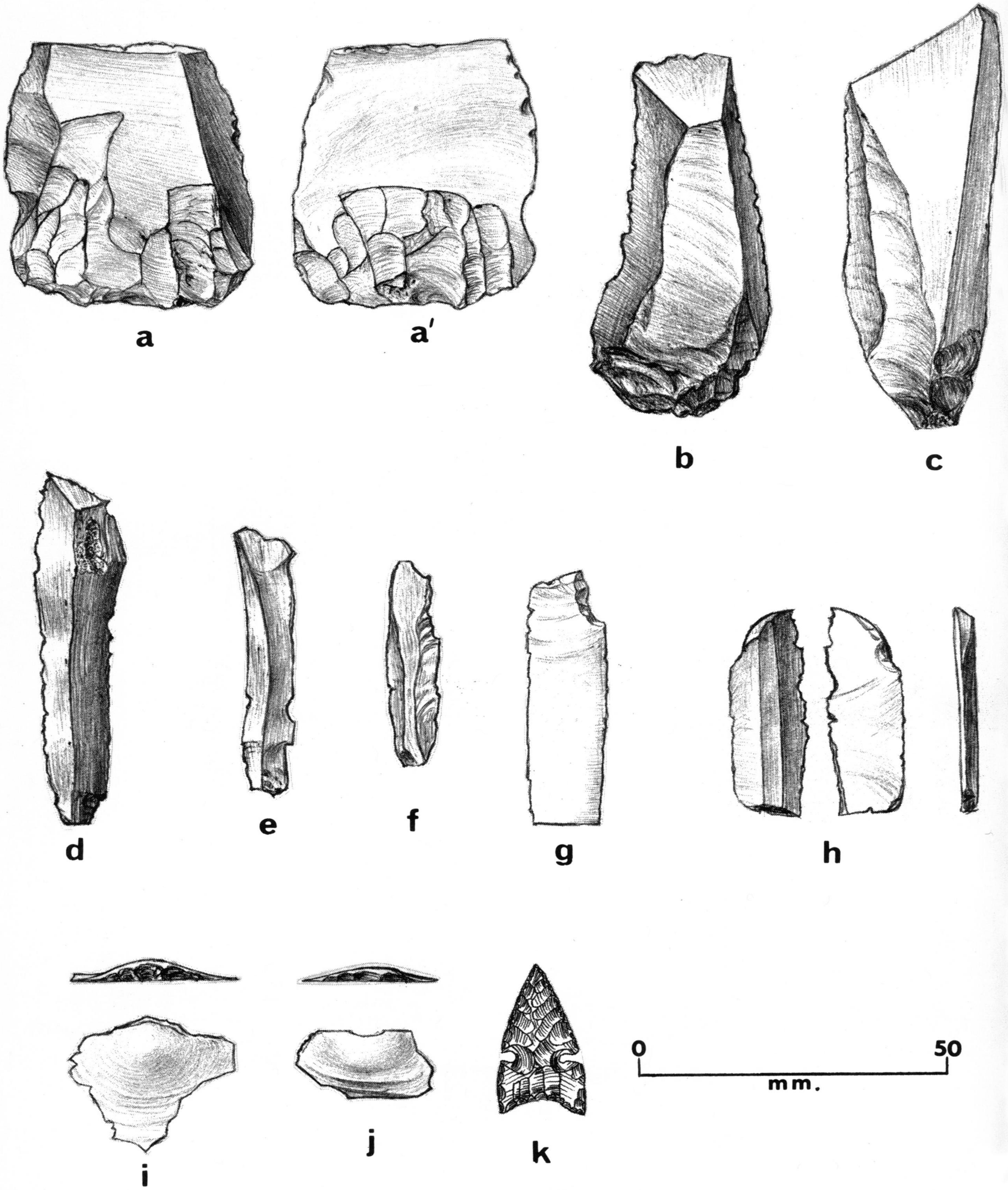


Fig. 2. a, a', thinned blade; b-f, complete blades; g, notched blade; h, burin on blade; i,j, scraper rejuvenation flake; k, side-notched point.

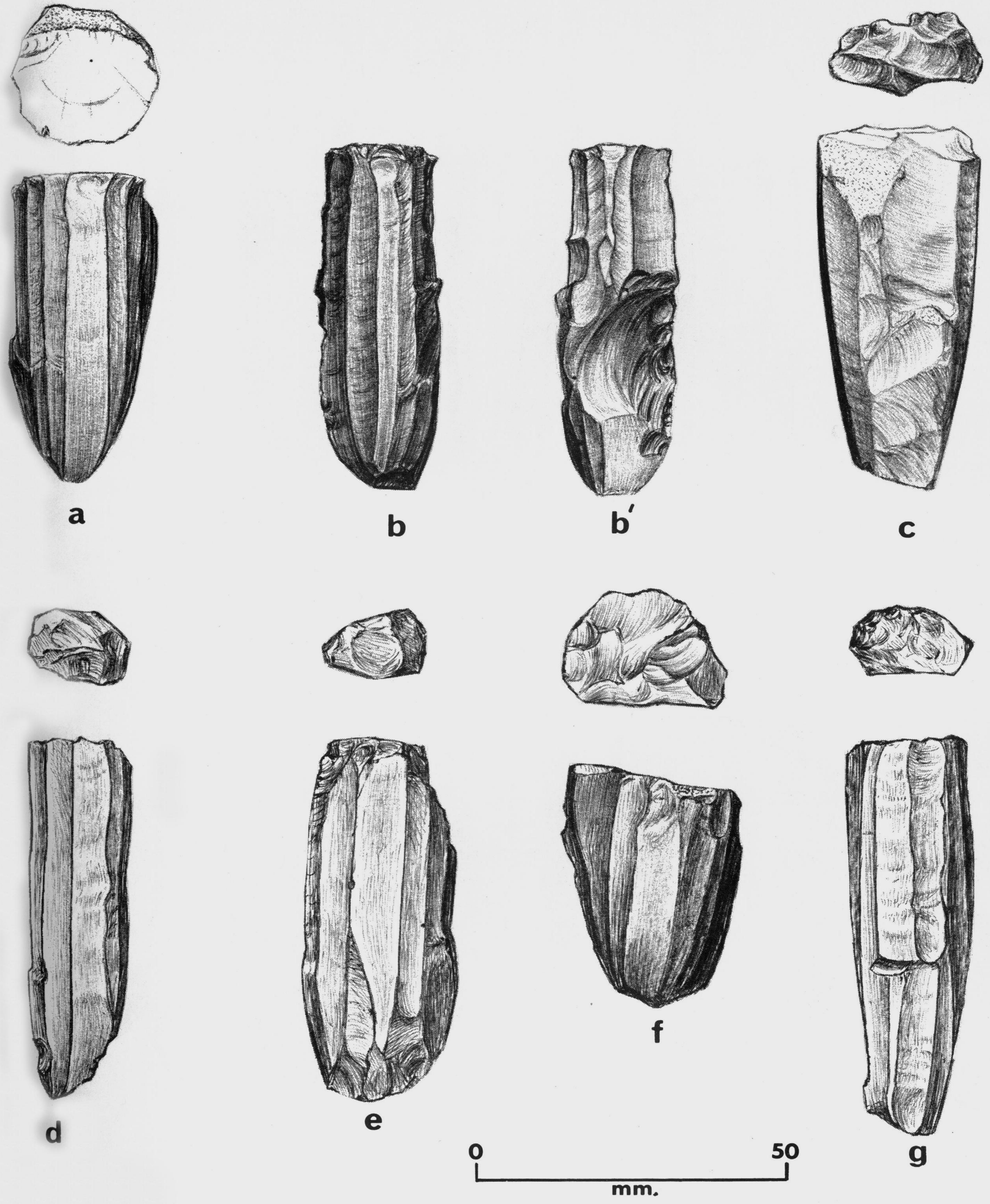


Fig. 3. a, single facet platform core; b–g, multifaceted platform cores. Platform views shown. (a, c–g).

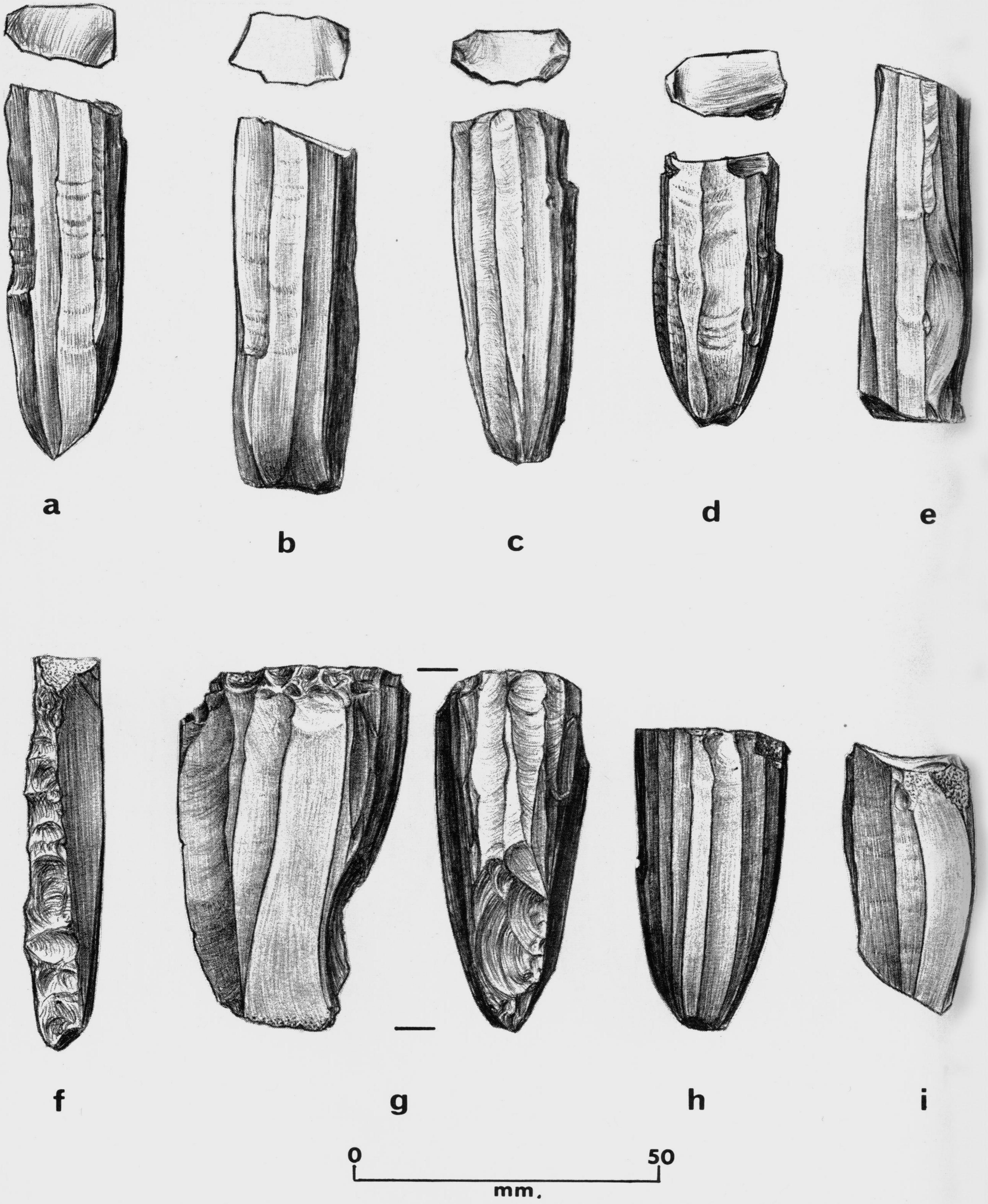


Fig. 4. a-i, proximally-truncated cores; e has been bi-truncated.

