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VARSITY ESTATES – A PALAEO-AMERICAN SITE IN SOUTHWESTERN ALBERTA, CANADA (1990 – 1992 INVESTIGATIONS)

ABSTRACT: Recent investigations in the Bow River valley, southwestern Alberta, Canada, provided evidence of a Palaeo-American occupation significantly predating the earliest (final Pleistocene) Palaeoindian cultures in this part of North America. Two formally identical stone tool assemblages produced from local clastic rocks have been recorded in deeply buried Late Pleistocene geological contexts. The flaked lithics display apparent technological and typological similarities with Palaeolithic industries from northeastern Eurasia. At Site 1 (the Varsity Estates Site) discussed in this paper, stone artifacts occur partly redeposited in a Cordilleran (the Bow Valley) till derived by a Rocky Mountain glacier, but also in situ on a gravelly surface of the till buried by glaciolacustrine deposits, more than 20 m thick, which were accumulated during the maximum Laurentide ice advance into the Calgary area. Simple, direct, hard-percussion was the dominant flaking technique, although soft-hammer percussion blade technology is also present. The formal typology of core tools consists of a variety of crudely modified "pebble tools", including choppers, chopping-tools, large scrapers on cobbles and exceptionally bifaces. Flake tools mostly occur as steeply retouched side scrapers; occasionally as end scrapers, including carinate forms, and simple dihedral and other burins. Utilized flakes and unmodified débitage are present. An early Late Wisconsinan age (ca. > 21,000 B.P.) is assumed for the artifact assemblage. Palynological data associated with the lithic record indicate a cool semiarid interstadial climate. The cultural evidence supports the concept of a "pre-Clovis" occupation of North America, and implies adaptation of the early prehistoric people to periglacial conditions.

KEY WORDS: Southwestern Alberta – Calgary Site 1 – Palaeo-American occupation – Lithic industry – Mid- and Late Wisconsinan – Cordilleran and Laurentide glaciations.

INTRODUCTION

Prehistoric peopling of the New World is one of the unresolved and probably the most controversial issue of American archaeology. The traditional scholarly as well as widely-held popular view envisages a very late arrival of ("Palaeoindian") people from Northeast Asia at the end of the Pleistocene (e.g. Haynes 1969, Martin 1973, Dincauze 1984, Owen 1984, Fagan 1987, Lynch 1990, Hoffecker, Power and Goebel 1993, Kunz and Raenier 1994). This presumably took place shortly after 12, 000 B.P., in the form of a human migration across the exposed Bering land-bridge just before submergence, and after reopening of the "ice-free corridor", i.e. the area along the eastern slopes of the Canadian Rocky Mountains partly deglaciated after coalescence of the Cordilleran and Laurentide ice-sheets (Rutter 1980). These fully modern people, archaeologically manifested by diagnostic lanceolate fluted stone projectile points, are thought to have rapidly colonized most of the American continent within only a few hundred years, causing mass faunal extinction by their uncontrolled predation (Martin 1973).

Alternative models argue for an earlier human dispersal in the Americas, sometime during the Late or even Middle Pleistocene (e.g. Bryan 1978, 1986, Morlan and Cinq-Mars 1982, Cinq-Mars and Morlan 1989, Shutler 1983, Guidon and Delibrias 1985, Dillehay 1989, Dillehay and Collins 1988, Adovasio, Donahue and Stuckenrath 1990). The presented archaeological evidence, however, has not been accepted by the "traditional" and generally skeptical American archaeologists, who tend to question the cultural validity of a particular record, especially if this constitutes "crudely" flaked lithics so different from the familiar perfectly bifacially shaped stone projectile points, such as Clovis. Even if the cultural authenticity of a lithic specimen or a stone assemblage is accepted, arguments are usually raised against its early dating and/or its primary geological context. In most cases, however, it is the "undiagnostic" nature of those rudimentarily flaked and otherwise simply modified lithics which does not inspire general confidence. The anthropological orientation of the (North) American archaeological school, lacking close ties to Quaternary geology and other natural sciences well-established in the Old World Palaeolithic studies, may be one of the most fundamental reasons why the controversy about the early occupation of the New World persists.

This paper presents evidence in support of an earlier, "pre-Clovis" occupation of North America, based on geological and archaeological investigations carried out since 1990/1991 at two locations in the Bow River valley on the northwestern periphery of the city of Calgary, province of Alberta, Canada (Chlachula 1991). A simple lithic industry, recorded in deeply buried Late Pleistocene deposits, is believed to represent an early, "pre-Palaeoindian" (i.e. a pre-projectile point) occupation of this area. Preliminary results and implications of the research at Calgary Site 1 (Varsity Estates Site) are discussed in this report. The archaeological record and the chronological assignment is explicitly manifested by a Palaeolithic stone industry in a primary geological context, and by a last glacial age of the artifact-incorporating deposits. The evidence of the cultural authenticity of these finds consists of the presence of patterned lithic artifact-diagnostic flaking and edge-retouching attributes identical with the Old World Palaeolithic stone tool assemblages produced on similar clastic raw materials. No excavation was conducted until November 1992. The previous geological and archaeological studies focused on the establishment of a detailed stratigraphy of the investigated sections, the correlation of the geological record within the larger study area, the reconstruction of sedimentary and Quaternary environments, the spatial and stratigraphic occurrences of the stone industry, and the assessment of its chronology.

GEOGRAPHY AND NATURAL ENVIRONMENT OF THE STUDY AREA

The larger study area is located on the southwestern margin of the Canadian Interior Plains at the foot of the eastern slopes of the Rocky Mountains (*Figure 1-A*). In Alberta, most of the Plains are characterized by a flat to gently rolling terrain rising from about 900 m asl. in the east to 1300 m asl. in the west at the mountain front. The landscape is transected in places by broad shallow depressions and narrow, deeply incised valleys with drainage patterns generally oriented in the west-east direction following the continental slope. Farther west, the Rocky Mountains create a natural boundary with maximum absolute elevations well above 3000 m.

The youngest bedrock geology is characterized by Tertiary sandstones, overlying Paleocene and Cretaceous sedimentary rocks. Most of the surficial deposits are formed by unconsolidated glaciolacustrine sediments laid down above glacial and fluvial deposits in the valley bottoms. Present environmental conditions in southwestern Alberta are characterized by a dry continental climate with the average annual precipitation of about 700 mm in the Foothills and 400 mm on the prairies, and a mean annual temperature of about 5°C. Most of the southwestern part of the province is covered by grasslands on the upland prairie. Aspen and willow scrub grows in the river valleys; parklands with spruce and poplar are distributed in the foothills. Coniferous forest with spruce and pine is established in the Rocky Mountains, with alpine meadow vegetation at higher elevations.

The western part of the Canadian Plains and the adjacent Cordillera experienced several glaciations during the Pleistocene (Clague 1989, Fulton 1989,

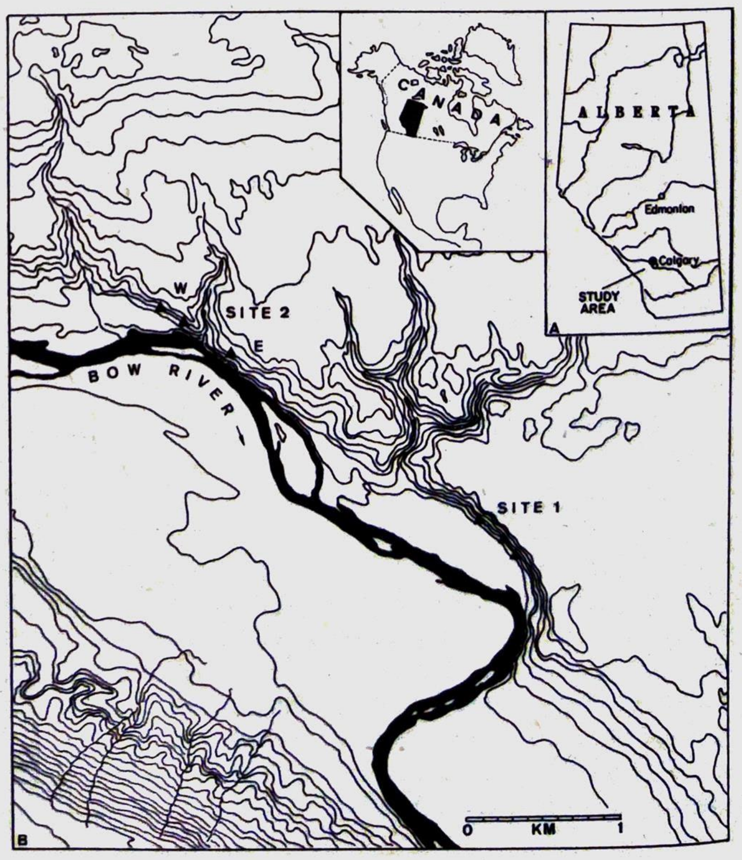

FIGURE 1. *Geographical location of the study area. Location of the investigated sites with the stone industry distribution (Site 1 – Varsity Estates; Site 2 – Silver Springs) in the Bow River valley, Calgary N.W.*

Fulton, Fenton and Rutter 1986, Bobrowsky and Rutter 1992, for review). The initial Late Pleistocene (Early Wisconsinan) glacial history after the Sangamonian (Eemian/Riss-Würmian) Interglacial is poorly known, as most of the record was obliterated during the Late Wisconsinan glacial advances, following the Watino Nonglacial Interval (65,000 – 23,000 B.P.). There has been disagreement about the timing and maximum extent of the Cordilleran and the Laurentide ice-sheets at that time. It seems that most Rocky Mountain glaciers in southwestern Alberta had retreated before the continental Laurentide ice reached its maximum extent; and that there was a decreasing magnitude of individual Cordilleran glaciations (Rutter 1972, Clague 1989, Jackson et al. 1989, Ryder, Fulton and Clague 1991, Bobrowsky and Rutter 1992). The only place of coalescence of the western and eastern glaciers is sufficiently well documented in west-central Alberta in the Athabasca valley (Bobrowsky and Rutter 1992). The spatial and temporal configuration between the two ice-masses during the last (Late Wisconsinan) glacial stage traditionally has been regarded as crucial for the timing of human dispersal into America south of the continental ice sheet.

SITE LOCATION AND GEOLOGY

Calgary Site 1 (the Varsity Estates Site), spatially defined by stone artifact occurrences, is located on the northwestern periphery of the city of Calgary on the left (northern) side of the Bow River valley ca. 2.5 km southeast of Site 2 (the Silver Springs Site) (*Figure 1-B*). The steep, cliff-forming slopes above the river are there up to 51 m high (1084 m asl. at the top), and are deeply dissected by gullying and intensively modified by slope gravity processes (*Figure 2*). The valley wall was exposed to river erosion during the early postglacial, transecting thick glaciolacustrine deposits of Glacial Lake Calgary and the underlying glacial diamicton (till) deposits (*Figure 3*). Above the upper margin of the NW-SE oriented river valley, which is the floor surface of the former glacial lake and the present top of the exposures, a broader (glacial) valley opens, which is bordered by rolling upland prairie. To the west, the relief gradually rises into the foothills area to the front range of the Eastern Cordillera about 100 km west of Calgary.

Geological investigations were carried out on the northern, southwest-facing side of the Bow River valley for a distance of about 3 km in places where sediments are exposed in several sections, varying

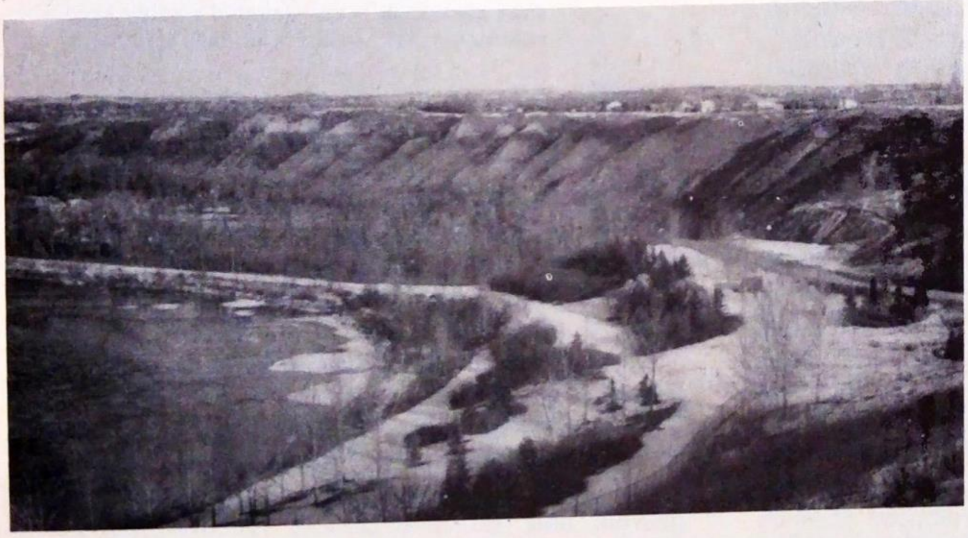

FIGURE 2.
View from the south of the Varsity Estates sections above the Bow River.

FIGURE 3.
Close view of the Varsity Estates sections from the southwest with exposed Glacial Lake Calgary deposits in the upper part of the bluffs. The arrow indicates the contact of the glaciolacustrine formation with the underlying Cordilleran Bow Valley till, i.e. the stratigraphic position of the upper series *lithic industry.*

horizontally and vertically in their extent according to stability of the slope. At Site 1, the geological structure is discontinuously revealed ca. 300 m toward the northwest and about 100 – 200 m north of the present river channel. A general Quaternary stratigraphy was established from two exposed sections located about 150 m from each other (VEw and VEe), comprising the middle and upper parts of the bluffs, respectively (*Figure 4*). The mapping of the lower part is hindered by eroded talus deposits covered by vegetation. Accordingly, geology of the lower sections is extrapolated from more accessible exposures located about 2 – 3 km farther west at Silver Springs (Site 2).

The lowermost exposed and laterally traceable deposits consist of an unstratified, unsorted, polymodal sandy-gravelly glacial diamicton (till), at least 1.5 – 5.0 m thick (Unit 1). The gravel clasts are well-rounded with the average pebble size of 3 – 5 cm, and the modal size of the cobble gravel of 13 – 15 cm, with a maximum of 50 cm. Occasionally, large (40 – 100 cm) angular to subangular sandstone blocks eroded from the local bedrock (the Tertiary Paskapoo Formation) are embedded within the diamicton. Gravel lithology is dominated by various quartzite and carbonate (siltstone and limestone) rocks followed, in much lesser amounts, by quartz, chert, sandstones, shales and schists. Small subangular to subrounded gneissic and granitic rocks from the Canadian Shield area occasionally occur on top of the till. However, these are extremely rare, so far limited to about a dozen pieces. The upper contact of the till with better-sorted gravelly deposits is diffused and erosional; the contact with fine clayey deposits is sharp and conformable (disconformity II). The till is capped by a gravel cobble lag, loosely incorporated in the fine-grained clayey matrix. In places, moderately-sorted glaciofluvial (outwash) silty sand and gravel beds are discontinuously deposited above the main body of the till. The silty-sandy sediments (Unit 3) are cross-laminated, 0.2 – 0.3 m thick and lithologically dominated by quartz and carbonate grains. The cobble-sized, clast-supported gravel strata (Units 2 and 4), 0.3 – 0.9 m thick, are petrographically identical with the till clasts formed by well-rounded pebbles and cobbles of yellow-grey, red purple-banded and pink quartzites, and dark grey carbonate (siltstone and limestone) rocks, all originating in the Rocky Mountains. Distinct striations cover surfaces of about 15 – 20 % of mostly weaker carbonate clasts.

The middle and upper parts of the Varsity Estates sections are formed by 20 – 25 m thick, moderately- to well-sorted and interbedded silty sands, silts and clays of Glacial Lake Calgary (Unit 5). These are almost completely exposed in a deeply eroded ravine in the west part of the site (*Figure 3*), whereas at other places the glaciolacustrine deposits are covered by grassy vegetation. The fine-grained sediment strata are largely laminated (varved) and display a significant vertical variability, suggesting glacial lake-level fluctuations. The individual laminae gradually decrease in thickness from more than 2 mm to less than 0.5 mm throughout the exposed sections (VEw). All sediments are highly calcareous. Occasional pebbles, 0.5 – 3.0 mm large, are embedded as dropstones in the fine-g rained matrix.

The overlying 1.0 – 1.5 m of aeolian (loess) and fine sandy colluvial deposits form the uppermost part of the cliffs. Two palaeosols, classified as a Dystric Brunisol with a distinct reddish Bf horizon (Unit 6) and a Black Chernozem (Unit 8), developed within these deposits, and are separated by a grayish layer of Mazama volcanic ash (6,850 B.P.). A recent Holocene chernozem covers the top of the site cliffs.

Profile of the investigated section (1992 excavation):

0 – 10 cm	Dark brown (10YR 2/2 d), largely truncated Ah horizon of a (Dark Brown/Black) Chernozemic soil.
10 – 12 cm	Pale brown (10YR 6/3 d), clayey, slightly hard eluviated Ae horizon of the soil.
12 – 40 cm	Dark grey (10YR 4/1 d), clayey, very hard Bmk horizon with a prismatic structure breaking into fine angular blocky towards the top.
40 – 150 cm	Light olive gray (5Y 6/2 d), clayey, very hard calcareous Ck horizon with a massive blocky structure, developed on the glaciolacustrine substratum.
150 cm	Gravelly surface of the poorly-sorted, clast-supported glacial diamicton (till) with cobble- to pebble-sized clasts loosely incorporated within a sandy-silty matrix. The surface is laterally continuous.

ARCHAEOLOGICAL EVIDENCE

The Varsity Estates Site was recorded in October 1990 after a few artifacts were found in and immediately below the eroded exposures in the middle part of the bluffs (*Figure 3*). The culturally modified lithics referred to as the *upper series* artifact assemblage originate from the gravelly upper part of the till and from the till surface beneath the lake deposits. At Site 2 (Silver Springs), identical flaked artifacts (the *lower series* artifact assemblage) are distributed, largely in a secondary position, in the upper part of fluvial gravels, and the basal part of the overlying glacial diamicton (the Bow Valley till), which is correlated with the till at Site 1 (Chlachula 1994). Large scale excavation has been prevented by the steep slope escarpment and thickness of the lake deposit overburden (*Figures 5* and *6*). Nevertheless, the excavated area at Site 1, although fairly limited, at that time, produced the most conclusive cultural evidence.

All artifacts from the till were imbedded in its upper part without any spatially concentrated and patterned distribution. Although clearly not in original context, some are relatively fresh in condition; others are abraded, sometimes to such a degree that their cultural modification might be questioned. Despite this fact, there are several well-produced and diagnostic tools, including some of the best found at both sites. It is possible that these abraded pieces were secondarily intruded from the former top of the

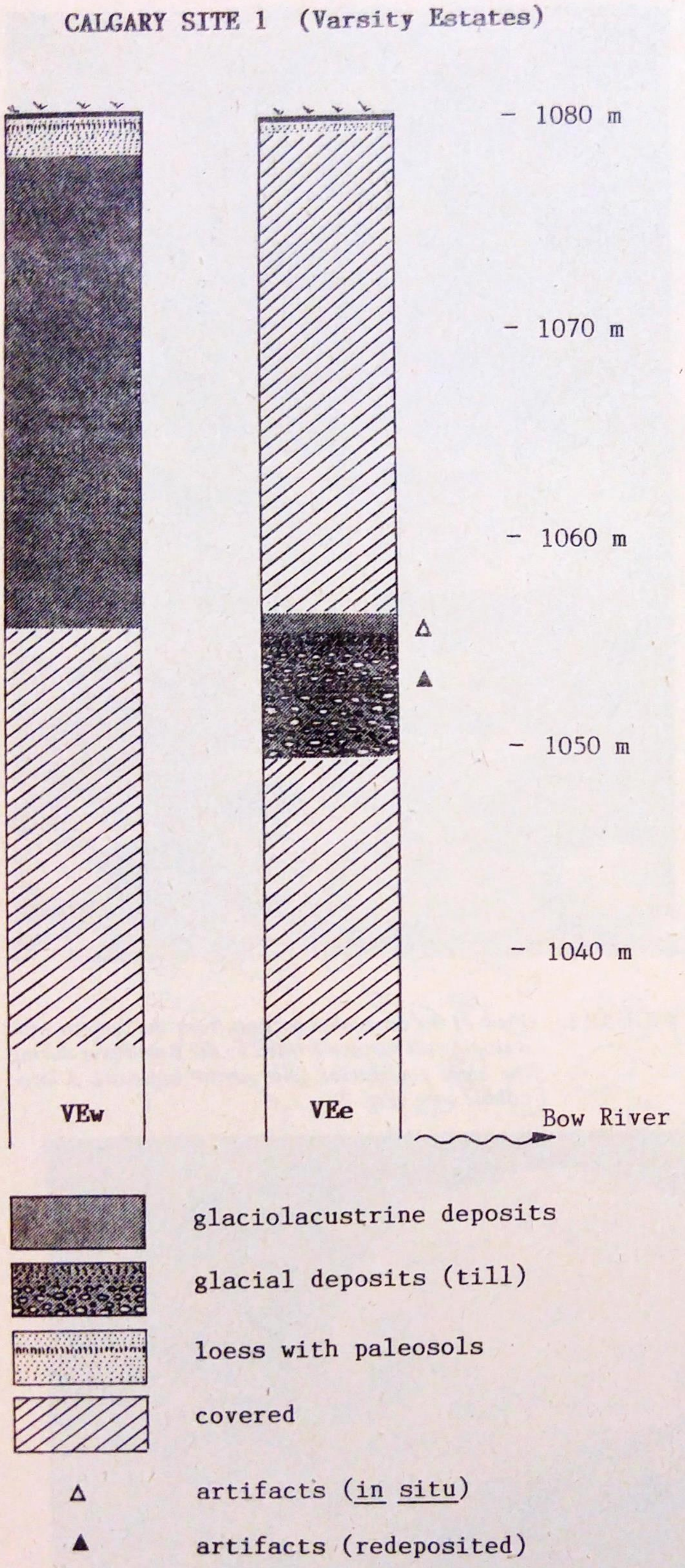

FIGURE 4. *Schematic geological profiles at Site 1; Varsity Estates Sections (VEw and VEe).*

proglacial outwash, forming the upper surface of the till, by subsequent mass-flow and stream processes affecting the poorly consolidated diamicton surface. However, it cannot be excluded that some artifacts were derived from an earlier cultural context (correlated with that of Site 2), which was disturbed by the advancing valley glacier and secondarily incorporated into the accumulated till. This would particularly concern the occasionally striated specimens with obvious traces of previous artifactual flaking. For now, their exact original provenance is not completely resolved.

Most of the artifacts assemblage from the gravelly surface of the till, buried directly beneath the lake sediments, are characterized by a largely uniform fresh appearance of the recorded lithics. Some specimens were excavated *in situ* on top of the till in November 1992. Specifically, this concerns the concentrated and partly clustered artifacts found in the excavated section in the middle part of the bluffs (*Figures 5 – 8*). The nearly original position of the cultural sample is documented by identical raw material, spatially restricted distribution of artifacts within an area of about 2 m^2, and by their almost fresh appearance without any apparent traces of secondary abrasion (*Figure 8*). Except for two cores and three tools (*Figure 9*), this excavated assemblage includes seventeen fragments *(débitage)* from a bifacially flaked quartzite artifact (*Figure 10*). Five of the seventeen flakes (*Figures 11 – 12*) were found prior to the excavation in a small gully near the naturally exposed lateral surface of the till in an area of about 50 × 50 cm (*Figures 11: 3 – 4, 10, 12: 4 – 5*). The minor recent erosion revealed that the lithic flakes had clearly been derived from the top of the gravelly till surface buried by the lake deposits. During a subsequent visit about a month later, the biface itself was removed from the intact steep exposure at the contact between the till and the glaciolacustrine deposits. The piece was discovered purely by chance, since only its unmodified basal part protruded about 3 cm from the incorporating glacial diamicton matrix. Although the area had been carefully searched several times, this cluster of flakes had not been discovered earlier, though other eroded artifacts were found below the section. Subsequent excavation carried out at this place in November of 1992 yielded the remaining (though not all) pieces of *débitage* represented by additional 12 flakes and a few other artifacts found densely distributed on the exposed excavated surface of the till (*Figure 8*). The +/– values in the grid demarcate the erosional surface with the glacial diamicton gravels sloping to the south (quadrants E-G/-1; E-G/-2). The slope erosion was caused by the degrading Bow River after the final drainage of Glacial Lake Calgary by cutting through thick glaciolacustrine and glacial deposits. The thickness of overburden progressively increases because of a rather steep angle of the slope (*Figure 5*). All recorded specimens lay on the gravelly top of the till and were embedded in a cohesive and hard silty-loamy matrix. The clear cultural evidence manifested by these finds provides a diagnostic control for comparison with other flaked specimens from both Calgary sites.

In addition to the artifacts recorded in their original (primary or secondary) geological contexts, some artifacts were collected on the slope just within the eroding exposures, and evidently derived from the same glacial deposits. Any possibility that these speci-

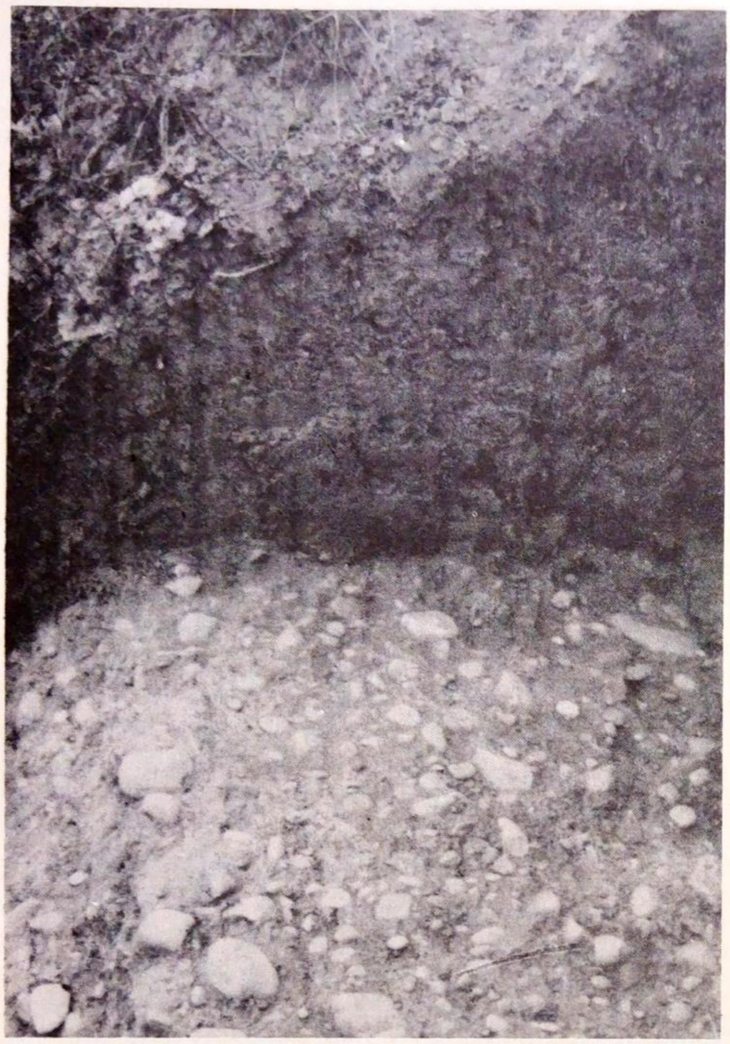

FIGURE 5. *View of the exposed industry-bearing gravelly surface of the Bow Valley till (1992 excavation).*

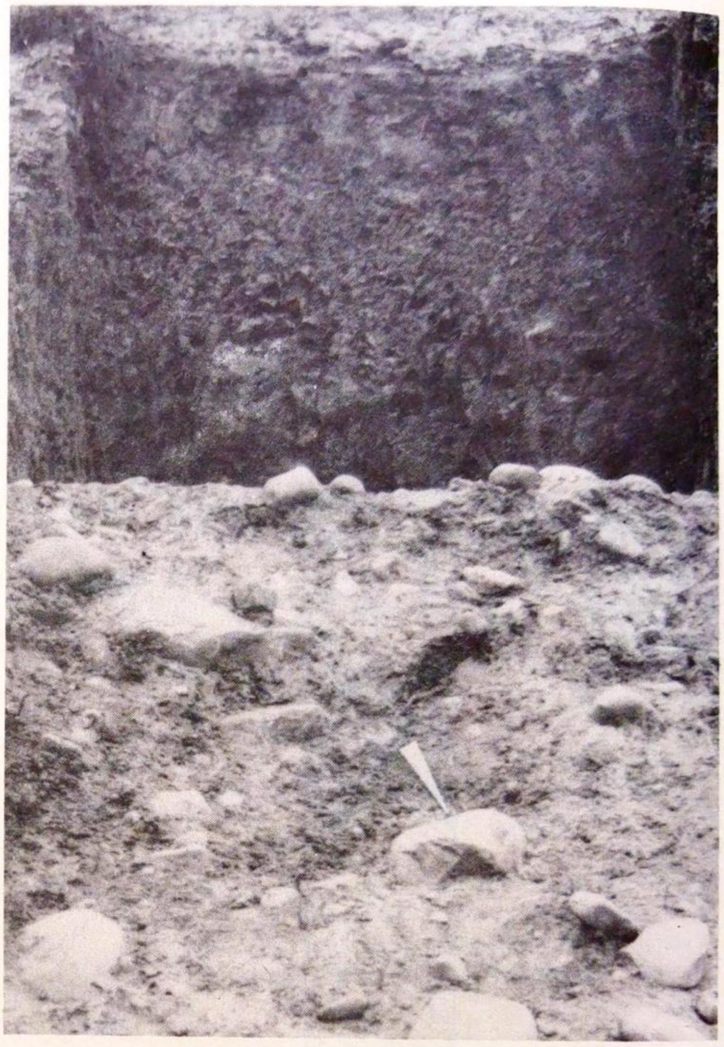

FIGURE 6. *View of the excavated section from the bottom with a sloping till surface eroded by the Bow River during the early postglacial. The arrow indicates a large cobble core (Fig. 7).*