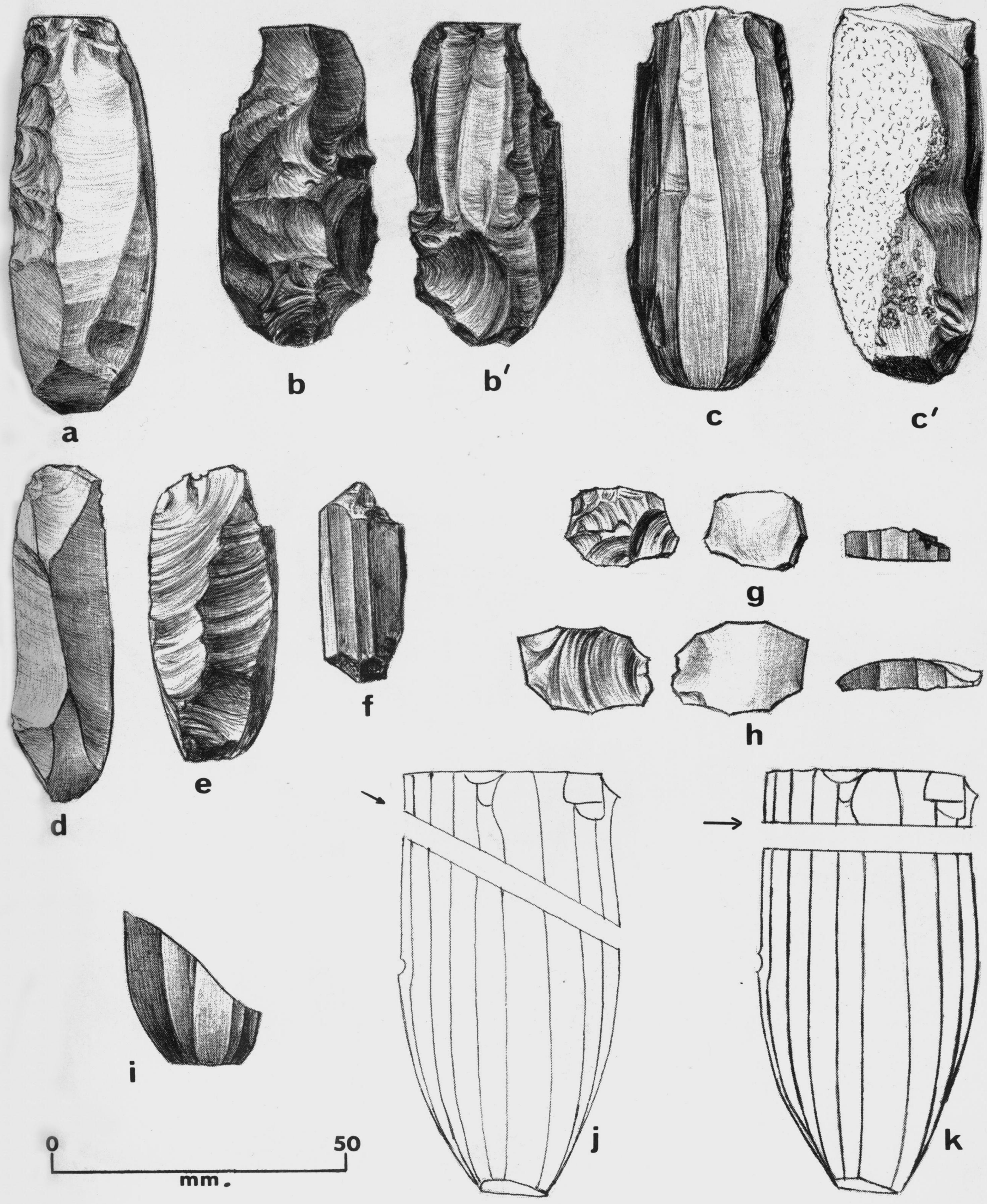


Fig. 5. a-c′, ground platform cores; d-f, cores with splintered platforms; g-i, core tablets; j, k, methods of core truncation.

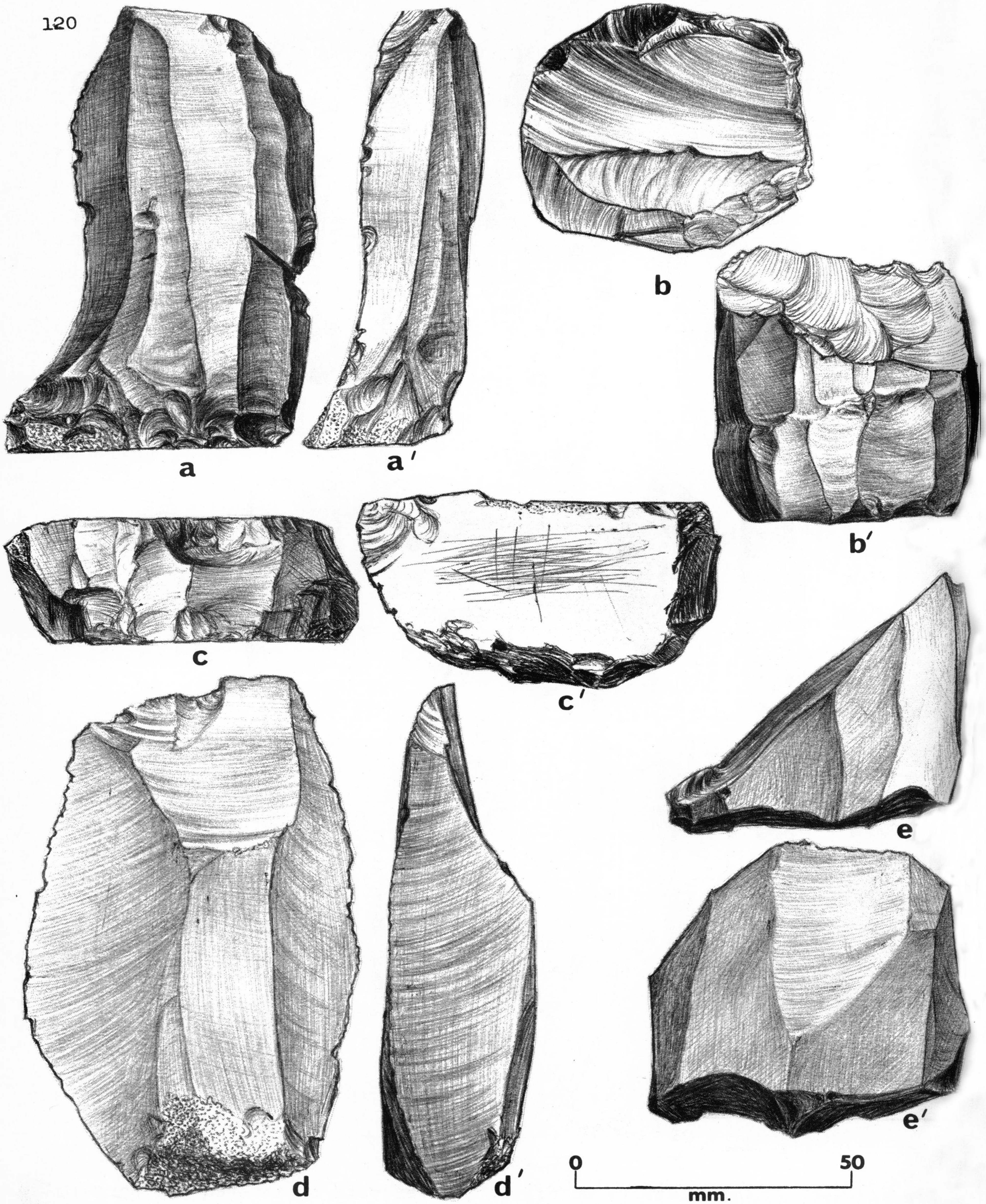


Fig. 6. a,b, core fragments; c, core tablet; d,e′, core modification detritus.

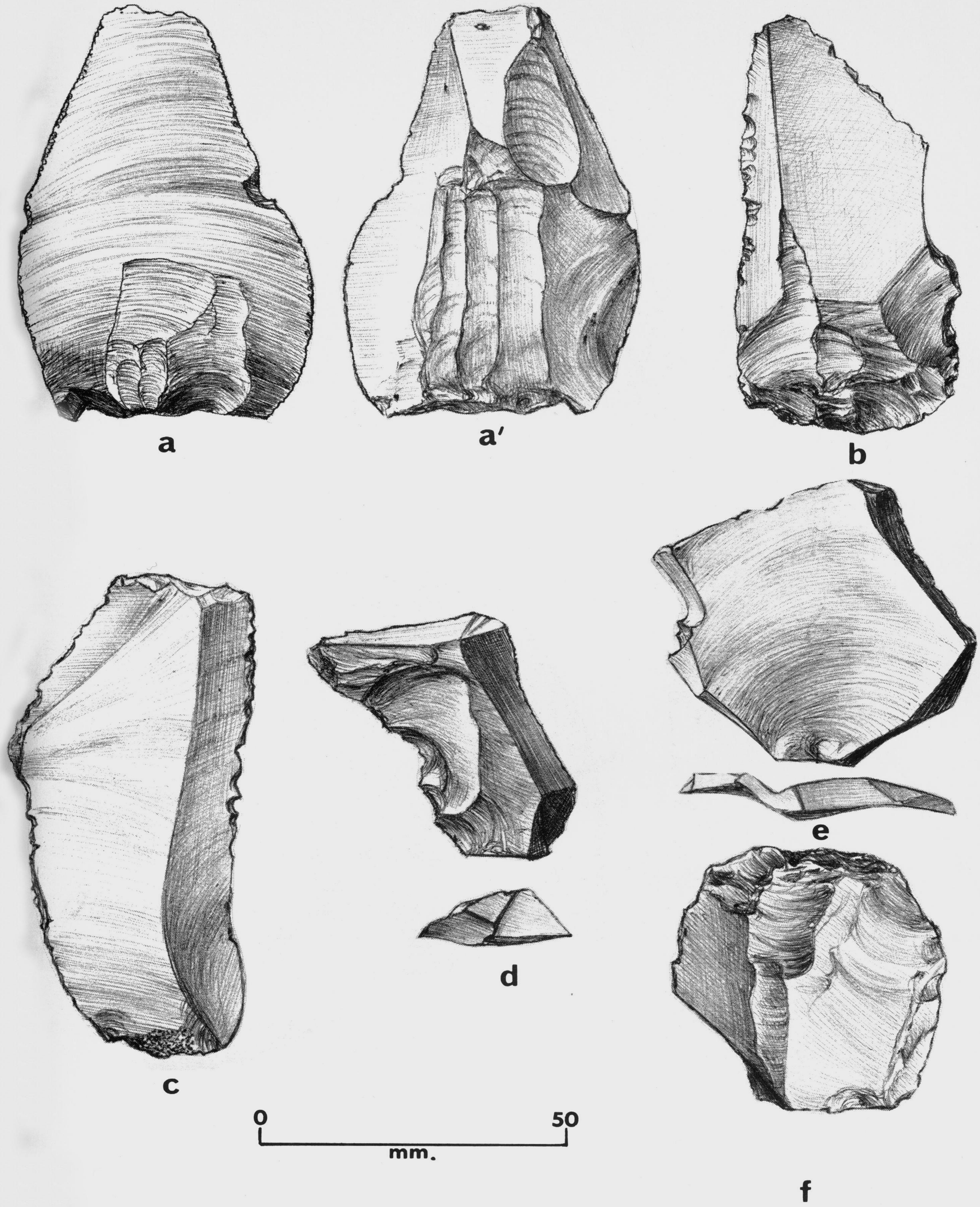


Fig. 7. a-c, retouched flakes; d, flake with single facet platform; e, flake with convergent platform; f, flake with crushed platform.