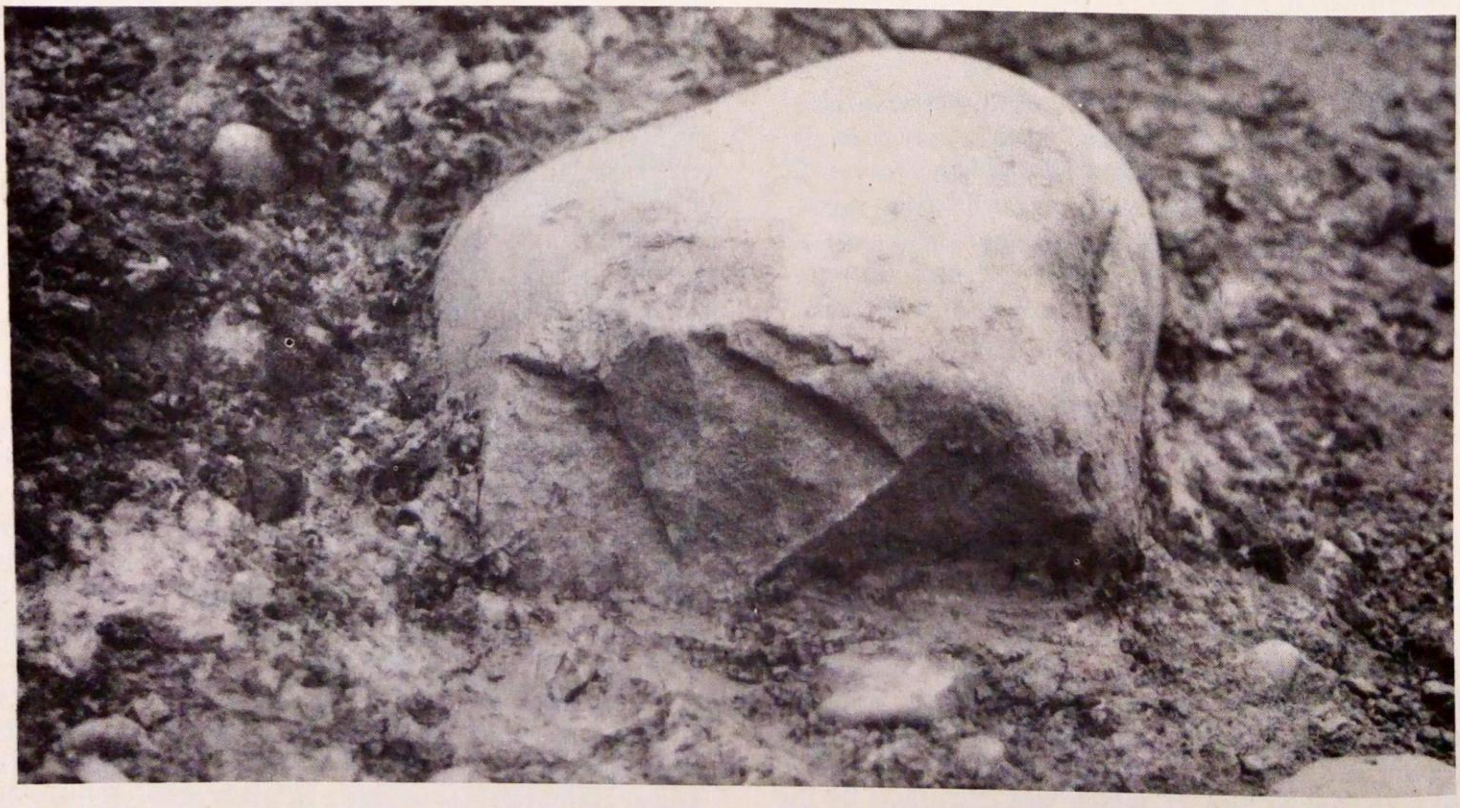

FIGURE 7. *Close-up view of the quartzite cobble core (ca. 18 cm in diameter) embedded on the till surface in a clayey matrix.*

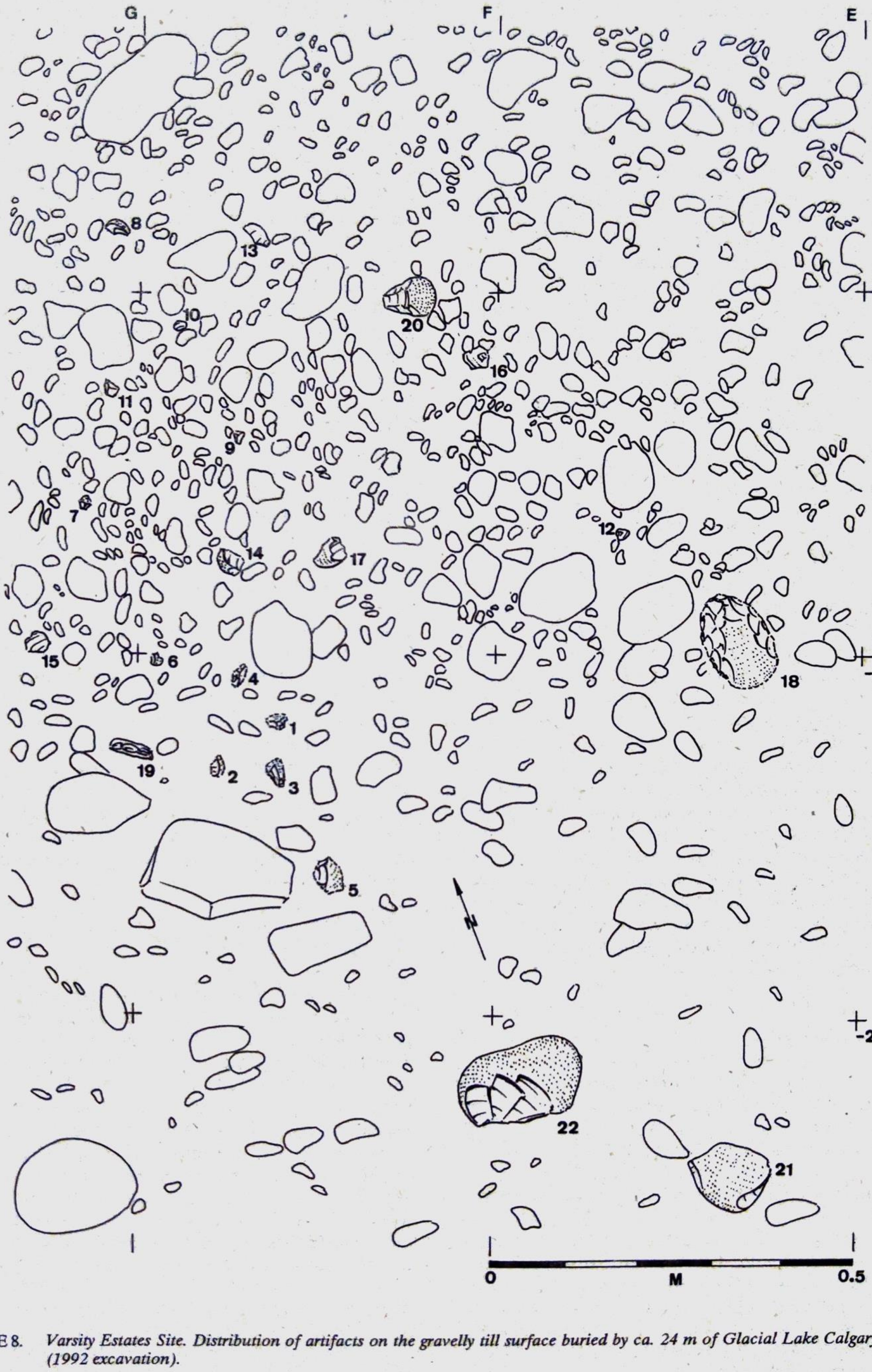

FIGURE 8. *Varsity Estates Site. Distribution of artifacts on the gravelly till surface buried by ca. 24 m of Glacial Lake Calgary deposits (1992 excavation).*

mens were introduced from the upper (modern) surface of the bluffs is excluded because of the presence of textural traits on the modified surfaces (glacial striations or fluvial abrasion, and calcium carbonate incrustation) identical with those encountered on the specimens excavated from the above geo-context. Moreover, not a single artifact has been found on top or near the present surface above the cliffs. Also, except for very rare small pebbles (maximum dimensions of 3 cm), no clasts occur on the upper part of the slope from above the till up to the (present) top surface. Finally, cultural modification of the investigated assemblage is documented by sets of patterned artifact-diagnostic modification attributes absent on clasts of the same lithology collected from glacial and fluvial, high-energy natural environments in Alberta. A detailed comparative analysis of cultural and natural flaking of local clasts is provided elsewhere (Chlachula 1994).

LITHIC INDUSTRY

Raw Material

Only local raw materials occurring in the gravelly deposits in the form of well-rounded, mostly low-sphericity cobbles were used for stone tool manufacture. The majority of these include various quartzite and hard carbonate (siltstone and limestone) rocks. More resistant sandstone blocks were occasionally modified into larger artifacts. The general physical appearance of the flaked specimens is largely uniform, although some differences in surface abrasion exist between those tools recorded on or close to the till surface, which are characterized by nearly fresh to slightly abraded flaked faces; and those embedded deeper within the diamicton deposits, which are more abraded. Occasional glacial striations are also present on the latter. The clastic rocks used vary considerably in size from pebbles to large cobbles weighing over one kilogram.

Technology

Lithic technology is overall rather simple, although well manifested in patterned occurrences on specific artifact types that were produced and possibly used in the same or a very similar manner. Technological aspects of the recorded lithic collection from Site 1 cannot be uniformly classified under a single mode of stone tool production. Despite this fact, recurrent patterns of primary flaking and edge retouching are evident. These include principal technological traits of "pebble-tool" or core and flake industries dominated by unifacial flaking techniques. Nevertheless, some more elaborate bifacial flaking, a variety of flake-based technologies, and a blade-oriented extraction technique are present as well.

The most basic but principal level of technology includes rudimentary flaking in the form of direct percussion. As observed on original specimens and tested by experimental flaking, this "hard hammer" technique was performed by using cobbles of a suitable shape and size in a variety of ways.

Easy-to-flake, low-sphericity cobbles were preferentially employed as *support,* whereas more resistant high-sphericity clasts were used as hammerstones as manifested by concentrated percussion marks apparently resulting from repeatedly induced blows on their exposed terminal ends (*Figure 15: 5*). Unifacial as well as bifacial flaking patterns were produced by applying this basic hand-held technique. Another primary flaking procedure applied to fracture large cobbles involves the static anvil percussion technique *(technique à l'enclume).* The point of impact is evidenced by distinct and concentrated percussion marks in the central basal part of the fractured cobble. Naturally sharp edges of these pieces were mostly successively retouched into massive side scrapers. A few flat cobbles are likely to have been fractured by a bipolar anvil technique.

Retouching was performed by smaller cobbles or pebbles according to the size of the worked piece and the nature of modification performed. Usually, one part of the *support* – a cobble or a flake – was retouched. The more or less uniform orientation and the frequent, consistently organized superimposition of individual flake scars, the uniform angle of their arrangement, the identical shape of negative scars after flakes were detached, and the intensity and regularity of edge modification bear witness to a high degree of control during the flaking process. As all observed forms of edge modification are easily replicable by direct percussion using readily available clasts, the use of indirect percussion, or a "soft-hammer" technique, was unnecessary and probably only exceptional.

Typology

The typological implement variety from Calgary Site 1 corresponds to the technological level of its production. Accordingly, numerous forms can be found which have parallels in the Old World Early, Middle as well as Late Palaeolithic. This fact makes the stone industry rather "archaic" and formally heterogeneous by looking from a European perspective. As the clastic raw material was abundantly available at the site, there was no need to curate produced artifacts and to use them, as well as the raw material itself, in a more economical way. Accordingly, this fact explains the presence of a high number of artifactually flaked and fractured cobbles mostly used as simple cores, whereas the number of finished tools is disproportional and relatively limited.

The most significant tool class in the assemblage is represented by choppers. Unidirectionally flaked pieces prevail over bifacial ones. In both cases the

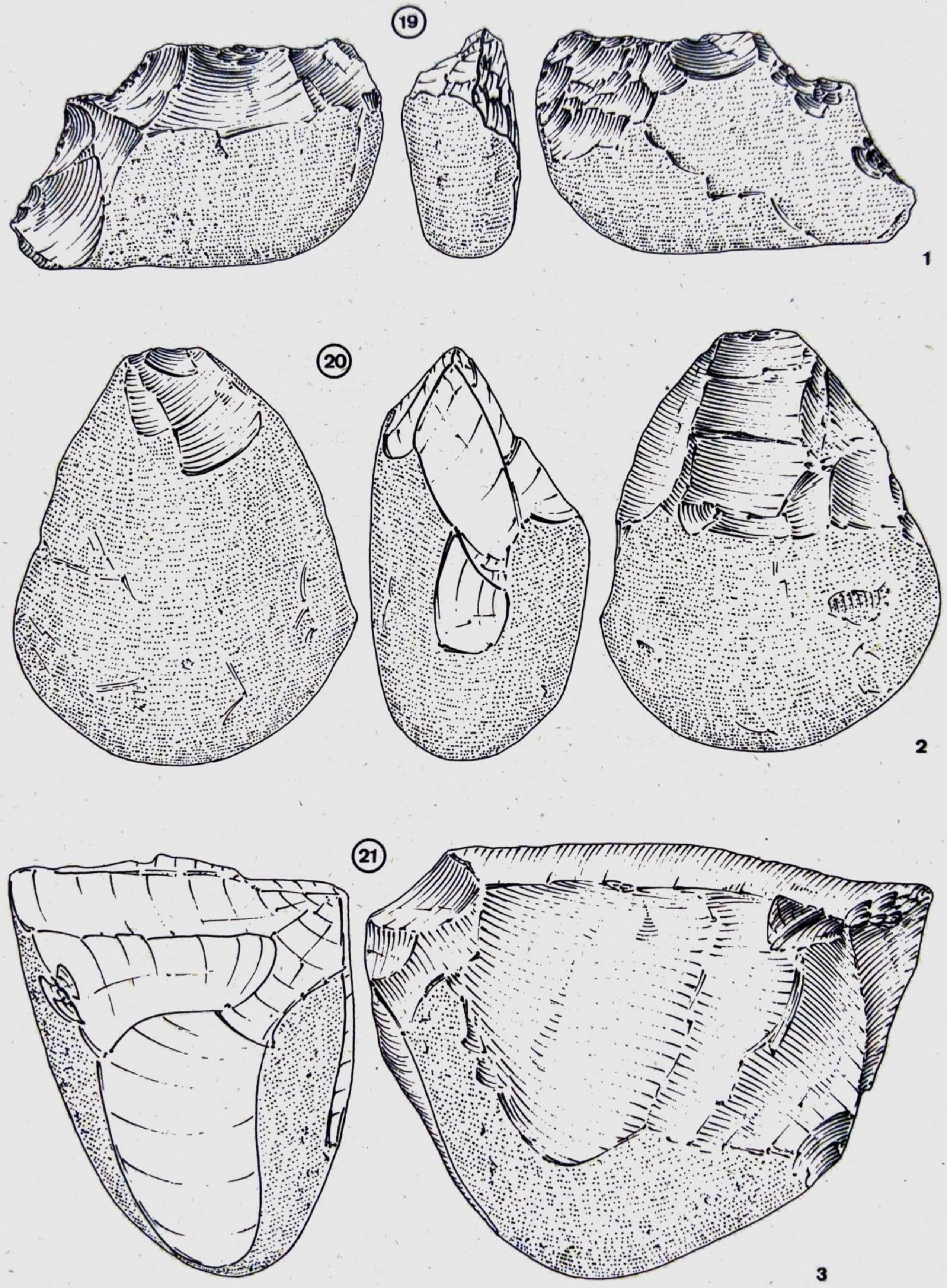

FIGURE 9. *Varsity Estates Site. Lithic industry: 1 – bifacial chopper / denticulate side scraper; 2 – pointed bifacial chopper; 3 – cobble core. All quartzite. The numbers refer to the spatial distribution of artifacts in the excavated section (Fig. 8). Drawings by the author.*