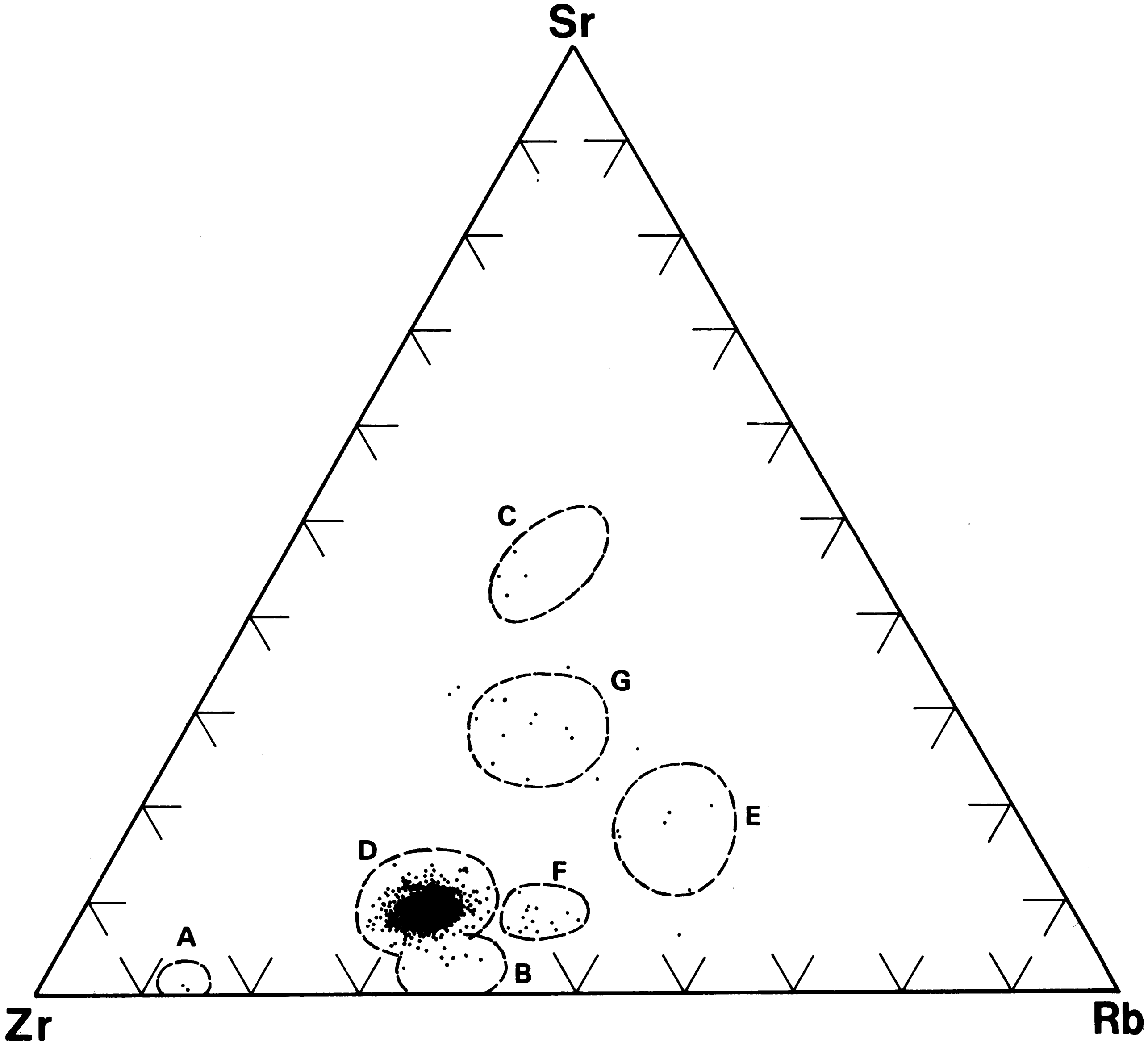


Fig. 8. Tres Zapotes Obsidian Samples.

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

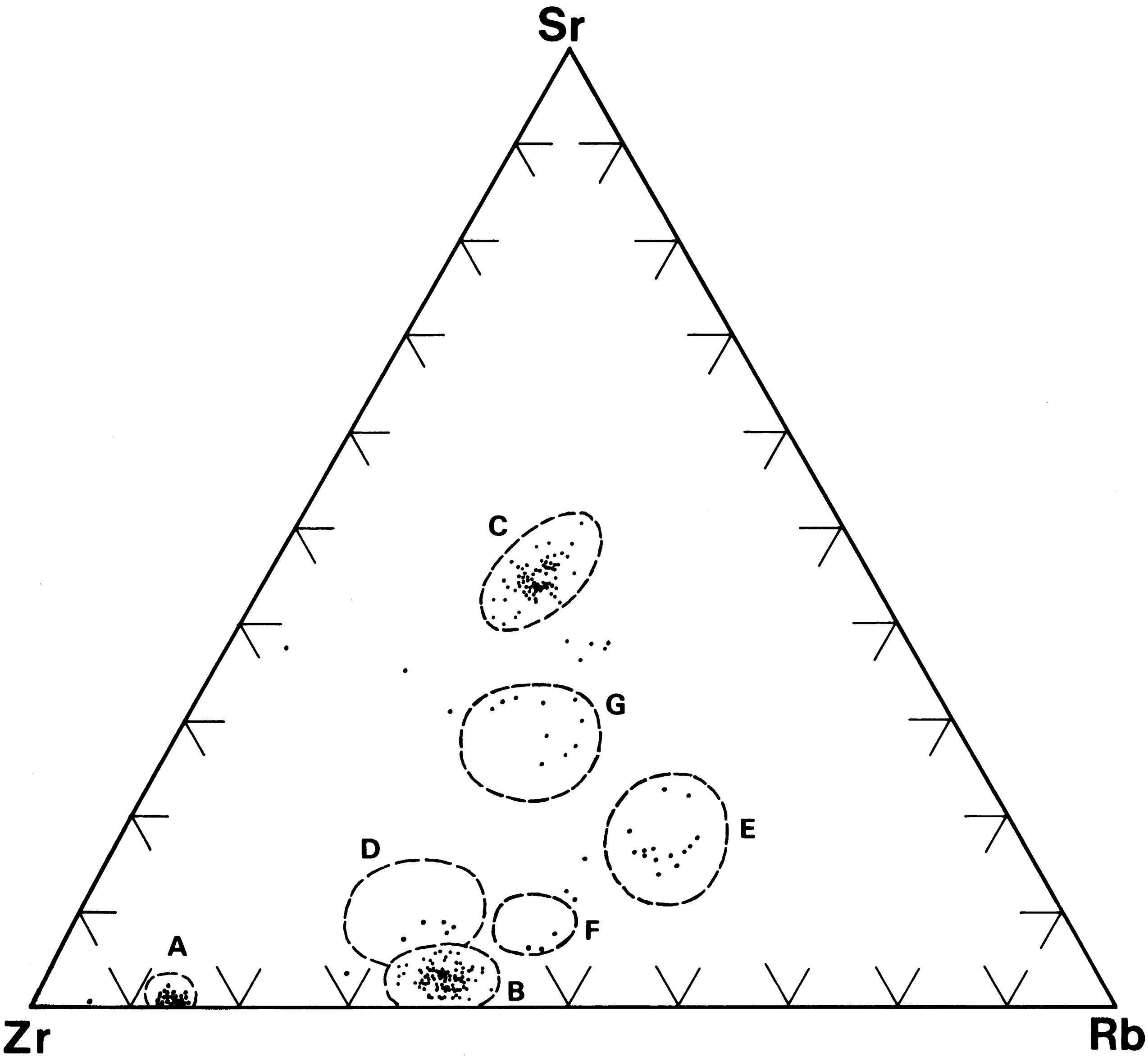


Fig. 9. La Venta Surface Obsidian Samples (combined 1968 and 1970 collections).

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

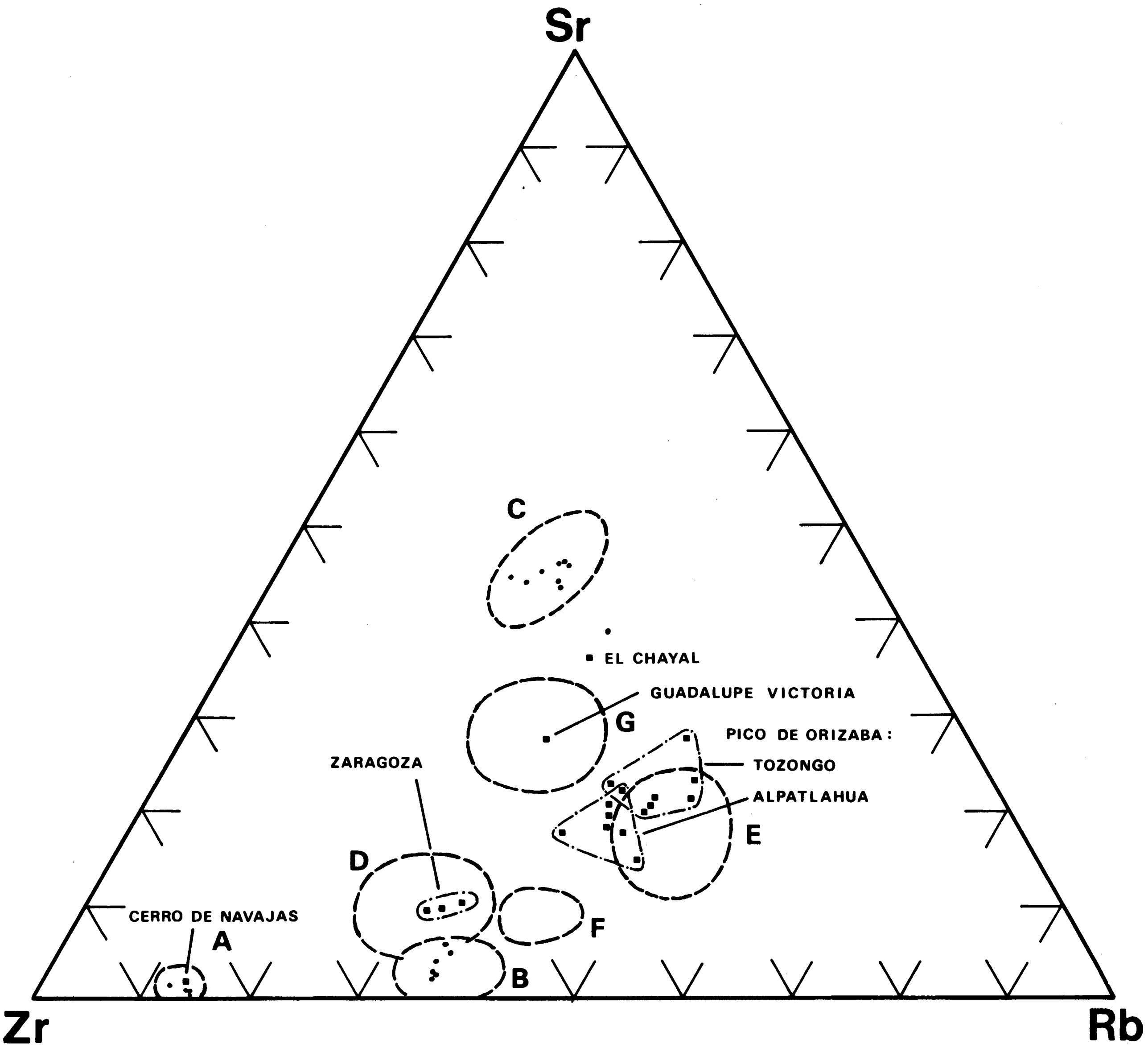


Fig. 10. La Venta Excavated Obsidian Samples and Some Mesoamerican Obsidian Source Types. Dots represent La Venta samples, squares represent source samples.

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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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III. TECHNOLOGY AND GEOLOGIC SOURCES OF OBSIDIAN ARTIFACTS FROM CERRO DE LAS MESAS, VERACRUZ, MEXICO, WITH OBSERVATIONS ON OLMEC TRADE*

Thomas R. Hester, Robert F. Heizer and Robert N. Jack

As a part of the continuing study of Mesoamerican obsidian being conducted at the University of California, Berkeley, we have recently analyzed a small collection of artifacts from the site of Cerro de las Mesas, Veracruz, Mexico. The site is located near the Rio Blanco, south of the city of Veracruz (see map in Stirling, 1941:283). It was partially excavated by a National Geographic Society-Smithsonian Institution expedition in 1941. The major discoveries at the site were briefly published by Stirling (1941); the ceramics, a remarkable jade cache, and other pieces have been described by Drucker (1943, 1952, 1955). From the 1941 excavations, 16 obsidian specimens were collected and are now in the United States National Museum. Unfortunately, this material lacks detailed provenience data. Drucker (1943:5) refers to the occurrence of "prismatic flakes" in the deposits at Cerro de las Mesas; these apparently were not saved or have been lost, as no examples of this artifact form are in the collection.

Technological Analysis

Of the 16 specimens in the collection, 14 are polyhedral blade cores, one is a large worked blade and the last is an unmodified waste flake.

Cores. These specimens have been sorted according to categories established by Hester, Jack and Heizer (1971) in their study of Tres Zapotes obsidian cores. The Cerro de las Mesas cores are only briefly described here, since they conform closely to those described from Tres Zapotes.

Ten cores have ground striking platforms. Three of these specimens are wedge-shaped and show crushing on the distal end; perhaps they were held in a vise or rested on an anvil while being worked (cf. Crabtree 1968: 453). Hinge fracturing of blades appears to have caused the discard of most of the cores. Since so few data are available on ground platform cores in Mesoamerica, dimensions of each piece are given below:

Length	Maximum Width	Platform Diameters: Maximum	Platform Diameters: Minimum
85	20	12	12
81	33	33	14
71	26	25	7
66	25	22	20
64	12	6	6
61	20	18	11
56	19	18	10
55	16	15	10
50	18	18	9

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

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* We would like to thank Dr. Clifford Evans of the U.S. National Museum for arranging the loan of the Cerro de las Mesas obsidian collection.

Two cores have truncated platforms. One is cylindrical and is truncated both proximally and distally, with no subsequent blade removals using the newly created platforms; length, 53 mm., maximum width, 13 mm. The second specimen has been proximally-truncated, but again no blades were removed; the piece has been heavily battered. Length, 61 mm., maximum width, 25 mm.

One specimen is a distal fragment of a blade core; the fracture was possibly caused by a large pumice inclusion near the center of the piece. The final specimen is a battered core. Heavy battering is present both proximally and distally, and along the sides. The piece probably saw secondary use of a hammerstone.

Large Worked Blade. The specimen is a very large blade showing bifacial modification. The dorsal surface has two median ridges, and has been extensively flaked near the distal tip. There is a 50 mm. area of rough dulling along one edge of the tip, possibly resulting from the use of the piece as a knife (cf. Semenov 1964; Hester 1970). Irregular retouch or trimming is found along most of both lateral edges on the dorsal face. A patch of nodular cortex is retained on this face.

On the ventral (bulbar) face, there is irregular trimming along both lateral edges. The proximal end (base) of the piece has been thinned by the removal of six narrow longitudinal flakes. This technique is very similar to that found on thinned blades reported from Tres Zapotes (Hester, Jack and Heizer, 1971).

This large blade was no doubt removed very early in the core-blade process, when a large, roughed-out blade core was being worked (cf. Graham and Heizer 1968:104; Hester, ms.). Similar large specimens found at the site of Papalhuapa, Guatemala, were blanks later modified into bifacial tools. (Graham and Heizer 1968, Pl. 3).

Length of the piece is 172 mm., maximum width, 64 mm., and maximum thickness, 24 mm.

Unmodified Waste Flake. This is an irregularly shaped flake, with a simple prepared striking platform.

X-Ray Fluorescence Analysis

The 16 obsidian artifacts from Cerro de las Mesas, Veracruz, Mexico, have been analyzed for the trace elements Rb, Sr, Y, Zr, and Nb by semi-quantitative (rapid-scan) X-ray flourescence technique (see Hester, Jack and Heizer 1971). Based upon these analyses the source of the obsidian from which each artifact was manufactured has been identified. The three sources, all in east-central Mexico, are (1) Zaragoza, Puebla; (2) Pico de Orizaba, Veracruz; and, (3) Guadalupe Victoria, Puebla (types D, E, and G, respectively, of Hester, Jack and Heizer 1971). The results are tabulated here:

Sample No.	Obsidian Sources: Type D	Type E	Type G	Artifacts
1		X		core
2	X			"
3		X		"
4		X		"
5		X		"
6		X		"
7		X		"
8		X		"
9		X		"
10	X			"
11		X		"
12		X		"
13		X		"
14		X		"
15			X	flake
16	X			large blade
Totals	3	12	1	

Table 2. Cerro de las Mesas obsidian artifact sources.

Based on the small artifact sample analyzed here, we can postulate that the major obsidian source for the site of Cerro de las Mesas was the Pico de Orizaba locality in Veracruz (type E). The obsidian industry at the site, as reflected by this sample, is technologically similar to others reported from the area (cf. Hester, Jack and Heizer 1971).

Our data from sites in the Tabasco and Veracruz lowlands suggest an emerging pattern in which the obsidian industries at major sites are dominated by materials from one particular obsidian source. The major source for Cerro de las Mesas is Pico de Orizaba, for Tres Zapotes, it is Zaragoza, Puebla (Hester, Jack and Heizer 1971), for San Lorenzo, it is Guadalupe Victoria, Puebla (Cobean et al 1971), and at La Venta, it is two yet-unknown localities (Hester, Jack and Heizer 1971). These three sites all have substantial Olmec occupation; Cerro de las Mesas is, of course, not an Olmec site.

A great deal has been written about trade in commodities and luxury goods in Mesoamerica in Preclassic times. Most of this writing has been speculative for the simple reason that practically nothing is known about what items were being transmitted from a specific area to another at known points in time. Thus, to speak of a "Jade Route" protected by garrisons of Olmec troops is premature when we do not know where the jade source or sourcs lay, or what the direction of trade was. Discussions of "trade networks", "Olmec pochteca," and "Olmec missionary-trade colony groups" all seem to be based on the Postclassic Aztec model, an extrapolation which has been critically reviewed by Parsons and Price (1971).

At the same time there is no question that the Olmecs of the Gulf lowland area, and particularly those who built and used the La Venta center, either travelled widely or were in contact with people who did so. The green serpentine, schist, jade and magnetite-ilmenite which have been recovered in some cases in considerable quantities from La Venta point to large-scale procurement from the Paleozoic metomorphic zone of the Sierra Madre del Sur in Oaxaca and/or Chiapas lying about 100 miles south of La Venta (see Williams and Heizer 1965: Map 3). The specific spots where these materials were secured have not been looked for, but it is highly probable that the area indicated will prove to be the source region. The La Union Quaternary volcanic area just south of Teapa was a source for the rocks used for metates and manos at La Venta,.as well as for some of its sculptures (Williams and Heizer 1965: 8-9). The Cerro Cintepec, just southeast of Lake Catemaco in the Tuxtla Mountains, provided boulders from which many of the San Lorenzo site sculptures and most of the La Venta sculptures were fashioned (Ibid; Map 2, passim). Thus, an arc drawn 100 to 150 miles around the La Venta pivot probably will prove to have produced most if not all of the varieties of stone used at La Venta. Whether this zone also contains the still unlocated obsidian sources from which the La Venta people secured the bulk of their obsidian we do not know, but we expect that it was. La Venta trade, therefore, whether or not it may have involved "networks", "pochteca" or "ports of trade", seems to have been a pretty provincial matter as far as we can now tell. The La Venta population may have managed all of this prospecting, mining and transport by themselves, so that long-walking professional traders and distributive markets were not needed.

Elsewhere in the lowland Olmec area there are hints that a similar regionalism obtained if we judge by Cerro Cintepec as the main source of the stone from which the monuments at Laguna de los Cerros were made. Tres Zapotes drew on the nearby El Vigia for most of its large stone, but Stela C from that site which is made of the Cerro Cintepec rock provides an intriguing hint that the now missing portion(s) of this interesting sculpture may be found someday in one of the more easterly lowland Olmec sites (Heizer and Williams 1965:16). The implication of this particular sculpture, as well as the La Venta duplicate of the sculpture found by Blom and La Farge on the summit of San Martin Pajapan volcano (Clewlow 1970), is that there may also have been trade in monuments between Olmec centers.

With reference to obsidian we are not yet in a position to suggest very much as regards its function in Olmec trade. The main La Venta geologic sources (Types B and C) have not been located. The green obsidian from Pachuca (Cerro de Navajas), Hidalgo, produced about one-eighth (12.3%) of the 295 La Venta artifacts analyzed, and in decreasing order are artifacts made of obsidian from Pico de Orizaba (5.1%), Guadalupe Victoria (3.6%) and Zaragoza(1.8%).