FIGURE 10. *Varsity Estates Site. Lithic industry: Biface on quartzite cobble.*

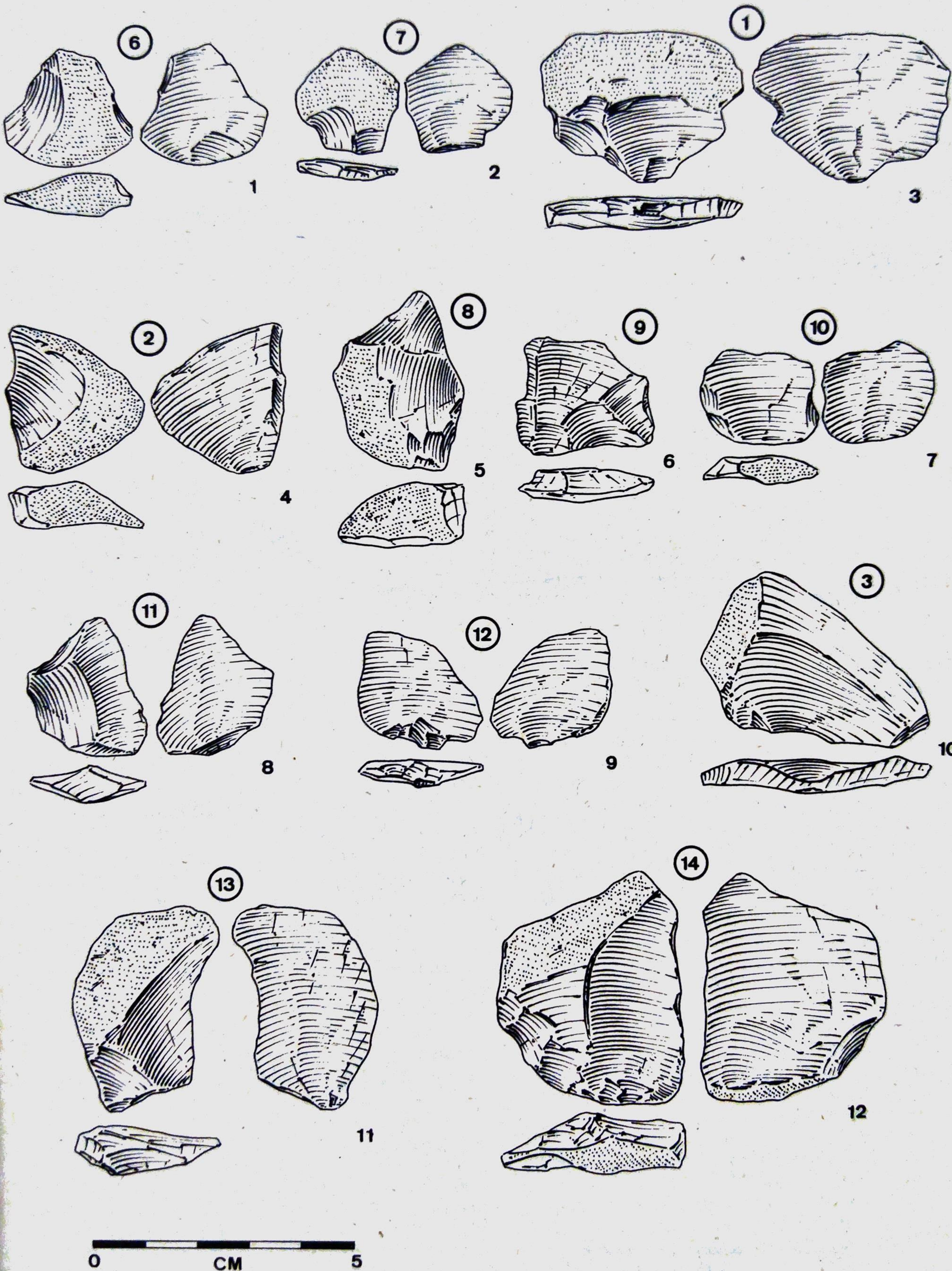

FIGURE 11. *Varsity Estates Site. Lithic industry: 1–12, débitage to the biface (Fig. 10).*

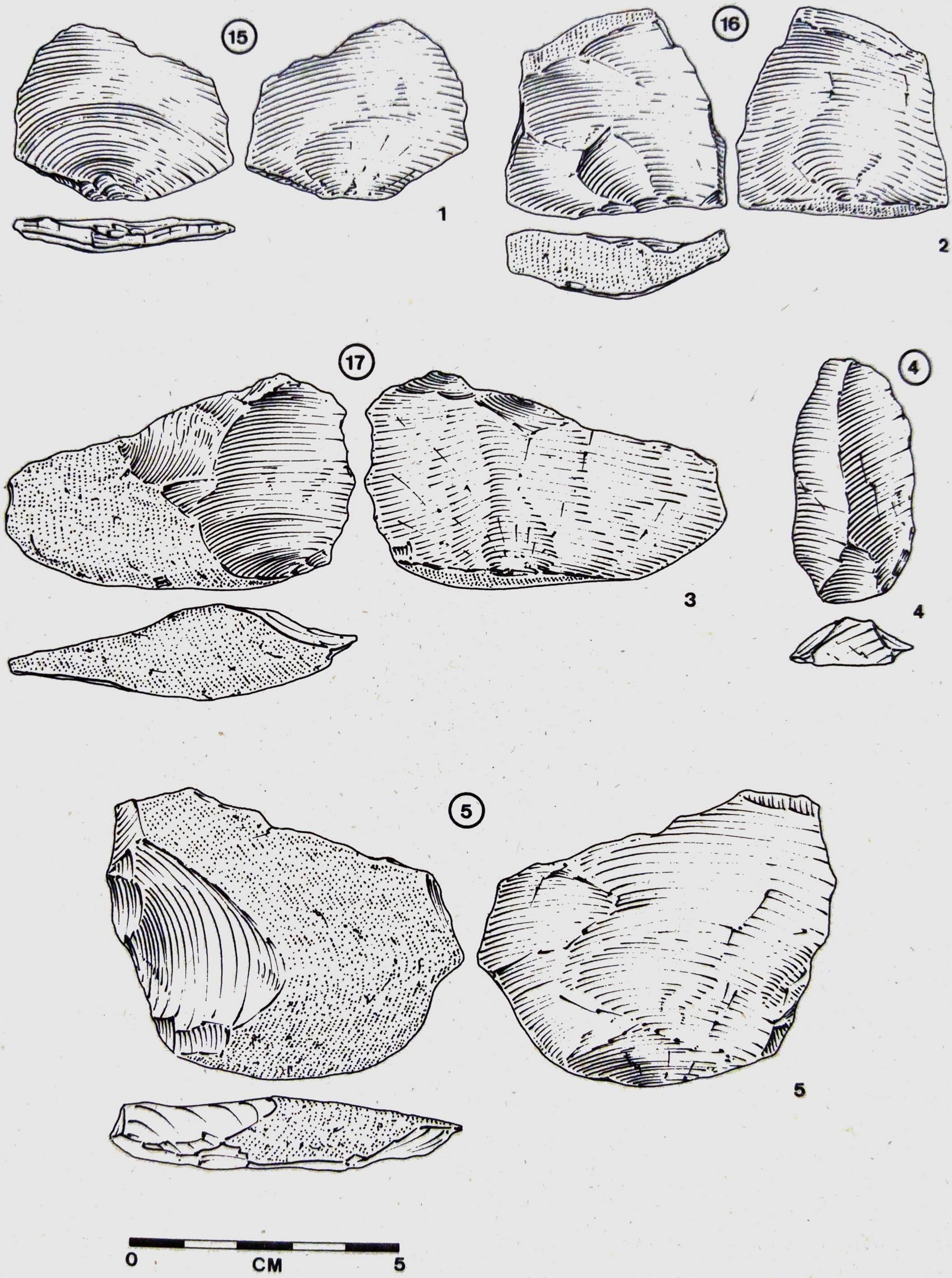

FIGURE 12. *Varsity Estates Site. Lithic industry: 1–5, débitage to the biface (Fig. 10).*

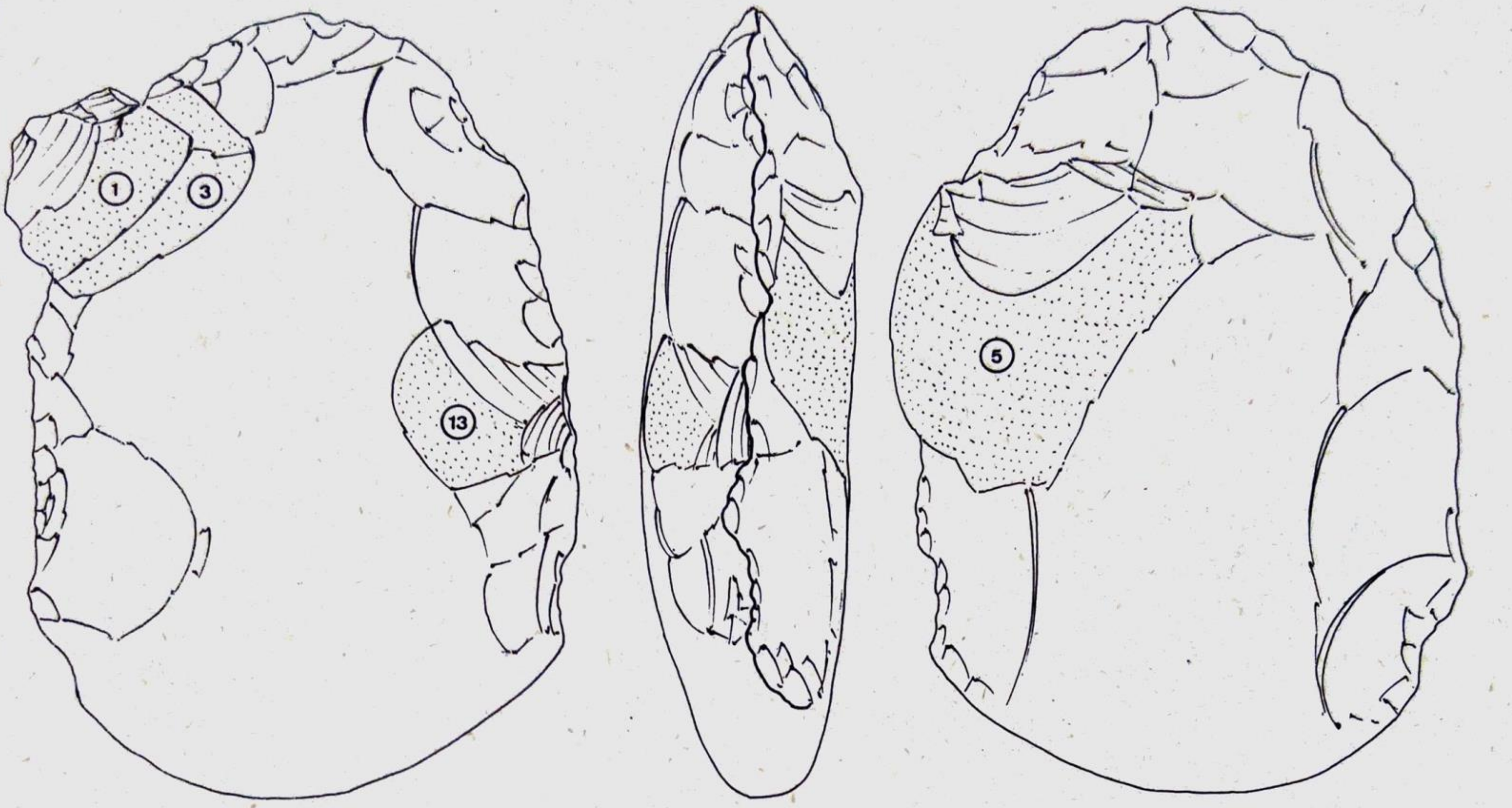

FIGURE 13. *Varsity Estates Site. Lithic industry: The biface with a part of the refitted débitage (Figs. 10–12).*

modification is usually confined to one end of the natural morphology of a pebble/cobble (*Figure 14*). Most choppers are single-edge specimens (*Figure 24*), but double-edge variants also occur. Functional edges are usually roughly denticulate or concave with apparent traces of damage caused by repeated blows centered in their middle part. Straight and convex forms are exceptional. Two specimens are classified as pointed choppers. In most cases, these rudimentarily worked tools are produced on suitably pre-shaped or broken clasts and show only minimal additional progressive flaking on naturally sharp edges provided by an irregular retouch or only a pseudo-retouch induced in the working process (*Figure 15: 3*). The bifacial choppers are characterized by only few detached flakes on each side (*Figures 9:1, 15:1–2, 4–5*). More consistent bifacial flaking patterns with alternately flaked sinuous edges are present only on a large bifacial chopper, a bifacial pointed chopper (*Figure 16*) and the biface from the excavated section (*Figure 10*).

Other bifacially modified artifacts, represented by single specimens, include bifacially pointed choppers (*Figures 9: 2, 17:1*), a *bifaçoide,* i.e. a unifacially flaked piece with rudimentary bifacial flaking around a part of the cobble which does not meet the criterium of a biface (*Figure 17: 2*), a pick-like quartzite tool with a narrow, elongated distal end triangular in cross-section, a tanged rhomboid "point" and another biface of an amygdaloid form. The last two artifacts produced on coarse sandstone fragments are, however, rather abraded and not well-shaped.

The most specific tool class of the lithic assemblage from Site 1 (as well as from Site 2) is represented by side scrapers on cobbles. These are produced on small, medium as well as large cobbles. The smaller forms were produced by a bipolar technique to break the clast; the massive side scrapers were manufactured on fractured cobbles using the static-anvil percussion technique (*Figure 19*). Secondarily flaked edges of these tools are almost straight or slightly convex, and more intensively and/or meticulously retouched than choppers. The retouch is exclusively unifacial, limited to a portion of the naturally available edge or the broken edge, and ranges from a steep to semi-steep form with mostly well-arranged and regularly overlapping flake scars (*Figure 25*). The remaining specimens were made directly on flat, easy-to-flake cobbles without any previous edge preparation (*Figure 20*). These less-perfectly-worked, dorsally retouched artifacts may be considered as transitional between choppers and scrapers, although they are formally classed as scrapers. They occur in single- as well as double-edge forms and are characterized by concave edges (*Figure 18*). Another "scraping" tool on cobbles, represented by two specimens referred to as *rabots* with a presumably functional edge at the distal end may, in fact, be secondarily reutilized cores (*Figure 21: 2*). Both are too heavily rolled to determine their actual function.

Only a few lithic well-diagnostic pieces could clearly be identified as cores. As the number of usable flakes discarded in the process of tool shaping is very high, the need for specialized cores was minimal. In

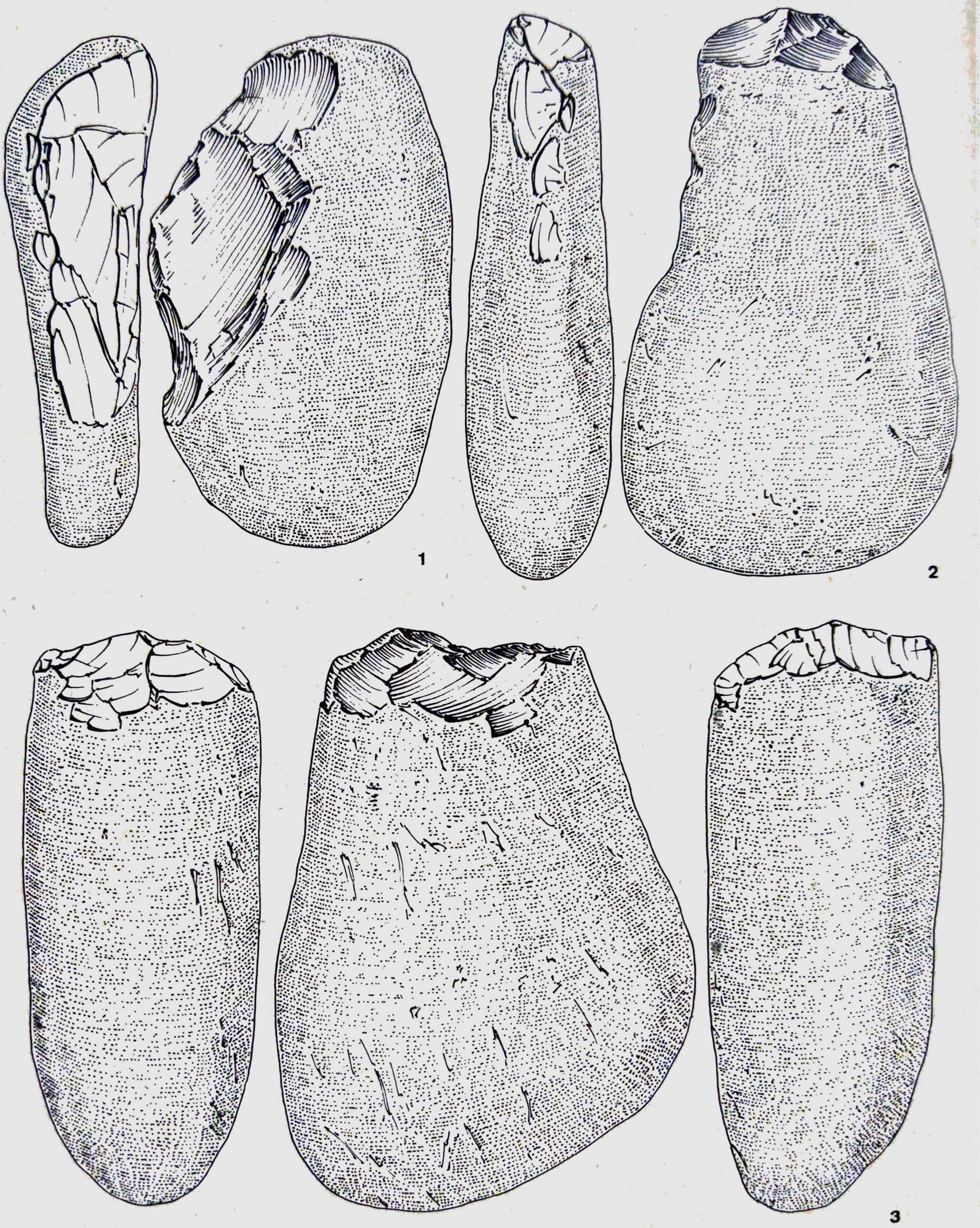

FIGURE 14. *Varsity Estates Site. Lithic industry: 1 – unifacial lateral chopper (till); 2 – unifacial distal chopper (eroded); 3 – distal chopper / core (till). All quartzite.*

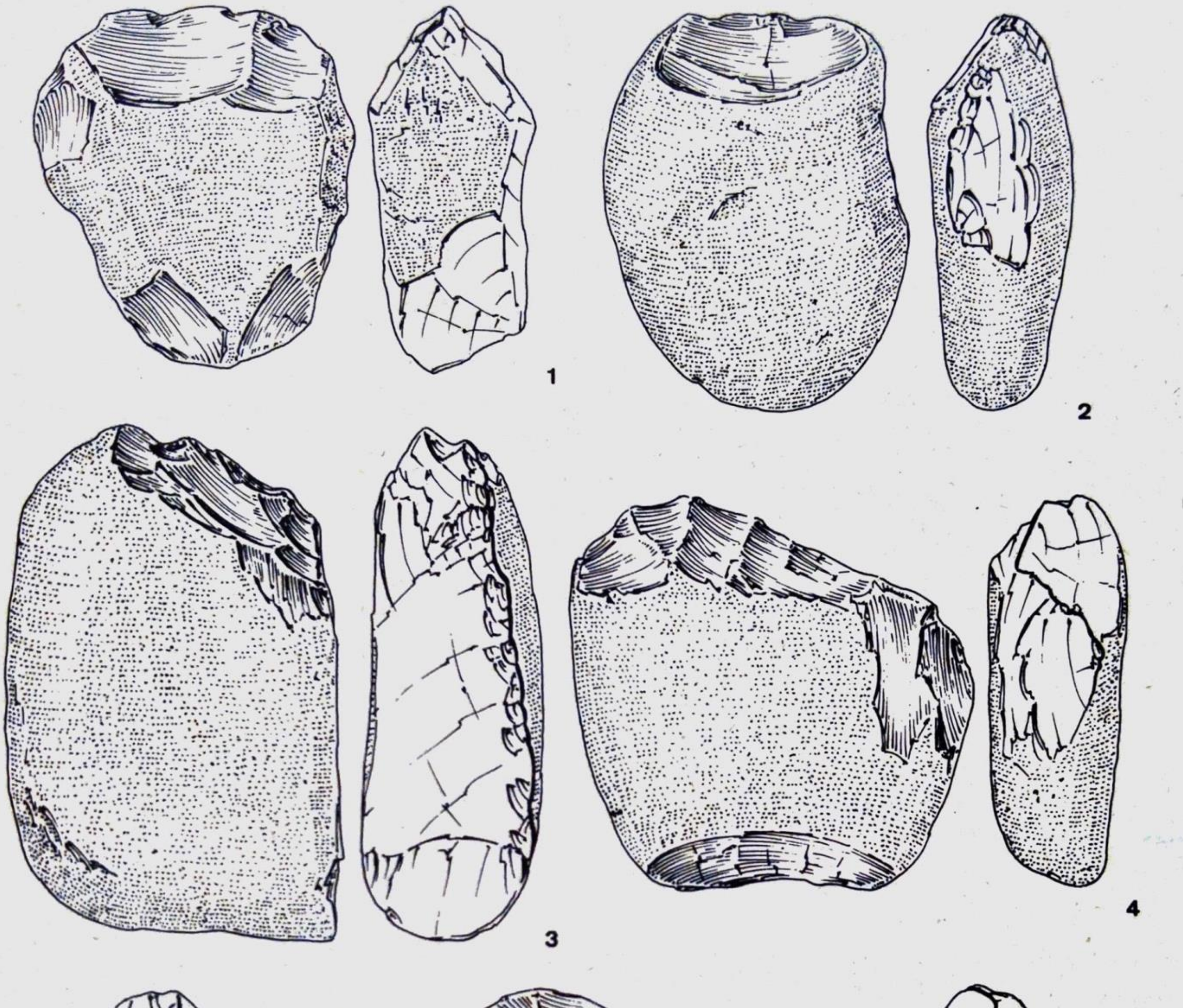

FIGURE 15. *Varsity Estates Site. Lithic industry: 1 – bifacial chopper (till); 2 – unifacial alternate chopper (eroded); 3 – angle chopper / side scraper (till); 4 – bifacial chopper (eroded); 5 – bifacial chopper used as hammerstone at the proximal end (eroded). All quartzite.*

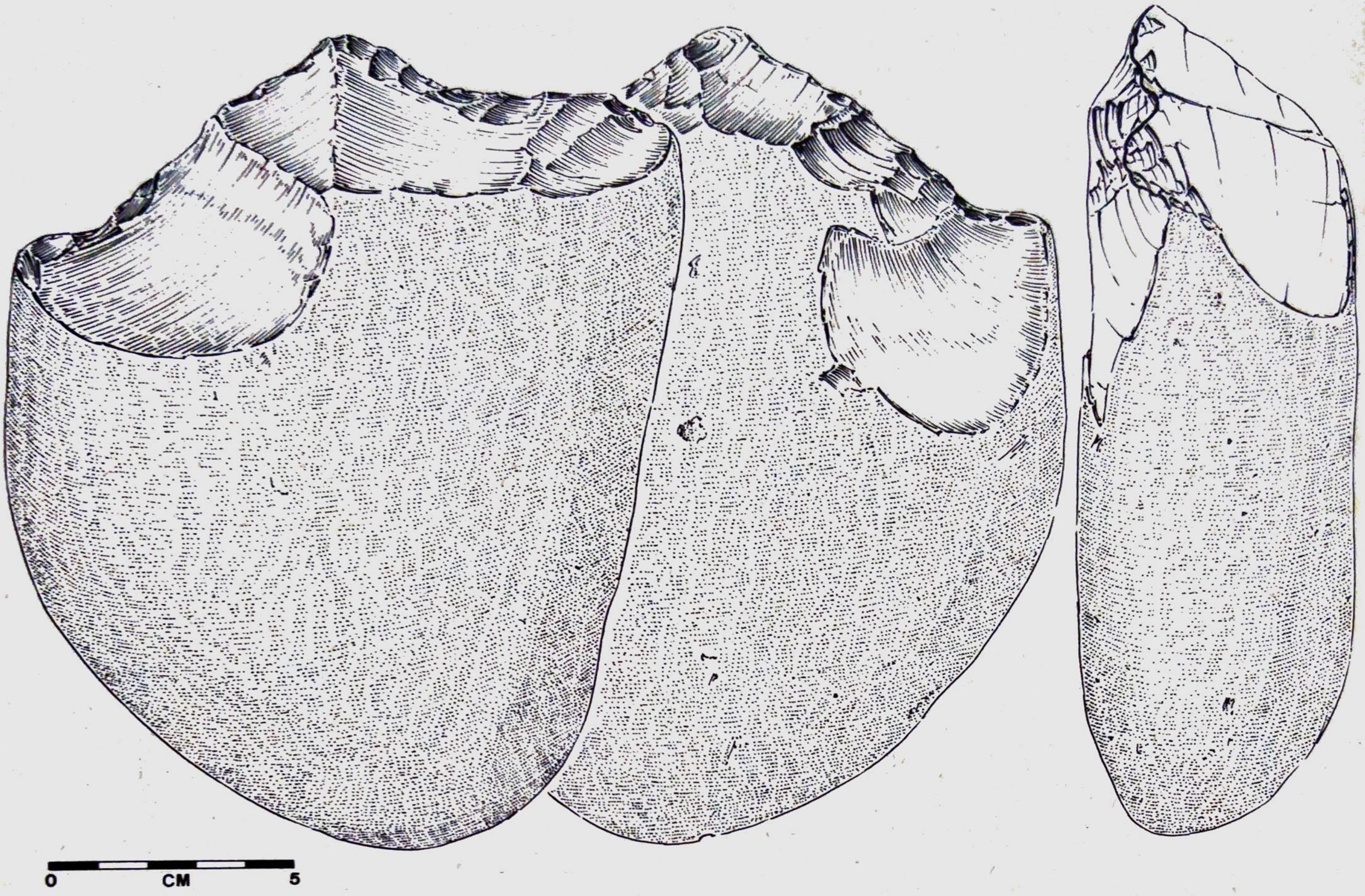

FIGURE 16. *Varsity Estates Site. Lithic industry: Pointed bifacial chopper (till). Quartzite.*

accordance with the overall technological trend, the application of hard-hammer flaking is indicated by the well-developed bulbs, and the thick basal parts of detached flakes. These may retain most of the original cortex on the dorsal side, or are fully non-cortical, as with butts preserving the residual flaking platform. Unprepared cobble cores show a differential degree of the reduction process, and simple as well as multiple flaking patterns (*Figure 9: 3*). More concentrated flaking was performed on a few chopper-like specimens, partly predetermined by the natural form of the raw material. A particular form is represented by a discoidal core that is completely bifacially flaked around its entire circumference (*Figure 21:1*). The most progressive of the recorded cores is the prismatic form with a single inclined non-cortical flaking platform displaying a series of parallel and well-organized negative blade scars, and preparatory lateral bifacial edge modification prior to the core extraction (*Figure 22:4*). The regularity of blade removals suggests an indirect-percussion technique. As the raw material available at the site is not really suited to a blade technology, it is not surprising that this specimen is unique among the artifact forms. The piece is very reminiscent of typical early Upper Palaeolithic European types.