At San Lorenzo if we take the total analyzed sample of 201 pieces and ignore time, 30.8% derive from the Guadalupe Victoria source, 19.3% are from Guatemala (El Chayal and Ixtepeque deposits), 6.5% from Pachuca, and 1% from Pico de Orizaba (see Table 3), 22.3% of San Lorenzo obsidian artifacts derive from sources not identifiable by Cobean _et al_ (1971).

When La Venta and San Lorenzo obsidians are compared we see that the people of each site placed main dependence upon different primary sources, and only a very small amount of Guadelupe Victoria obsidian which was the chief source of artifacts at San Lorenzo is present at La Venta. The main La Venta sources (Types B and C, comprising 43.5% and 27.5% of the total sample from the site) are unrepresented at San Lorenzo.

We have preliminary indications that La Venta Type C obsidian is derived from a Guatemalan source, perhaps that of San Martin Jilotepeque, Depto. Chimaltenango. However, no definitive statements can be made prior to further analyses. If this should prove to be the case, it would not be surprising since San Lorenzo drew 193% of its obsidian from the Guatemalan area. In view of the partial contemporaneity of the San Lorenzo and La Venta site occupations (Berger, Graham and Heizer, 1967; Coe 1970) their relative nearness (about 50 miles), the sharing of certain nearly-identical kinds of monumental sculpture (table-top altars and colossal heads), and the mutual use of Cerro Cintepec stone for large sculptures, it is most surprising to find the two sites did not secure obsidian from the same sources by means of what was almost certainly exchange rather than direct procurement.

Tres Zapotes obsidian was derived for the most part (93.1%) from the Zaragoza source. This type of obsidian is barely present (1.8%) at La Venta, and unreported for San Lorenzo. While much of the Tres Zapotes obsidian must be later than Olmec (La Venta-San Lorenzo periods), nevertheless it is practically certain that the Olmec population of Tres Zapotes got their obsidian from Zaragoza. So we have a third example of site-obsidian source correlation for Olmecs.

We believe that the apparent exclusiveness of these several populations as regards the main kind of obsidian each one used would tell us a lot about how lowland southeastern Mexican Olmec culture operated, but we cannot interpret its meaning at this time. Several possible interpretations can be suggested:

1. Tres Zapotes Olmecs, La Venta Olmecs and San Lorenzo Olmecs were population-territorial units across whose borders there was little or no trade in industrial materials such as obsidian.

2. Tres Zapotes, La Venta and San Lorenzo are non-contemporary sites and the occupants of each of these sites had extra-territorial trade relationships with different peoples who were in a position to supply obsidian in quantity from supply sources each controlled.

3. Tres Zapotes, La Venta and San Lorenzo were, as generally believed, essentially coeval, and the Olmec occupants of each site preferred one type of obsidian to the practical exclusion of any other. In these terms the small amounts of non-preferred obsidian types represented at each site merely indicate inter-city exchange of an industrial material which was rated as of inferior quality, or at least of some non-preferred sort as judged by whatever standards prevailed at the time.

The three possibilities set forth above do not cover all of the possible explanations for the somewhat surprising (at least to us) distributions shown in Table 3, but of these three we are inclined to accept the first as the most probable. Before anything can be settled as far as Olmec trade in obsidian two things are needed: 1), the unknown sources of artifacts from La Venta, San Lorenzo and Tres Zapotes should be discovered and analyzed, and; 2), obsidian from an additional major lowland Olmec site such as Laguna de Los Cerros should be analyzed. With such a body of information the pattern of obsidian trade which now is difficult to reconstruct should become reasonably clear.

The trans-lowland trade routes of Aztec times running from the Basin of Mexico southeasterly through Tochtepec and across the Veracruz-Tabasco lowland area via Coatzacoalcos, Cimatan, Potanchan and Xicalango where the choice of route was offered between the land-river route across southern Yucatan and the Peten via Tayasol, Nito and Naco, or the circum-Yucatan coastal sea route (Chapman 1957; Cardos 1959; West, Psuty and Thom 1969: Fig. 32) scarcely seem to fit even what little we know of Olmec trade. By this statement we mean to say that main trade routes from the altiplano or the upper Veracruz area are not suggested by the distribution of obsidian types in Olmec sites. Obsidian exchange does not seem to have followed a diffusion route which cut across the lowland Olmec districts whose "capitals" were at Tres Zapotes, Laguna de los Cerros and La Venta,* and none of these large sites seems strategically located in such a way as to control trade traffic.

This is not to say that in Middle Preclassic times there was no long-distance trade in which the La Venta and San Lorenzo Olmec participated because the green Pachuca obsidian and Guatemalan highland obsidian was reaching these sites. But how important obsidian was as an exchange commodity, and whether it was an incidental item or principal substance in trade, we really do not know. Until we can answer such questions we might make more solid advances by speculating less about pochteca-like professional traders, ports of trade, sumptuary goods, and the like, because there is always a possibility that someone will take such hypothesizing seriously.

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* Drucker (1961:70) suggests the possibility that "communications difficulties of the day may have limited the efficient exercise of authority" and for this reason the major Olmec sites are spaced at fairly equal intervals--proceeding from west to east, Tres Zapotes and Laguna de los Cerros are 33 km. apart; Laguna de los Cerros and San Lorenzo are 40 km. apart; La Venta and San Lorenzo are 55 km. apart measured in airline distances.

	Tres Zapotes	San Lorenzo	LaVenta	Cerro de las Mesas
No. specimens analyzed	865	201	295	16
Pachuca source	.2%	6.5%	12.3%	- %
Zaragoza source	93.1	-	1.8	19.0
Pico de Orizaba source	.7	1.0	5.1	6.0
Guadalupe Victoria source	1.4	30.8	3.6	75.0
Guatemala sources:				
El Chayal	-	13.4	-	-
Ixtepeque	-	5.9	-	-
Unknown sources				
*Types A, A', B, C, C', D and E.	-	22.3	-	-
+Type B	1.5	-	43.5	-
+Type C	.5	-	27.5	-
+Type F	1.7	-	-	-
+Other	.9	-	-	-

Table 3. Sources of Artifact Obsidian from Four Southeastern Mexican Sites.

The La Venta and San Lorenzo columns do not total 100% because a few extraneous sources were not included.

* Of Cobean et al, 1971.

\+ Of Hester, Jack and Heizer, this volume.

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IV. NON-CLASSIC INSCRIPTIONS AND SCULPTURES AT SEIBAL[1]

John A. Graham

Background.

The Maya ruin of Seibal is found in the southwestern corner of the Guatemalan Department of El Peten. The site rests upon several steep limestone hills high above the left bank of the Pasion River some 100 kilometers upstream from the Pasion and Salinas (or Chixoy) confluence which originates the Usumacinta. In common with much of the Southern Lowlands of the Maya region, this is an area of high rain forest and dense tropical jungle.

The existence of the Seibal ruin has been known since the 1890's when the site received its first important explorations. In 1892 a Guatemalan commission made casts of some of the Seibal sculptures for exhibition at the Columbian Exposition in Chicago. In 1895 and again in 1905 Teobert Maler visited Seibal on behalf of Peabody Museum who published his report. Maler made a rough map of a small portion of the ruin and photographed the sculptures then known. In 1914 and 1915 Sylvanus Morley visted the site briefly to study its epigraphy; this he subsequently analysed in his great study, The Inscriptions of Peten. In brief, then, this is the extent of archaeological explorations at Seibal prior to 1961.

In 1959 Peabody Museum at Harvard University began an excavation program at the site of Altar de Sacrificios, downstream from Seibal and at the mouth of the Pasion; it was from this project that the present studies at Seibal derive. During the course of excavations and study in the Altar project it proved possible to establish a good chronological record for the sculptural and textual materials. This begins at 9.1.0.0.0 which may mark the arrival of the so-called Classic stela cult. Excepting the usual hiatus of the 6th century, this inscriptional record carries forth through Cycle 9 to 9.17.0.0.0 when it appears to terminate abruptly.[2]

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[1] This paper was prepared for delivery at the session on Maya archaeology at the annual meeting of the Society for American Archaeology held on May 5, 1966, at the University of Nevada, Reno. The text is unrevised but is updated by the references, footnotes, and appendix.

The Peabody projects at Altar de Sacrificios (1959-1963) and subsequently at Seibal (1964-1968) were conceived and directed by Gordon R. Willey and A. Ledyard Smith, to both of whom I am deeply indebted for the privilege of participating in these explorations. I wish also to acknowledge the financial support of my Seibal studies since 1964 by the Committee on Research, the Archaeological Research Facility, and the Humanities Institute, all of the University of California, Berkeley.

[2] Of the surviving Altar stelae only Stela 2 appears to postdate 9.17.0.0.0. Almost surely dedicated at 10.1.0.0.0, this small monument may have been raised under the influence of the powerful regime upstream at Seibal which celebrated this critical date in such lavish manner.

My study of Altar texts and sculptures, The Hieroglyphic Inscriptions and Monumental Art of Altar de Sacrificios, is in press as Vol. 64, No. 2, of the Peabody Museum Papers, Cambridge.

Curious as to the reasons why this long record should so end at the height of the Late Classic development, I noted that the epigraphic record at Seibal appeared to commence at just about this time and I wondered if this might be more than just coincidence. I wondered, for instance, if there might have been some shift in hierarchial organization from Altar de Sacrificios upstream to Seibal at this time and, if so, what the reasons for it might have been. As a result of such speculation, I visited Seibal twice in 1961 on behalf of Peabody Museum.[3] A number of surprises resulted from these explorations, and it was found that the late history of Seibal tied in with that of Altar de Sacrificios even more closely than first suspected.

The explorations of 1961 demonstrated that the ruin of Seibal was of far greater importance than previously suspected. The ruins themselves were found to be far more extensive than the explorations of Maler and Morley had revealed. Half again as many sculptured monuments as were previously known at the site were found. Furthermore, many of these monuments are stylistically related and compose a complex of highly exotic non-Classic sculptures relating to an alien intrusion at Altar de Sacrificios in terminal Classic times which was uncovered in the ceramic investigations. A shift in importance and political power from Altar de Sacrificios to Seibal was thus possibly verified, with the natural defensive advantages enjoyed by Seibal providing one suggestive reason for the shift (Smith and Willey 1966:387-388).

Discussion.

The only thorough and formal definition of the great Maya art style, characteristic of Maya civilization in the Southern Lowlands during the Initial Series Period, has been undertaken by Proskouriakoff who terms the tradition the Classic style (Proskouriakoff 1950). It is important to follow Proskouriakoff's restriction of the term Classic to that coherent and unified artistic development of the greater Peten area, and thus to term the exotic and stylistically alien elements described in this paper as non-Classic (Cf. Proskouriakoff 1951). In order to avoid any misunderstanding it should be emphasized explicitly that non-Classic refers not necessarily to non-Maya but simply to features not characteristic of the integrated Classic tradition of the Southern Lowlands.

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[3] I wish to thank Timothy Fiske who joined in the very soggy explorations of Seibal in that very rainy January of 1961; Stelae 14-16, the jaguar atlantean altar, architectural Groups C and D, and Structure A-9, the largest building of Group A, were first seen and the blazing of a new, much shorter and direct route to the site was accomplished during these hectic explorations. In March of 1961 somewhat drier explorations of the site were shared with R. E. W. Adams who undertook ceramic testing and correction of the grossly inaccurate Maler map of Group A (Adams 1963); Stelae 17-18 were discovered at this time and further exploration of Groups C and D was carried out.