The number of flake tools is still disproportional compared to the larger core tools. Their paucity reflects their limited visibility in the till deposits and the non-diagnostic nature of modification of some pieces not included in the type list below (*Table 1*). The sample of *débitage* appertaining to the biface is exceptional by its nature (*Figures 11 – 12*). Pieces formally classified as side scrapers prevail among the few modified flakes, so far recorded at the site. Their "typological" variability is primarily caused by the particular original form of blank flakes, reflecting different stages of core reduction, and by the location and type of retouch. Nevertheless, the overall character of modification is uniform with edge flaking performed on the dorsal side retaining part of the residual cortex. Only one specimen exhibits a (distal) ventral retouch. The butts of these artifacts are cortical or without the cortex; the functional edges are usually steeply retouched in a more or less denticulate form (*Figure 23:3*). There are two definite end scrapers. A denticulate edge is present on one specimen produced on a vertically split elongate siltstone cobble (*Figure 23:7*). The second is a well-manufactured, typical carinate end scraper made on a quartzite flake partly dorsally prepared with converging negative scars after previous flake removals, a narrow cortical butt, and a prominent bulb on the ventral flake face (*Figure 23:6*). The distal end is characterized by a steep, although not very distinct retouch, due to the mediocre quality of the raw material employed. It may be mentioned that this was one of the first artifacts found in October 1990 that precipitated further site investigations. A diherdal burin (*Figure 23:1*) and a flat-faced burin on coarse quartzite are

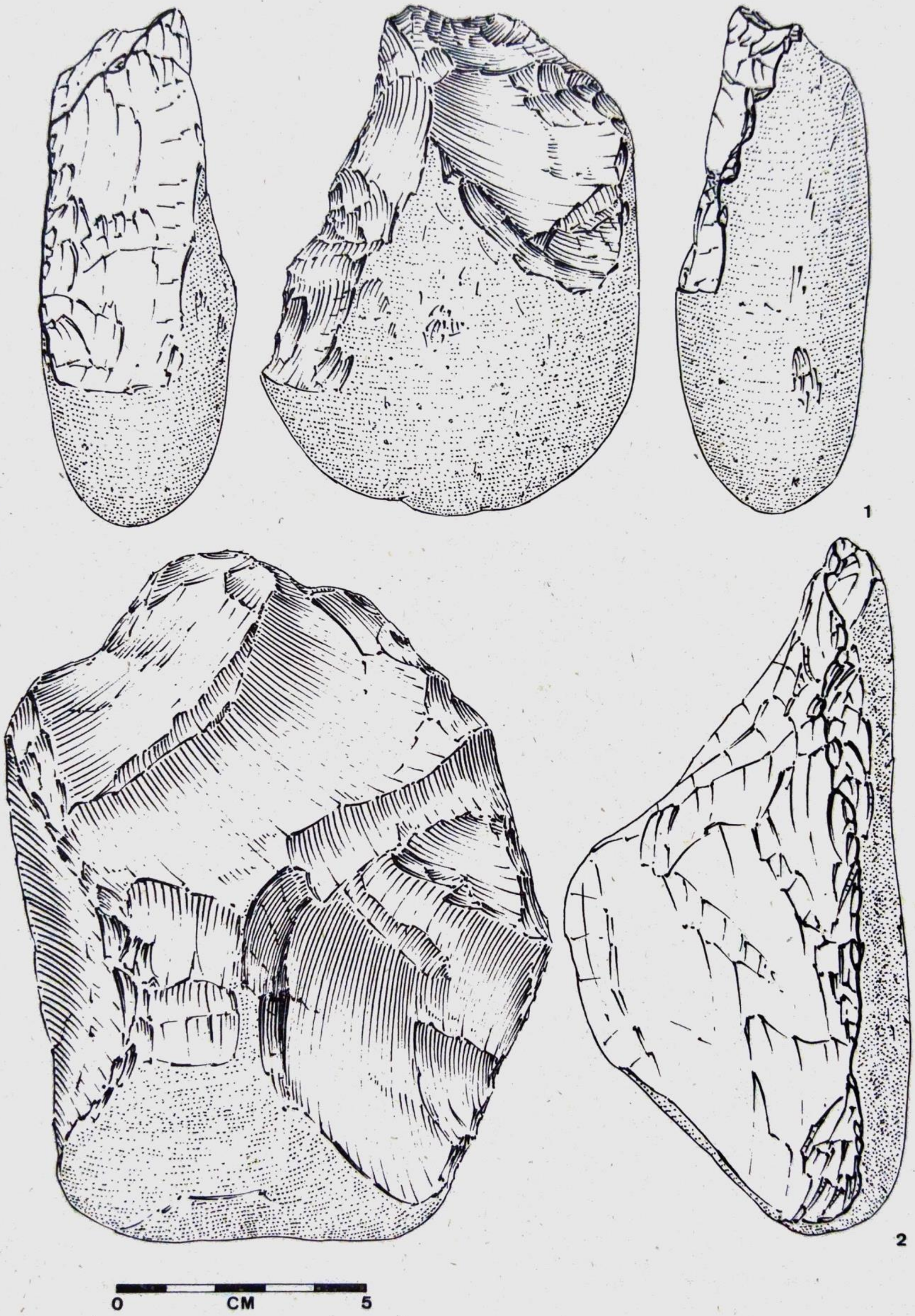

FIGURE 17. *Varsity Estates Site. Lithic industry: 1 – bifacial pointed chopper (till); 2 – bifaçoid (eroded). Siltstone (1), quartzite (2).*

FIGURE 18. *Varsity Estates Site. Lithic industry: 1 – transverse, double concave side scraper on cobble (till); 2 – lateral, double concave side scraper on cobble (till). Quartzite (1), siltstone (2).*

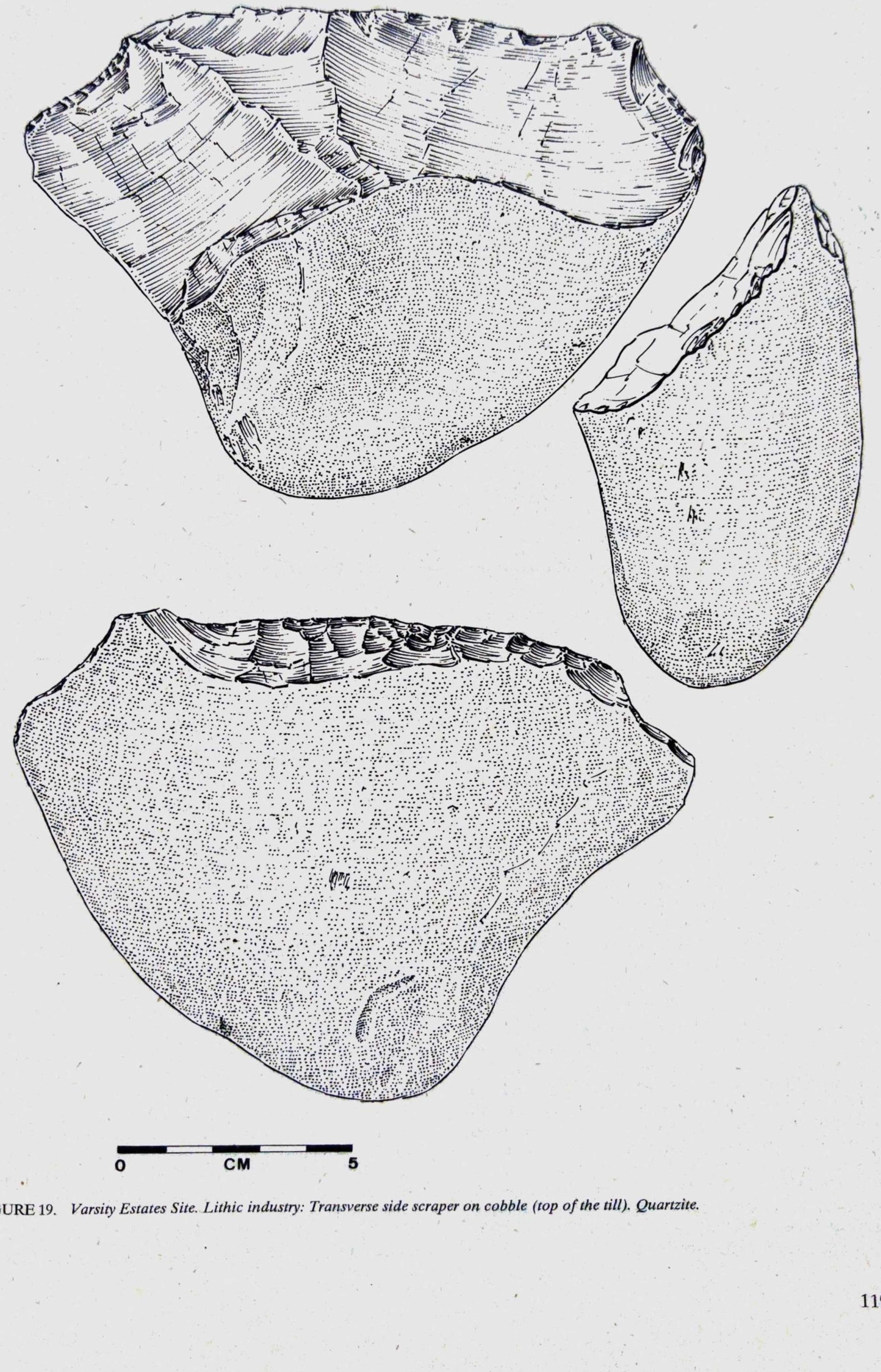

FIGURE 19. *Varsity Estates Site. Lithic industry: Transverse side scraper on cobble (top of the till). Quartzite.*

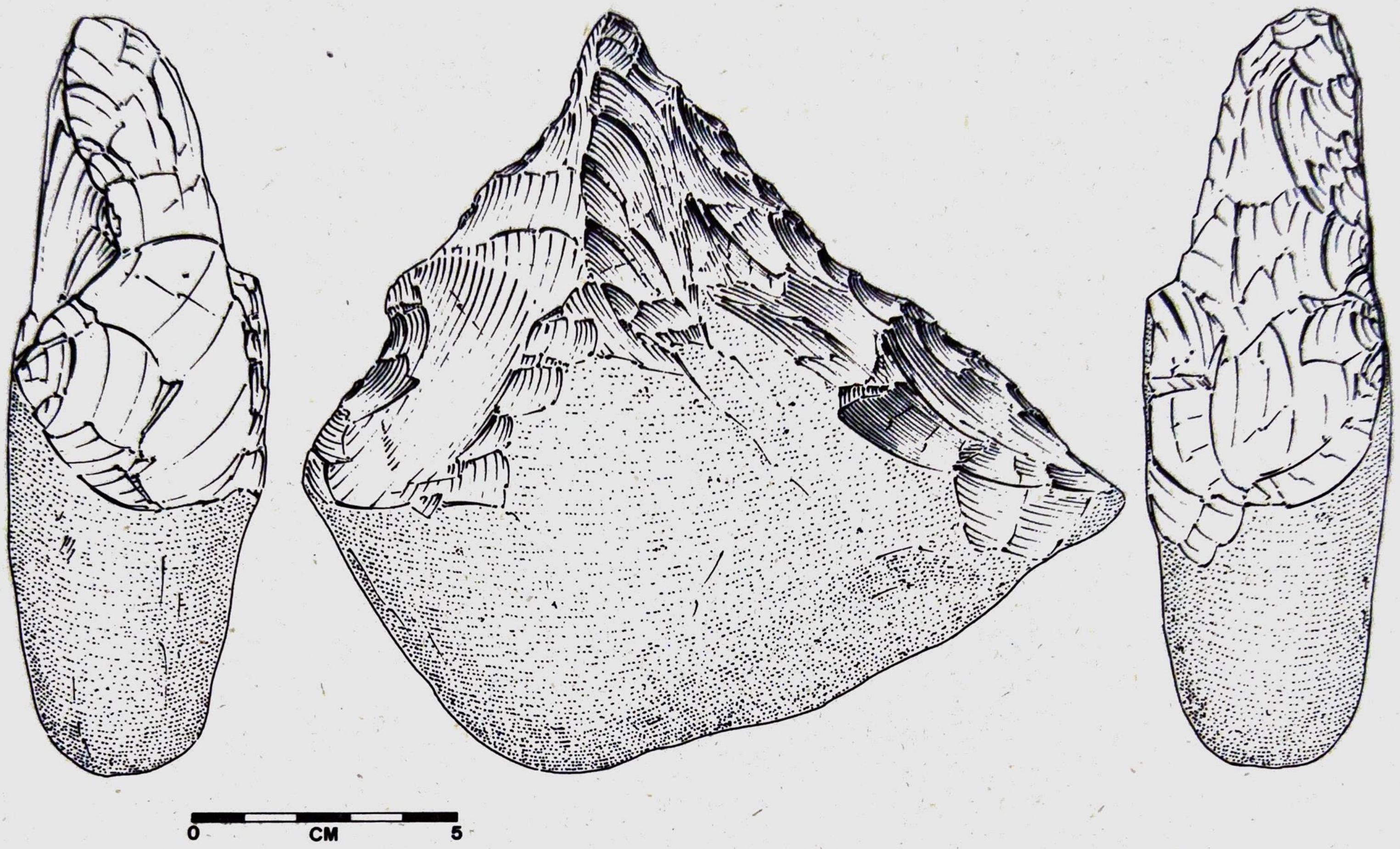

FIGURE 20. *Varsity Estates Site. Lithic industry: Convergent side scraper on cobble (eroded). Quartzite.*

also present. A few other specimens, including a denticulate and a notch flakes, are very rudimentarily modified and largely reworked by natural processes (*Figure 23:2, 5*). As their artifactual status is not fully established, they were not included in the summarizing stone artifact list (*Table 1*). Finally, there is one utilized quartzite flake with apparent micromorphological use traces on the sharp edge. The most explicit edge-wear, microscopically identified as differential polish, is manifested on the distal end of the carinate end scraper (*Figure 23: 6*).

In sum, the recorded artifact assemblage can be characterized as a simple core and flake industry. There are no formal differences between the flaked artifacts found as being redeposited mostly in the upper part of the till and those recorded from its gravelly surface. Accordingly, the entire collection can be assigned to one Palaeo-American tradition. As stated earlier, the lithic assemblage displays both technological and typological traits of stone tool production analogous to the Palaeolithic of northeastern Eurasia. Particularly, the level of lithic technology and the resulting artifact forms correspond well to the Lower and Middle Palaeolithic stages, especially in southern Siberia, the Russian Far East, Korea and Japan. However, some specific and more advanced aspects of Upper Palaeolithic lithic industry modification are present as well (e.g. Derevianko et al. 1990, Derevianko and Markin 1992, Derevianko, Drozdov and Tchekha 1992, Vasil'ev 1992, Larichev, Khol'ushkin and Laricheva 1987, 1990, Sohn 1978, Choi 1987, Anzai and Sato 1990).

QUATERNARY ENVIRONMENTS

The interpretation of the Quaternary history at the Varsity Estates sections is based on field investigations, analytical studies of the particular sedimentary facies, and their correlation within the existing Late Pleistocene geology framework in the broader Calgary area (Chlachula 1994).

The exposed glacial diamicton (till) facies is discontinuously distributed as a 2 – 8 m thick deposit between the Varsity Estates Site and the Silver Springs Site (Site 2), located about 2.5 km upstream to the northwest. At Silver Springs, the lowermost unconsolidated sediments above the bedrock are formed by a thick series of interstratified sandy and gravelly beds deposited in a fluvial, presumably periglacial, environment. There, artifacts were recorded in the upper part of these gravels and also in the basal part of the overlying till. The glacial deposit relates to the same valley-glacier advance as that at Site 1. The lithological composition and fabric (clast-orientation) data indicate a western (Cordilleran) source of the valley ice. At Varsity Estates (Site 1), the matrix-supported sandy-clayey glacial diamicton mass with embedded clasts is interpreted as a melt-out / gravity flow till, or related ice-terminal mass-flow deposit, integrating some proglacial gravels on the top. The gravelly strata were derived by a sheet-wash ablation-discharge over the saturated deposits within a proglacial setting.

The overlying 20 – 25 m thick glaciolacustrine sediments of Glacial Lake Calgary were accumulated

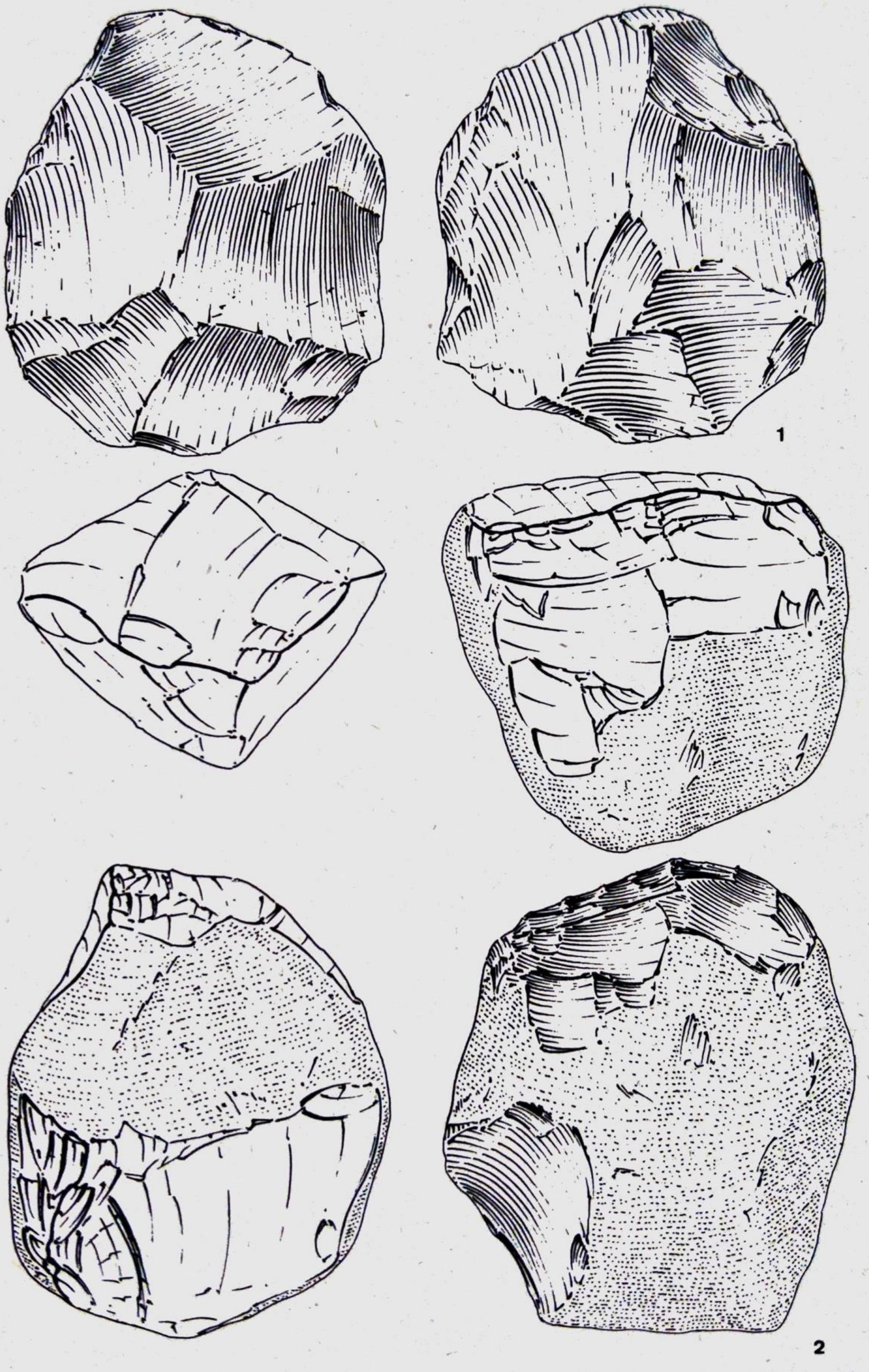

FIGURE 21. *Varsity Estates Site. Lithic industry: 1 – discoidal bifacial core (till); 2 – reutilized single-flaking platform core – rabot (eroded). Sandstone (1), quartzite (2).*

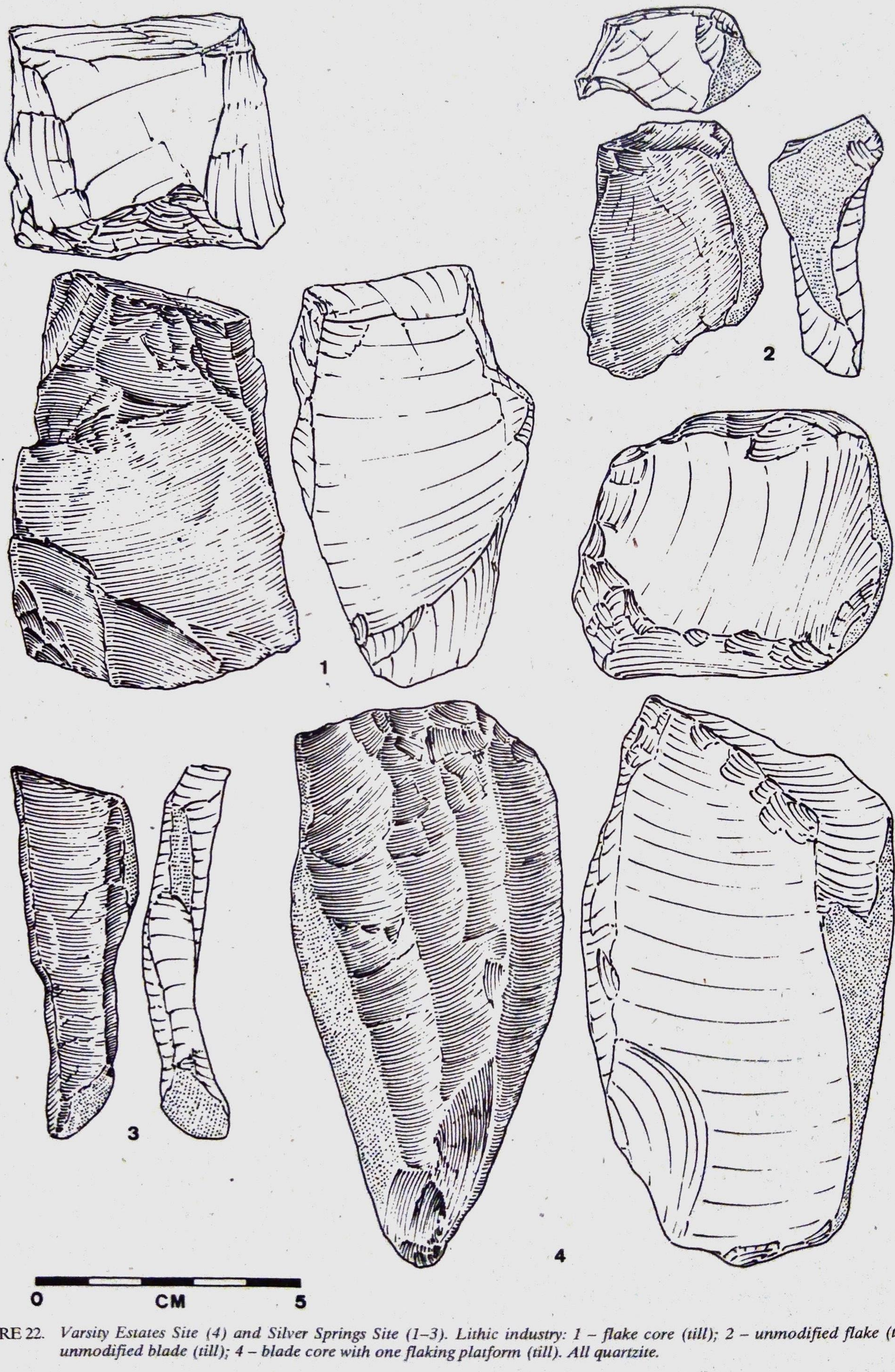

FIGURE 22. *Varsity Estates Site (4) and Silver Springs Site (1–3). Lithic industry: 1 – flake core (till); 2 – unmodified flake (till); 3 – unmodified blade (till); 4 – blade core with one flaking platform (till). All quartzite.*

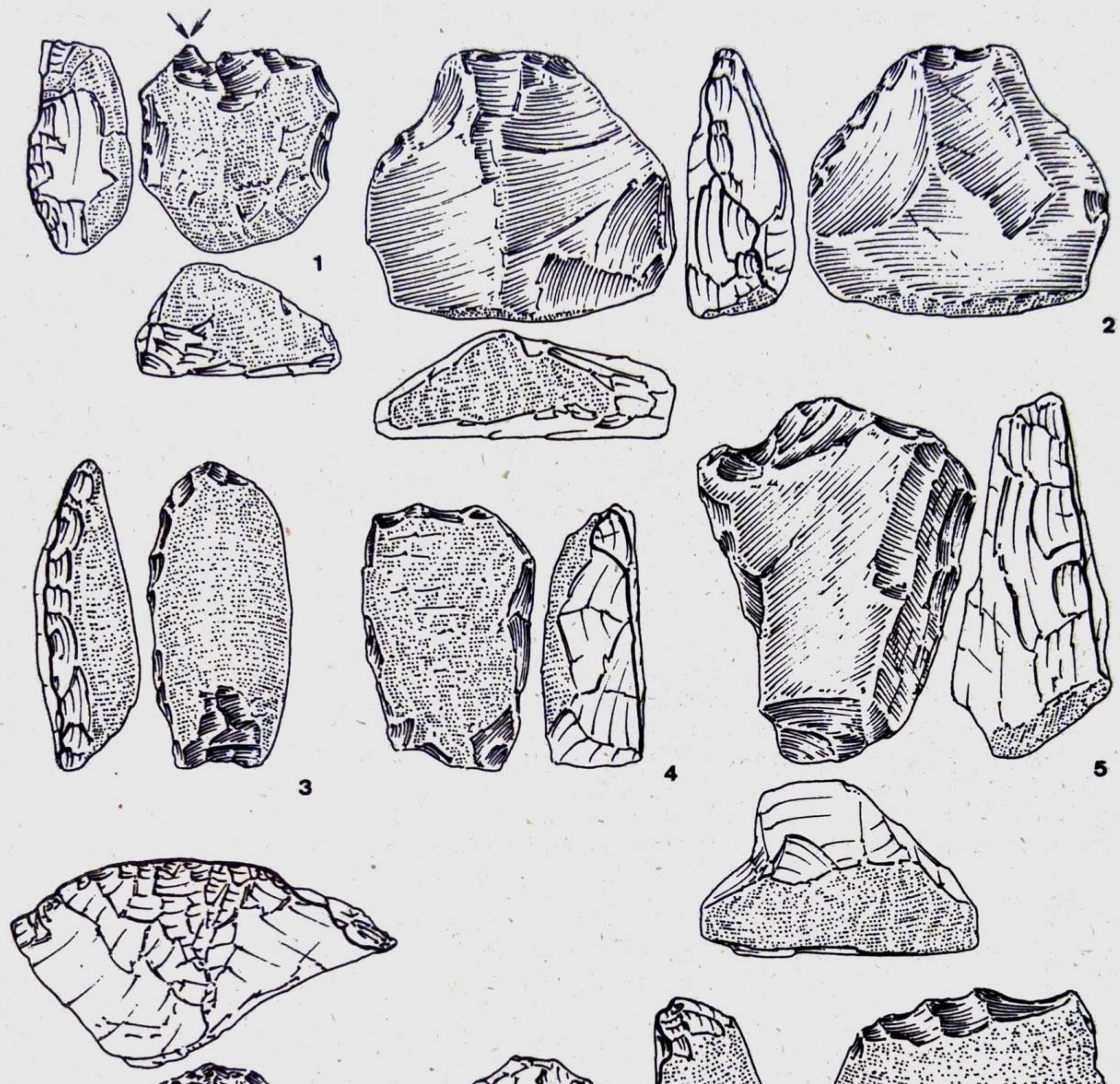

FIGURE 23. *Varsity Estates Site. Lithic industry: 1 – dihedral burin on flake (eroded); 2 – lateral side scraper (?) (eroded); 3 – denticulate side scraper (till); 4 – distally retouched flake (eroded); 5 – notch (?) (eroded); 6 – carinate end scraper (top of the till); 7 – denticulate end scraper on a fractured cobble (till). Quartzite (1–5, 6), siltstone (7).*

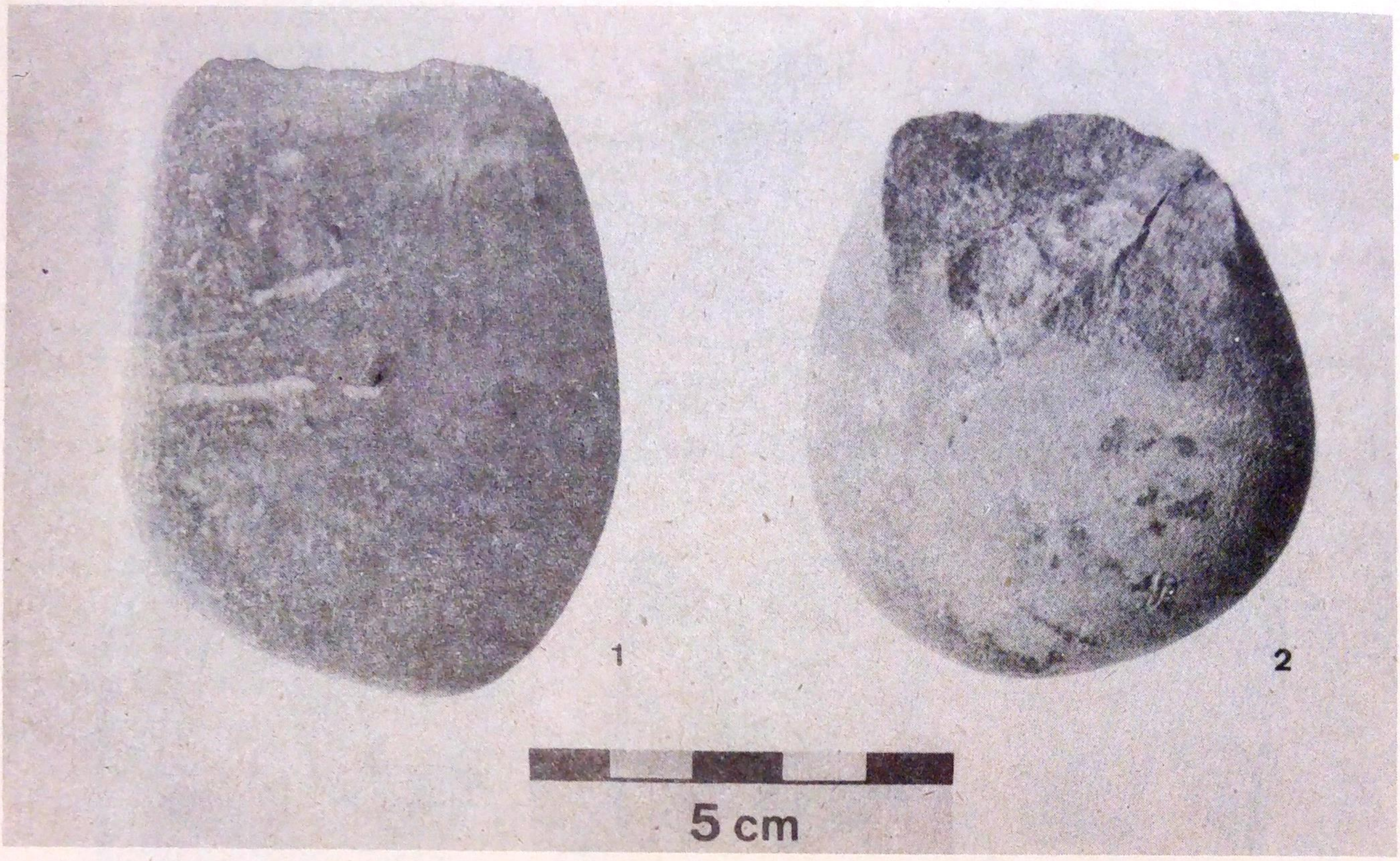

FIGURE 24. *Varsity Estates Site. Lithic industry: 1–2, unifacial choppers (top of the till). Siltstone (1), quartzite (2).*