The non-Classic elements discussed here are from the corpus of nearly two dozen Late Classic sculptured stelae from Seibal. Some of the stelae are characterized by a predominance of these non-Classic elements, may not have been raised at Classic katun endings or subdivisions, and hence might properly be termed non-Classic monuments. In other instances, however, the non-Classic features figure as intrusions into predominately Classic compositions. Obviously, this is an important aspect of the non-Classic presence at Seibal, and it holds chronological as well as other significant implications.

In terms of the epigraphy one signature of the non-Classic presence is the squared cartouche. Four of these inscriptions are now known at Seibal, none, unfortunately, in an outstanding state of preservation. These texts are found upon Stelae 3, 13, 16, and 18; only one of these monuments has been known previously--namely, Stela 3 published by Maler. Each of the texts opens with a variable glyphic element framed in a rectangular border which I term the squared cartouche. In each instance there is a numerical prefix. Twice this is a coefficient of one; twice this is a coefficient of seven. In one only of these texts (Stela 3) immediately sequent to the initial glyph with coefficient of seven, is a second squared cartouche glyph; it presents the same interior glyphic element seen in the initial glyph, but in this instance the coefficient is five.

In two of the inscriptions the remaining text following the squared cartouche introduction is very brief and virtually illegible. Only in the inscriptions of Stelae 3 and 13 are there preserved additional glyphs suitable for study. In the case of Stela 3 there are four glyphs additional to the double squared cartouche construction which stands at the top of the monument. As these glyphs are located in a lower panel, presenting a different scene, they might not relate directly to the squared cartouches of the upper panel. It is interesting to note, however, that these four glyphs are fully within the canons of Classic Maya epigraphy and would pass unnoticed in a more conventional context. Two of the glyphs form a CR statement read as 1 Chicchan 8 Kankin and placed at 9.18.9.5.5 by both Morley and E. W. Andrews (Morley 1937-8; Andrews 1936).[4] The associated art of this monument is, however, entirely non-Classic in character.

In Stela 13, our final text, we have our most lengthy inscription, consisting of about a dozen glyphs arranged in a single hieroglyphic caption over a sculptured human figure. With the exception of the initial squared cartouche, none of the text's remaining characters possess numerical coefficients. While these remaining glyphs of the text are derived, possibly in all instances, from Classic Maya epigraphy, the use of some of the signs is irregular. Unfortunately I am unable to present an interpretation of the text other than pointing out the color/direction/year count notation.

Since the epigraphy affords little direct chronological controls, dating of these texts must be derived indirectly from the art, the positioning of the monuments, and similar considerations. On this basis the four texts are

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[4] Repeated study of this Calendar Round date leads me to read it as 1 Oc 8 Kankin, which I would place at 10.2.5.3.10.

assigned to the first quarter of Cycle 10.[5]

The immediate interpretation of these four squared cartouche texts is difficult because, aside from their small number, of their very poor state of preservation. While there are other possibilities, I think the squared cartouche glyphs are best regarded as calendrical and, in fact, are probably chronological statements. In addition to the bar and dot affixation, their initial position with the absence, with one exception, of other chronological statements in their texts contribute to this interpretation. If this view is accepted, then the variability of the framed interior elements and the lack of coefficients of greater than thirteen (in, admittedly, an inadequate sample) strongly suggest that we are dealing with day formulae. Just possibly these might be year bearer statements; we recall that in Central Mexico year bearer formulae were sometimes enclosed in rectangular frames, although these frames encompassed the coefficient as well as the day sign.[6]

I am aware of only a few parallels for the squared cartouche texts of Seibal. At Ucanal on the Mopan, about fifty airline miles northeast of Seibal, there is the very important Stela 4 of early Cycle 10 date. The text, which is otherwise of Classic appearance, presents three probable instances of squared cartouche glyphs. Here, the coefficients are 7, 10, and 13. The associated sculpture, while basically in the Classic tradition, has non-Classic aspects. Most important is the "capture motif" shown: the principal figure is a lord bearing the Manikin Scepter and standing upon a captive. A related scene occurs on a monument of the same date at Seibal. The critical importance of the events of this date at Seibal are attested dramatically by the erection of no less than five sculptured stelae (Stelae 8-11, 21). The date is 10.1.0.0.0.

A more distant, but equally important, parallel for the squared cartouche glyphs is at Chichen Itza. These glyphs occur on two, possibly three, of the gold disks from the Cenote of Sacrifice. Disk I from the Cenote presents eleven squared cartouche glyphs which have human and animal head as the interior elements. There are no Maya glyphs on this disk, and the only personages depicted are Toltecs. Disk J also bears two squared cartouche glyphs together with others of Yucatecan Maya style. The eleven squared cartouche glyphs of Disk I lack numerals, and perhaps are mainly decorative in function. The two glyphs of Disk J may have coefficients, but it is difficult to separate them from other elements and these glyphs also may be merely decorative.

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[5] As a result of subsequent studies I now venture to suggest more precise datings of these and other Seibal monuments; see the appendix of this paper.

[6] It is now clear that this interpretation will not fit the several squared cartouche texts now known at other sites such as Jimbal and Ucanal. The recent discovery of El Zapote Stela 5 (Easby and Scott 1970: 214-215) provides the most fascinating new light upon the squared glyphs. On this monument a year sign is interpolated between the coefficient of 12 and the squared frame. The very early date of this stela, 9.0.0.0.0, confirms Proskouriakoff's perceptive observations with respect to another element of the non-Classic group, the I-A5 pose (Proskouriakoff 1950: 19, 152-153).

I have previously noted the possibility of a connection between the squared cartouche glyphs and the rectangular year bearer frames in Central Mexico. Otherwise, outside of the Maya area, these squared cartouche glyphs do not appear to point to any particular region.

Turning now from the epigraphy to the sculpture, we see that there is a larger array of elements complexly distributed. It is possible here, therefore, only to note some of the general features of non-Classicism found in the sculptural art of Seibal.

The non-Classic presence is to be seen in specific elements of costume and accoutrement, in the physiognomy of depicted personages, in symbolism, and in certain artistic conventions such as in modes of portrayal or representation. As a fascinating example of the latter, we now have three instances of human figures being portrayed in virtually the precisely same pose (type I-A5) typical of Cycle 8 art. As Proskouriakoff (1950:19, 152-163) has noted, the reappearance of this pose in Cycle 10 at Seibal does not reflect its survival here through the centuries of Cycle 9, but rather its re-introduction from a foreign source uninfluenced by the evolution of the Classic style during Cycle 9. That we are not contending with the phenomenon of archaism is demonstrated by the exotic context.

Many of these non-Classic features in the sculpture of Seibal have as their closest parallels examples in the art of Chichen Itza, western Yucatan, and Campeche. Long nose beads, certain types of slippers and sandals, the use of the so-called fending club or curved stick, certain serpentine symbolism, these are instances of specific ties to Chichen Itza. Now it is of the greatest interest to note that these ties with Chichen Itza are to be seen both in the Toltec and in the Chichen Maya who were themselves of non-Classic tradition.

A more immediate and most significant tie of Seibal's non-Classicism is to be seen downstream at Altar de Sacrificios. At Altar a recently discovered intrusive ceramic complex has defined the Jimba Phase.[7] Dated as terminal Classic or very early PostClassic, the Jimba Phase represents a short term occupation of the old Classic ceremonial precincts by an intrusive group. There is the impression, almost, of a bivouacking in the old ceremonial buildings and courts (Smith, Willey, and Adams 1962:35-36; Adams 1964:376-377). Characteristic above all of the Jimba intrusion is the enormous quantity of fine paste pottery. In this pottery's carved decoration there may be seen squared cartouche glyphs associated with long haired warriors dressed in peculiar skirts. Now these very same figures are to be seen in some of the monumental art of Seibal.

The most remarkable example of this is found on Stela 17. The monument presents a scene with two figures. One figure is attired in typical Late Classic Maya dress of the Southern Lowlands. In terms of Proskouriakoff's chronological study of the Classic style, the figure derives from the terminal Decadent Phase of Southern Lowland Maya art. In his left hand, this lord holds the Manikin Scepter, not raised, but lowered. The right hand is raised toward the left chest in what may be the traditional "gesture of submission." The remarkable figure who confronts the Maya lord is long haired and skirted, and the features of his face are far from the Classic ideals.

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[7] Fully defined in Adams 1971; cf. Sabloff 1970 for the related complex at Seibal.

In one hand he holds the curved stick weapon. The obvious question is: Does the sculpture depict the surrender of a Maya lord to the skirted warrior?

The data reported here are still in the process of being researched and evaluated. There are several critical factors yet to be brought under control, while simple and immediate interpretation is confounded by the possibility of more than one facies to the non-Classicism of Seibal. There is the suggestion of initial military success, recorded at 10.1.0.0.0, but only to be followed shortly by ultimate extinction. Some of these points are beginning to be clarified as research progresses, so that it is premature to push the interpretations at this moment. Rather, in conclusion, I prefer simply to underscore that these sculptures and texts of Seibal reflect very crucial events during the final moments of Classic Maya civilization in the southwestern lowlands. While the collapse of Classic Maya civilization long has been subjected to a great variety of abstract theorizing, here we have tangible documentation for some of the important events of the times. I am not suggesting that military conflict and conquest was the primary factor behind the Classic debacle as it may well have been only symptomatic of other failures and problems. I do cite it, however, as a highly significant feature of the final collapse.[8]

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[8] See Sabloff and Willey 1967 for a recent hypothesis on the Classic collapse derived from the Altar and Seibal materials.

Plate 1. a) Seibal Stela 14. b) Seibal Stela 18.

a

b

Plate 2. a) Seibal Stela 17. b) Stela 19: see Plate 3b for rubbing with upper left fragment of stela replaced

a

b

Plate 3. a), Seibal Stela 18. b), Seibal Stela 19. Rubbings by Merle Greene Robertson.

Appendix

The following tabulation presents my current (1970) conclusions with respect to the dating of Seibal monuments; some dates are somewhat tentative and further studies may lead to minor revisions. Christian equivalents to Maya dates are calculated with a constant of 584,283.0 days. Absent from the tabulation are Maler's Stela 4, which is apparently non-existent, and Morley's Stela 12, which is not located at the main Seibal ruin but at "Group B" several kilometers distant.