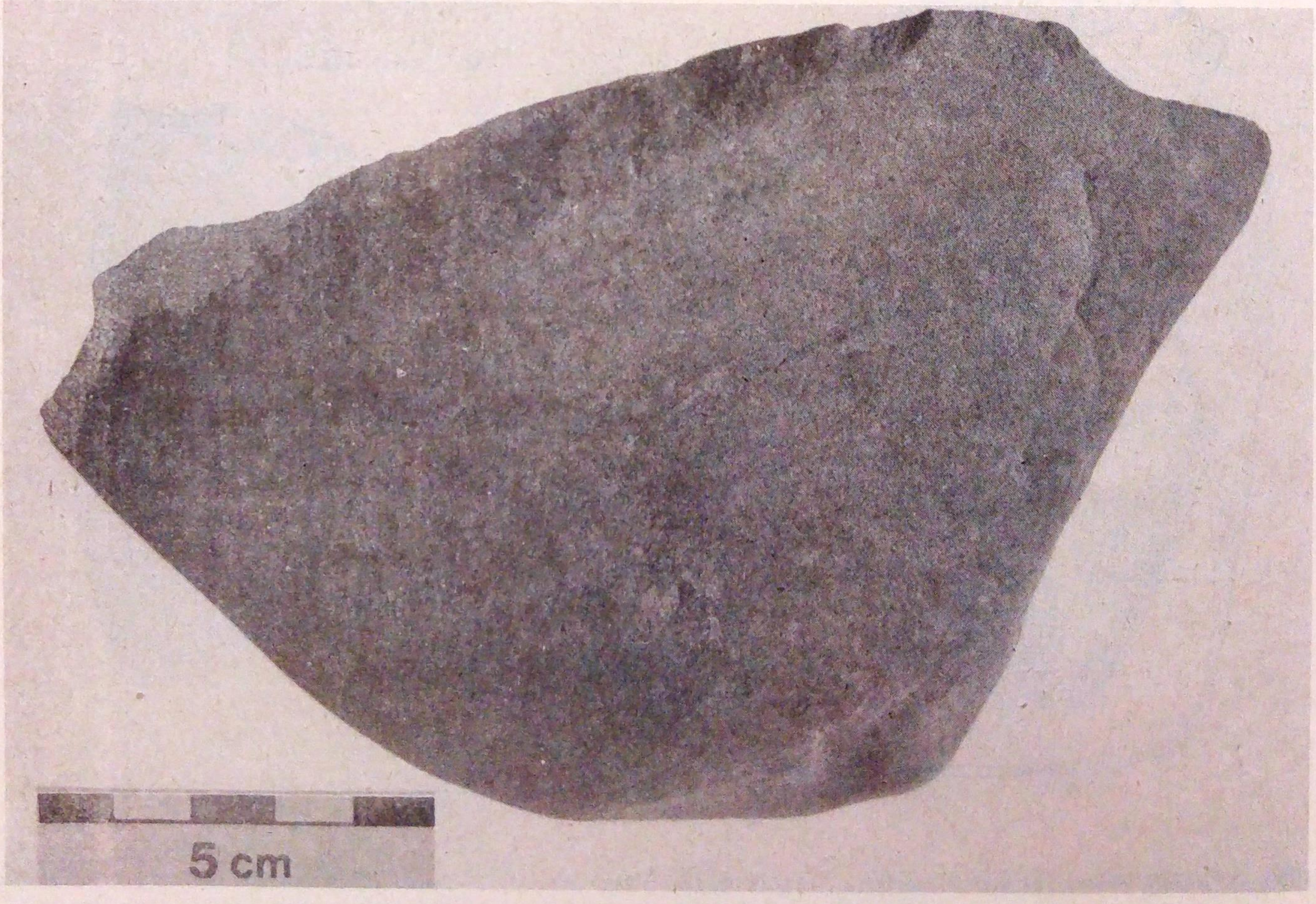

FIGURE 25. *Varsity Estates Site. Lithic industry: Transverse side scraper on cobble (top of the till). Quartzite (Fig. 19).*

later when the Laurentide ice dammed the Bow River and prevented free fluvial discharge from the ice-free area west of Calgary. The gravelly top of the till includes an admixture of sediments subsequently derived by ice floating on the glacial lake in front of the continental ice, and releasing clastics as drop-stones. This assumption is corroborated by small sub-angular granitic and gneissic rocks from the Canadian Shield transported by the ice, that have been occasionally found on top of the diamicton and subsequently eroded on the present slope below. Accordingly, glacial materials from two glacial advances are present in the Varsity Estates sections. The disconformity (II), separating the till deposit from the overlying ice-marginal glaciolacustrine sediments, shows a temporal hiatus between the Bow Valley glacier advance and formation of the glacial lake (i.e. the Laurentide continental glaciation). This is explicitly manifested by the occurrence of the stone industry partly found *in situ* on top of the Cordilleran till below the lake deposits. As stated above, the presence of the abraded artifacts from the till itself may relate to an earlier occupation prior to the Bow Valley ice advance correlated with the occupation from Silver Springs.

A changing Late Pleistocene environment is also evidenced by non-uniform textural (i.e. surface-characteristic) patterns on stone tools. In addition to the variability of abrasion degree on individual artifacts, the presence of glacial striations and chatter marks is another indicator. Unlike the more abraded flaked lithics from the till, no striations have been observed on the modified faces (i.e. negative flake scars) of tools, often produced on otherwise heavily striated cobbles, recorded *in situ* on top of the till below the lake sediments. This fact suggests that the (later) pre-Palaeoindian occupation took place during a period of reduced glacial activity in southwestern Alberta that allowed people to occupy this part of the Bow Valley under periglacial conditions until it was overflowed by the glacial lake.

A pollen sample, including sedges (Cyperaceae) and some arboreal taxa *(Pinus, Picea),* was recorded at Site 1 in association with the stone industry from the excavated surface of the till at the contact with the Glacial Lake Calgary deposits, and at Site 2 in the basal part of this glaciolacustrine formation in the same stratigraphic position. Despite the admixture of older pre-Quaternary taxa with some redeposited organic material and coal detritus in the samples, the well-preserved and relatively fresh coniferous pollen, which differs from the older, strongly altered and fragmentary grains, very likely manifests environmental conditions in the western Calgary area and the nearby prairie sometime prior to the subsequent (Laurentide) glaciation. The palynological data indicate a relatively moderate interstadial climate, which would provide a further support of ice-free conditions, rather than a scenario of the local Cordilleran and Laurentide ice coalescence during the last glacial (Late Wisconsinan) stage (*cf.* Moran 1986, fig. 35, Jackson 1987: 104, fig. 9 – 18).

CHRONOLOGY

Because of the absence of absolute radiocarbon and other chronometric dates, an approximate relative chronological assignment of the industry-bearing deposits is estimated from their geo-stratigraphic context. The temporal placement of the stone tool assemblage is extrapolated from the reconstructed Quaternary history of the closer study area as well as a broader regional setting (Rutter 1972, 1980, Moran 1986, Jackson 1987, Wilson 1987). There is a general tendency to assume a more recent Wisconsinan (Würmian / Weichselian) age of most glacial events in the Calgary area, especially with the bulk of the surficial glacial deposits widely distributed over the prairies east of the city. The earliest of these events is associated with the Lower Spy Hill till from the Rocky Mountain region, and estimated to date between 25,000 and 20,000 years B.P. (Moran 1986). This till is likely to be correlated with the Bow Valley advance described from the Banff area in the upper Bow River valley in the Rocky Mountains (Rutter 1972). Later glacial events are associated with the continental Laurentide ice, which experienced several major fluctuations (advances and retreats) in the eastern part of Calgary but did not reach the immediate study area located more to the west. These glacial readvances of decreasing magnitude, are spatially recognized by specific chemical, lithologial and mineralogical characteristics of the derived tills (Moran 1986). The earliest advance relates to the Upper Spy Hill till that presumably marks the maximum Late Wisconsinan glaciation around ca. 21,000 – 20,000 B.P. The latest (the Crossfield Advance) is tentatively assigned to 14,000 – 12,000 years B.P., preceding the period of final deglaciation (op. cit.). The last two ice-advances (the Balzac and the Crossfield) reached only the northeastern periphery of Calgary. The above chronological framework, however, is no longer supported by any radiocarbon dates, as two dates from the Chalmer's Bog (SW of Calgary), allegedly about 18,000 year-old (Mott and Jackson 1982), are now considered as likely contaminated.

In any case, the initial formation of Glacial Lake Calgary clearly correlates with the maximum Laurentide (Upper Spy Hill) ice advance in this area. As the lithic industry is distributed beneath about 24 m of glaciolacustrine sediments, the glacial episode, causing the ponding of the Bow River and formation of the proglacial, ice-marginal lake evidently postdates the archaeological record. This would imply an early Late Wisconsinan age for the lithic industry (> ca. 21,000 B.P.). The uncertainty about the latest Lake Calgary history has no implication for the cultural assemblage. Moreover, the stone tools embedded on top of the till are clearly separated by a certain hiatus from the accumulation of the lowermost glaciolacustrine deposits.

The assumed early Late Wisconsinan age, predating the last glacial maximum, would corroborate the palynological evidence from the archaeological horizon. If a later Late Wisconsinan date for the upper series artifact assemblage were assumed, the pollen record would contradict the evidence for a sparse, cold and very arid herbaceous tundra characterized by Gramineae, Cyperaceae and *Artemisia*, which existed in western Alberta around the height and after the last glaciation (Mandryk 1992). Spruce and pine, both present in the pollen sample, were, on the other hand, widely distributed throughout western Alberta during the Mid-Wisconsinan Non-Glacial Interval (65,000 – 23,000 B.P.). They became re-established in the western Calgary area after the final deglaciation sometime around 10,000 B.P. (Jackson, MacDonald and Wilson 1982: 2219).

Rolled and striated artifacts incorporated in the till may correlate with the *lower series* artifact assemblage recorded at Site 2 below the Bow Valley till and thus predate the first Late Wisconsinan glaciation in the study area. Accordingly, this would imply their earlier, presumably late Mid- to early Late Wisconsinan age. As there are no formal (technological and typological) differences between any of the artifact collections from both sites, they are assigned to one Palaeolithic (Palaeo-American) tradition. The stratigraphically fixed artifacts from the base of the Bow Valley till at Site 2 (Silver Springs), and those from the more intact excavated context from top of the till at Site 1, i.e. the *lower series* and the *upper series* lithic assemblages, respectively, may in fact be temporally separated only by a short time span, possibly in the range of a few hundred years or even less. This assumption is based on the geological contextual data, the proximity of both sites, and the overall formal similarity of the artifact series.

CONCLUSION

The lithic artifact records from Calgary Site 1 and Site 2 (the latter not discussed in detail in this report), both with clear cultural characteristics of stone flaking, are considered to be archaeological manifestations of an earlier, "pre-Palaeoindian" occupation established east of the Rocky Mountain in southwestern Alberta prior to the last glaciation. The *upper series* artifacts excavated *in situ* at Site 1 on top of the Cordilleran till beneath Glacial Lake Calgary deposits evidently predate several Late Wisconsinan Laurentide glacial advances (i.e. the continental ice-margin fluctuations) into the north-eastern Calgary area. The *lower series* artifacts redeposited in the main body of the till date prior to the early Late Wisconsinan Bow Valley ice advance. As only a relatively short-time presence of the valley glacier after having reached its terminal position is envisaged, and in view of the formal identity of both artifact assemblages, it is assumed that the recorded lithic industry relates to an early prehistoric (pre-Palaeoindian) occupation that was temporarily disrupted by the Bow Valley glaciation. Accordingly, an early Late Wisconsinan age is suggested for the occupation episodes (ca. 25,000 – 21,000 B.P.).

The cultural evidence from the Calgary sites supports the concept of an earlier Late Pleistocene peopling of the New World, predating the generally recognized fluted bifacial stone projectile point (Palaeoindian) cultures that emerged during the early postglacial after 12,000 B.P.

TABLE 1. *Formal typological classification of the artifact assemblage from the Varsity Estates Site (1990–1992 investigations).*

	till	till surface	eroded	Σ
Side scraper, convergent	–	–	1	1
Side scraper, transverse	2	–	2	4
Side scraper, ventral	1	–	–	1
Side scraper, bifacial	–	1	–	1
Side scraper, denticulate	–	1	–	1
End scraper, typical	1	–	–	1
End scraper, carinate	–	1	–	1
Burin, dihedral	–	–	1	1
Burin, flat-faced	–	–	1	1
Rabot	1	–	1	2
Tanged piece	–	–	1	1
Chopper, unifacial	4	–	2	6
Chopper, pointed	1	–	1	2
Chopper, double	1	–	2	3
Chopper, bifacial	2	2	1	5
Pick	1	–	–	1
Bifaçoid	–	–	1	1
Biface	–	1	1	2
Hammerstone	1	–	1	2
Utilized flake	–	–	1	1
Core, unifacial	–	1	–	1
Core, discoidal	–	–	1	1
Core with one platform	1	1	–	2
Débitage	–	17	–	17
Total Artifacts	16	25	18	59

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