Stela 1.	10.2.0.0.0 3 Ahau 3 Ceh, August 15, 869.
Stela 2.	No inscribed date. Stylistic considerations place carving within Katun 1 Ahau, ending at 10.3.0.0.0, i.e. between 869 and 889.
Stela 3.	Best reading of the Calendar Rounddate is 1 Oc 8 Kankin, and this is to be placed at 10.2.5.3.10, September 28, 874. Erection was probably at about this date or shortly thereafter, perhaps about 879.
Stela 5.	Incomplete Period Ending date places this monument almost surely at 9.17.10.0.0 12 Ahau 8 Pax, November 30, 780, or 9.18.10.0.0 10 Ahau 8 Zac, August 17, 800.
Stela 6.	A Calendar Round date of 13 Ahau 18 Cumku almost surely places this monument at 9.17.0.0.0, January 22, 771.
Stela 7.	9.18.10.0.0 10 Ahau 8 Zac, August 17, 800.
Stela 8.	10.1.0.0.0 5 Ahau 3 Kayab, November 28, 849.
Stela 9.	10.1.0.0.0 5 Ahau 3 Kayab, November 28, 849.
Stela 10.	10.1.0.0.0 5 Ahau 3 Kayab, November 28, 849.
Stela 11.	10.1.0.0.0 5 Ahau 3 Kayab, November 28, 849.
Stela 13.	Stylistic considerations place carving within Katun 1 Ahau, ending at 10.3.0.0.0 i.e. between 869 and 889.
Stela 14.	Stylistic considerations place carving within Katun 1 Ahau, ending at 10.3.0.0.0, i.e. between 869 and 889.
Stela 15.	Stylistic considerations place carving within Katun 1 Ahau, ending at 10.3.0.0.0, i.e. between 869 and 889.
Stela 16.	The small surviving fragment of this minature stela is too incomplete to suggest a precise dating of the carving; however, its positioning upon the platform with Stelae 14 and 15 was surely no earlier than Katun 1 Ahau, ending at 10.3.0.0.0.
Stela 17.	Stylistic considerations place the carving after 10.3.0.0.0 (889), perhaps at about 894 or 899.
Stela 18.	Stylistic considerations place the carving after 10.3.0.0.0 (889), perhaps at about 894 or 899.
Stela 19.	The text opens with a most unusual double date, unfortunately badly damaged. The first date of the pair is probably the Calendar Round 1 Ben 1 Pop which would surely be at 9.19.5.11.13, January 19, 816, or 10.1.18.6.13, January 6, 868. Even if the Calendar Round reconstruction suggested here is incorrect, stylistic considerations place the date of carving surely very close to these dates, and there are good arguments in favor of either date.
Stela 20.	10.3.0.0.0 1 Ahau 3 Yaxkin, May 2, 889.
Stela 21.	10.1.0.0.0 5 Ahau 3 Kayab, November 28, 849.
Stela 22.	This is the re-erected upper fragment of Stela 6. Presumably, this event follows the latest carved monument "normal" raisings, considered to be Stelae 17 and 18 at about 894 or 899.
Structure A-I Panels.	The text opens with the only surviving Initial Series date at Seibal: 9.15.13.13.0 4 Ahau 3 Uo, February 27, 745. Dedication was probably at 9.16.0.0.0 2 Ahau 13 Tzec, May 7, 751, a date recorded in the text as a Period Ending.

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V. A MAYA HIEROGLYPH INCISED ON SHELL[1]

John A. Graham

This minimal Maya hieroglyphic text, now to join the Gates manuscript collection of Maya & Middle American documents at Princeton, is known only to have been purchased from a Florida dealer in antiquities. The glyph, incised on the inner surface of a shell and reproduced here at actual size, perhaps served as an inlay or adorno. In view of the meaning of the glyph as suggested here, the shell and its incised glyph perhaps served as an insignia or badge of a Maya of noble rank. With these brief introductory remarks, we may turn to an examination of the glyphic construction.

The hieroglyph's construction brings together several familiar glyphic elements. The total construction may be transcribed as 12.36.1016:23, the numerals corresponding to the particular glyphic elements as catalogued by J. Eric S. Thompson. As the symbolism of some of these signs has been investigated in depth, it is of interest to first examine the construction from what might be termed the symbolic approach.

Affix 12, the first prefixial element, consists of a vertical bar-like element preceded by short horizontal lines and eye-like elements. This was identified many years ago by Hermann Beyer as symbolizing the eyes and hair (or wig) of death. The affix is a member of Thompson's "count" group and has been regarded by him as an ending sign, probably corresponding to the Yucatec litz' and meaning "death throes," "expirations," or "end."

The second prefix, Affix 36, is a familiar member of the so-called "water" group and consists of an encircled formée cross with a tail of parallel dots or strokes. This is the kan cross with the dots probably corresponding to the glyphic "circlets of water." Symbolically, it is regarded by Thompson as a sign for turquoise and water as well as "precious." With the exception of a few rare examples, the affix occurs only as a prefix and this in a highly restricted range of contexts.

The main sign to which these two familiar signs are affixed is the monkey-like head of God C. A very similar head, frequently regarded as the same although there is some reason for believing it to be distinct, forms part of the glyphic construction for north and is referred to as the "North God." God C, whose peculiar profile suggests a profile view of the symbolic Ahau face, is a ubiquitous diety in the hieroglyphic texts, whose specific functions are difficult to delimit. I return to the possible significance of the sign shortly.

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[1] This note was written in 1962, in response to an inquiry about the possible meaning of the text when it was acquired by Princeton University, and it is published here as illustrating a minor exercise in glyphic interpretation. Several years subsequent to its writing I learned, with delight combined with chagrin, that the proposed interpretation of the God C form was anticipated, on other grounds and with respect to divinities, by William Gates at least as early as 1931.

Completing the hieroglyphic construction on the shell badge is Affix 23 employed as a suffix. Barthel has suggested that this common affix corresponds to Yucatec *al*, but to my knowledge the symbolism of the sign has not yet been satisfactorily explained. Of the four glyphic elements with which we are concerned here, Affix 23 is the most frequently occurring sign and occurs in the greatest number of distinct combinations. This frequency of occurrence and diversity of combination confirms the suggestion of phonetic value.

Having examined the components of our hieroglyph, what can be suggested as to its meaning? It would be relatively simple to take the explained symbolism of the various elements and to construct a plausible "reading" or interpretation on that basis. While such a procedure may be justifiable in the analysis of some Maya glyphs, it would seem to be more profitable to employ another method here.

In analyzing hieroglyphs of unknown meaning, careful examination of the glyph's context combined with a comparative survey of other contexts in which the construction occurs is often helpful. This cannot be done here since our text consists solely of the hieroglyph under scrutiny though it is possible to examine the hieroglyph's context in other inscriptions. Although usually presenting distinct methodological complications, it is also possible to examine the contexts of the separate glyphic elements, and this combined with the former discloses an interesting avenue of study here.

Since our first prefix, Affix 12, as well as our suffixed *al*, occur in many diverse constructions, it is convenient to set these aside to examine first the second prefix and the main sign. Examination of the entries for Affix 36 in the Thompson catalogue immediately discloses that this "water" group affix is almost exclusively associated with "emblem" glyphs or glyphs identified by the characteristic affixation of Affix 168 ("Ben-Ich") and a "water" group affix, and especially associated with a particular locality or ruined city, possibly representing a local clan name, a ruling dynasty, or even the city itself. This restricted incidence suggests that the element does not have a phonetic value but rather functions as an unpronounced determinative or as a specific word-sign ("ideogram") of quite restricted usage. Further clarification and perhaps support for this suggestion might result from careful study of Affix 36's relation to other "water" group affixes in the emblematic context and the chronology of its occurrences.

The Thompson catalogue does not provide incidence data for "portrait" glyphs, but a random sampling of the corpus of Maya texts shows that Affix 36 also occurs with God C, paralleling our incised shell example. God C, on the other hand, we also frequently find associated with emblem glyphs, on occasion in affixial form (with the "water" Affix 32 on his head) prefixed to emblems but more customarily in glyphic phrases which include emblem constructions. A second and quite common context for God C is in what appears to be personal name phrases, some of which also include emblem statements. The full range of God C contexts is unknown to me; God C enters into Glyph G_1 constructions (sometimes with our Affix 36 as prefix) and in many Lunar Series glyphs (also frequently with a "water" group affix) but only lengthy search through the inscriptions would define the full range of contexts (I ignore the uses of God C in the codices).

On an onyx marble bowl in the Bliss Collection (National Gallery, Washington) is a hieroglyphic text which is most interesting in regard to our present inquiry. In front of a male figure depicted on the bowl is a single glyphic construction identical with our shell glyph save for the substitution of another "water" group affix for the kan-cross-with-dots. This glyph is the first of a phrase which continues in a column of glyphs behind the figure and which again repeats the glyph but this time with Affix 12 being replaced by the lunar Affix 181. Another figure on the bowl, a woman, bears only a two glyph caption, glyphs probably constituting her name but in any case surely of nominal significance. The glyphs of the "God C phrase" of the male figure are also repeated in a band of glyphs below the rim of the bowl, together with a calendrical statement.

Now the glyphic constructions of the Bliss bowl and the associations of God C and his "water" affix in the inscriptions with names and emblems clearly argue for some sort of nominal significance, perhaps something related to a title as "dignitary" or "lord." This line of thought is further borne out by certain hieroglyphic phrases carved on the great sarcophagus of the famous secret crypt in the Temple of the Inscriptions at Palenque. The texts of the sarcophagus, as first pointed out by Heinrich Berlin, contain repeated name phrases. On some of the supports of the sarcophagus are carved small human heads linked with short glyphic statements. The first glyph perhaps is part of a personal name; the second glyph in three instances is "death eyes and hair" prefixed to God C with al suffix. Elsewhere on the sarcophagus there are two personages portrayed each with a glyphic text of four hieroglyphs. The first glyph is clearly nominal and refers to the depicted personage. The third glyph is God C with a "water" prefix and the following final glyph is the Palenque emblem without "water" affix. Presumably the lack of the "water" affix in the emblem glyph is explained by God C and "water" as the preceding glyph (as previously noted, God C with a "water" affix occurs as the "water" prefix to emblems in some instances). A most significant feature of these two constructions is the carving of a closed eye in each of the God C heads. The closed eye is a widespread sign of death in ancient Mesoamerican iconography and its presence in God C here is entirely consistent with the context and import of the inscription and further confirms the suggested nominal reading of our shell hieroglyphic construction.

To conclude, we may briefly return to our remaining two affixes, al and "death eyes and hair." As far as the linguistic reading of the suffix as al is concerned, we are in no position to judge its usage here without a linguistic reading of the God C element. It may be observed simply that the uses of al in Yucatec are not inconsistent with a suggested nominal meaning for the God C construction. Thompson's interpretation of Affix 12 as "death throes" would be suitable for the examples on the Palenque sarcophagus supports while one might reason that in the other sarcophagus examples the closed dead eye substituted for it. Nevertheless, such an interpretation does not seem consonant with the great majority of the examples elsewhere. Since the affix is of wide and varied occurrence, it is tempting to see in it a possible phonetic value. Yu. Knorozov has suggested that this affix has the value of ah which in Yucatec Maya is a masculine nominal prefix. Knorozov denies that ah had this meaning in the language of the hieroglyphic texts but ah as the masculine prefix would fit very well the interpretation suggested here. Nevertheless, as Knorozov has yet to document the interpretation of Affix 12 as ah, one is hesitant to suggest this reading here without more convincing evidence.

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Plate 1. Recto and verso of shell with inscribed glyph. Natural size.

VI. TWO UNUSUAL MAYA STELAE

John A. Graham and Howel Williams

As is generally known, the Maya lowlands comprise a vast province of massive limestone deposits. Since these limestones are usually exposed or only slightly buried, ready material in unlimited abundance was ordinarily available for the cutting of building stone, for reduction to lime for mortar, and for the carving of sculptures and other monuments. At a number of Maya lowland sites quarries have been observed in the sites, or their immediate vicinity, and there has been little reason to suspect the long distance transport of large and heavy stone for monuments as was characteristic of the ancient Olmec civilization in its principal sites of La Venta and San Lorenzo.

For the most part it is only on the peripheries of the Maya lowlands that major non-limestone monuments and architectural constructions are found.[1] The two best known examples are Copan and Quirigua, and in each case local stones were quarried. At Quirigua in the lower Motagua Valley, separated from the Maya lowlands proper by the Santa Cruz range, ignimbrites, not immediately available but probably transported from no great distance, and local sandstones were employed in monument carving as well as in architecture. At Copan in the foothills of southwestern Honduras, even farther removed from the true Maya lowlands, ignimbrite from the Copan Valley was preferred to the local limestone. At Maya sites within the lowlands proper, non-limestone monuments or architectural constructions are very rare, and the major example is Altar de Sacrificios on the lower Pasion where during the Early Classic period local sandstone supplied the material for both monuments and architecture until after 9.10.0.0.0 (A.D. 633) when limestone supplanted sandstone (Graham, in press).

During the course of archaeological research in southern Mesoamerica in 1967, we had the opportunity to examine two quite unusual non-limestone Maya sculptures: Stela 1 of Ichpaatun and Stela 9 of Calakmul.

The ruins of Ichpaatun are situated on the west coast of the Bay of Chetumal on the Caribbean coastline of the Yucatec peninsula. The site and its single monument were discovered in 1926 by Thomas Gann (Gann 1926a, 1926b). Although data on the ruins are very scarce (Gann 1926b; Escalona Ramos 1946; Sanders 1960), the use of non-limestone materials is apparently

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[1] The stone of seven of the Caracol monuments is described as a gray slate, but the great majority of monuments at the site are of limestone (Satterthwaite 1954:26-27). The sculptures of Tonina, situated in the Ocosingo valley on the periphery of the Classic Lowland domain, are at times described as "yellow, coarse-grained limestone," at times as "yellow sandstone" (Blom and La Farge 1927:251, 269, 303), and there is confusion as to whether limestone or sandstone, or both, were used at Pusilha (Morley 1937-38, Vol. IV:18, quoting Gann and Joyce; Morley 1947:359). Single examples or small numbers of non-limestone monuments are reported for Salinas de los Nueve Cerros, Naranjo, Tikal, and other sites. Unfortunately, we have not been able to study samples from these other sites.

limited to the stela, identified by Gann as shale. Gann had the monument removed to Yucatan, evidently hoping to arrange for its exportation, and eventually in 1938 the stela came into the hands of the Museo Regional in Merida where it is now exhibited.

The irregularly shaped shaft, of sub-rhomboidal cross-section, measures 266 x 54 x 30 cm. and originally had carving on both faces and overlapping onto the sides. The monument is now badly battered, and most of the details of the standing figure portrayed on the front are lost although the Late Classic stance with feet pointing outward seems to be present. Only the all-glyphic back preserves substantial detail. Here the hieroglyphic text opens with a clear Initial Series date, recording 9.8.0.0.0 5 Ahau 3 Ch'en (A.D. 593, GMT), followed by Glyphs G9/F and a lunar series. The recorded moon age of 19 Glyph D is in agreement with an average age of 19.6 days calculated for 9.8.0.0.0 on the basis of an arbitrary average age of 13.260 at IS base.

The ruins of Ichpaatun include a large stone walled enclosure and various buildings which are strikingly reminiscent of the Late Post Classic site of Tulum some hundred miles to the north. W. T. Sanders undertook brief ceramic testing at Ichpaatun in 1955, finding a major Post Classic occupation and thus confirming the resemblances to Tulum, but also encountering indications of a minor Classic period occupation (Sanders 1960). Since the general character of the site is Post Classic, the possibility that the stela is secondarily associated with the ruins should be borne in mind. We are reminded of Tulum Stela 1, with dedicatory date at 9.6.10.0.0 (A.D. 564), which surely must have been removed from a Classic period ruin and re-used in Late Post Classic Tulum many centuries later. The circumstances surrounding Ichpaatun Stela 1 are not so clear cut, as we know so little of the Ichpaatun ruins and as, in contrast to Tulum, there is evidence for Classic occupation; nevertheless, we are inclined to entertain doubt about the original association of the monument with the site of its discovery (Andrews 1965: 299, 300).

The stone of the Ichpaatun monument may be described as a quartz-muscovite-chlorite-garnet-graphite schist or phyllonite. It is characterized in hand specimens by a conspicuous alternation of layers composed mainly of granoblastic quartz with undulose layers composed mainly of silvery white mica (muscovite), graphite, and chlorite. These layers range in thickness from a millimeter or less to about a centimeter. Numerous ovoid garnets are disseminated throughout, most of them concentrated within the granoblastic layers; the flaky minerals are molded around them.

The microscope reveals clear evidence of strong differential movement. All of the quartz grains show the shadowy extinction indicative of strain; their irregular boundaries interlock into a firm mosaic. Many of the muscovite flakes, which range up to a millimeter in length, are strongly bent, and trains of graphite dust swerve at various angles to the dominant schistosity. The garnet crystals, most of which measure between 0.5 and 2 mm. across, also contain trains of graphite dust inclined to the general schistosity. Most of the chlorite is concentrated around the garnets, suggesting regressive metamorphism. Accessory constituents include apalite and sphene.

C. G. Dixon (1956: 15) mentions the presence of garnetiferous schist and gneiss within the Maya Series, apparently intruded by muscovite granite.

He notes that they are exposed along the walls of the valley of Silk Grass Creek, the floor of which is cut mostly in granite. It seems possible that the garnetiferous phyllonite of the Ichpaatun stela came from this region. The Caribbean coast near the town of Stann Creek lies only about ten miles away. It would not have been difficult to transport slabs downstream to the coast, and to raft them northward during times of calm water.

Garnetiferous schists are widespread in the Chuacus metamorphic series of the Central Cordillera of Guatemala, north of the Motagua Valley (McBirney 1963). They are abundant also around Mixco Viejo in the upper part of the Motagua Valley. Those described by McBirney differ mineralogically, however, from the phyllonite of the Ichpaatun stela, most of them carrying hornblende, albite, and epidote in addition to the mineral present in the stela rock. It is obvious, moreover, that transport of rocks from the Central Cordillera of Guatemala to Maya sites in the Yucatan peninsula would involve much more severe logistic problems than would transport from the northern part of the Maya Mountains of British Honduras.

The ruins of Calakmul lie little more than a hundred miles inland in a southwestern line from Ichpaatun and about forty miles north of the Guatemalan frontier. Stela 9, described by Denison in his account of Calakmul monuments as carved from slate, is apparently the only non-limestone monument of the 103 stelae catalogued for the site since no reference is made to the material of the other monuments (Ruppert and Denison 1943). The monument is now on exhibit in Campeche, having been removed there for the dedication of the new Museo Regional in 1943.

Stela 9 of Calakmul is a perplexing monument. Measuring 294 x 49 x 15 cm., the stela is carved with portraits of human figures on front and back with the hieroglyphic captions to the portraits as well as the glyphic texts along both sides of the shaft being badly damaged and eroded. On the left side a lengthy column of glyphs opens with the IS 9.10.16.16.19 3 Cauac 2 Ceh while the long column of glyphs on the right side encloses an IS probably at 9.11.10.0.0 11 Ahau 18 Ch'en. The panel on the back presents the certain CR date of 11 Ahau 18 Ch'en, presumably also at 9.11.10.0.0. The front panel presents the date 11 Ahau 18 VY, half-period, presumably the PE date 11 Ahau 18 Ch'en at 9.11.10.0.0. This is followed by 10 Ahau 8 Yaxkin´(?), presumably a reference to the current katun end at 9.12.0.0.0 10 Ahau 8 Yaxkin.

We interpret the epigraphic evidence to strongly indicate a dedicatory date at 9.11.10.0.0 (A.D. 662, GMT), but with dedication ten years later at 9.12.0.0.0 being a less favored alternative possibility. Unfortunately, the stylistic evidence afforded by the sculptured figures does not satisfactorily confirm this chronological placement. Proskouriakoff (1950: 114) points out that while certain stylistic features are consistent with an early Late Classic age, there are other traits (the frets of the loincloth apron and the diagonally held staff) which strongly argue for a much later placement. While not ignoring these stylistic aspects, we feel the epigraphic evidence, though not conclusive, outweighs the stylistic features in this instance. We believe the situation is somewhat analogous to Stela 9 at Altar de Sacrificios whose dedication is surely fixed earlier than certain features of the sculpture would suggest (Graham, in press; Proskouriakoff 1950:117).

Stela 9 is cut from a dark gray semischist strippled with minute crystals of pyrite. The rock has a pronounced fissility produced by the sub-parallel orientation of minute flakes of muscovite and by a streaky concentration of graphite dust. The rock is very much finer grained than that of the Ichpaatun stela, and is devoid of garnet.

Most of the rock consists of fractured and granulated crystals of quartz, none of which exceed 0.05 mm. across, most measuring only about half this size. The margins of the crystals are frayed. Next in abundance are flakes of muscovite, but even the largest of these measures not more than 0.1 mm., and most are much smaller. Clouds of irresolvable graphite dust are gathered in flamelike streaks. The constituents of the matrix between the quartz and muscovite are too fine to identify, but probably pulverized quartz predominates. Rare, broken crystals of calcic plagioclase appear to be the only feldspars.

The rock is probably a sheared siltstone that has undergone a moderate amount of metamorphism; much, perhaps most of the finely divided muscovite may have originated from feldspars, and much of the original clastic quartz has recrystallized.

Dixon states that although many sedimentary rocks of the Maya Series in the Maya Mountains are unmetamorphosed, most of them exhibit low-grade metamorphism. Included among the series are graywackes, quartzites, slates, phyllites, and shales "with some schists and gneisses." It seems likely that the semischist of Stela 9 comes from this suite of rocks, but published descriptions of the Maya Series are far too brief to permit an exact localization.

Similar semischists may be present in the Santa Rosa and Tactic formations of the Central Cordillera of Guatemala, on the north side of the Motagua Valley (McBirney 1963: 199-203), but much more study would be needed to confirm or deny this suggestion. It seems certain, however, that neither the phyllonite of the Ichpaatun stela nor the semischist of the Calakmul monument can have come from the metamorphic belt on the south side of this valley.

The Maya Mountains are little more than 100 miles south of the coastal site of Ichpaatun, and assuming Stela 1 was originally raised in the vicinity of Ichpaatun it is most probable that the stone was rafted to the site along the coast line. We know that upon the arrival of the Spanish in the 16th century the east coast of Yucatan was regularly plied by large commercial canoes, and doubtless this was true earlier as well. Sites such as Ichpaatun and Tulum probably existed mainly in order to regulate the coastal trade. The Calakmul monument was probably transported along this route also, perhaps about the same time, and then carried inland for the overland journey to the site. Both monuments being derived from the same general source, being carved about the same size and proportion, and having been dedicated within some 70 years of each other, must have a related history that remains to be further elucidated.

Plate 1. a), Calamul Stela 9, front. b), Ichpaatun Stela 1, back. c) Ichpaatun Stela 1, front and left side.

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