

Fig. 1. Map showing the location of Batza Tena and selected major archaeological sites in Alaska.

ARCHAEOLOGY OF THE BATZA TENA OBSIDIAN SOURCE, WEST-CENTRAL ALASKA

A Preliminary Report of Initial Reconnaissance Surveys

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INTRODUCTION

Among field projects undertaken by the Archaeology Division of the National Museums of Canada in 1969 and 1970 have been brief reconnaissance surveys of an obsidian source area located southeast of the village of Hughes on the Koyukuk River of west central Alaska (Fig. 1).

The Interior Alaskan occurrence of obsidian or volcanic glass was located by W. W. Patton Jr. of the U.S. Geological Survey in 1967, and subsequently, but prior to our knowledge of Patton's activities, it was reported to us by Koyukon Athabaskan informants at Allakaket in 1968. Dr. Patton kindly provided us with further information about the exact location of the bedrock source, and with Thomas P. Miller, has published a brief description of the source (1970) including neutron activation analyses by the University of Michigan which confirm the probability that the Koyukuk locality (*Batza Tena*) is the source for obsidian utilized in northwestern Alaska, (Griffin *et al* 1969; Patton and Miller 1970:761).

Inasmuch as no sources had heretofore been located for the obsidian found in archaeological sites in Alaska, other than for the Aleutian Islands, it was considered highly desirable to examine the natural source area on the Koyukuk in order to determine the presence and nature of archaeological material there. During 21 days on location distributed over parts of two field seasons. A McFadyen Clark and I visited parts of the natural source and collected from 50 sites and small chipping stations.

The source areas reported by native informants are principally the Little Indian River (better called “creek”), small lakes in the same area, and the adjacent uplands. Little Indian River is known as *Batzitna* which translates “Obsidian River,” but frequently is referred to as *Batza Tena* which means “Batza Trail” and is the term we have selected to apply to this source area and associated site cluster. Many additional place names in the region contain the stem word *batza* which, according to our informants on the Koyukuk, means obsidian — “that glassy rock” to the exclusion of any other hard materials.

Most of the sites were found on two short ridges, elevation 300 to 500 feet, that form part of the transition between the Koyukuk River flats of *ca* 250 feet elevation and the upland source area, elevation 800 to 1000 feet, located to the east on the west flank of the Kokrines-Hodzana Highlands. A forest fire of 1968 greatly expedited survey work because some indication of each site was visible on the surface after the ground cover had been burned off. By 1970, however, the burn had become densely carpeted with a new growth of saplings. Several additional sites were found in 1970 at *Batzatiga* (a local name which translates “Obsidian Hill”) located on the lowlands two to three miles east of the Koyukuk River near the mouth of Little Indian River. Further sites were found by R. Reger on ridges to the northeast of the obsidian source during the course of geomorphic investigations in 1969 (D. Reger personal communication 1971).^{*} Usually a site consists of one to several flake concentrations and also a thin wide scatter of flakes. A flake concentration might range from as little as two feet to more than ten feet in diameter, and in maximum dimensions the sites range from the size of a single cluster to more than 300 feet.

Artifacts are few relative to the large amount of flaking detritus exposed. Among the 400-500 pieces considered as artifacts there is a substantial number of undistinguished or amorphous worked pieces. The most common formal implement is a roughly fashioned bifacially flaked knife blade. The 33 projectile points, mostly bases, include several specimens apparently related to fluted Paleo-Indian points.

^{*} See following paper

THE OBSIDIAN

According to Patton and Miller (1970) the primary obsidian source, located in the upland area, consists of mid-Tertiary age pearlitic ash beds in which the obsidian occurs as "Apache tears" or small bombs. The ash beds have disintegrated wherever they are exposed. We examined one major outcrop indicated by Patton (personal communication). The "Apache tears" which we found there generally are one inch or less in average dimensions — much too small for flaking — but some larger pieces were found in frost hummocks downslope from the ash outcrop. Obsidian pebbles also were found in the gravelly soil that mantles Batzatiga and they occur secondarily in stream and lakeshore gravels of the region. Patton and Miller indicate a maximum size of 10 cm which conforms well to the size of the largest artifacts that we recovered.

Colors represented by chipped material are predominately transparent to translucent or various gray, black, and blue-gray hues with or without banding. Many other light gray, brown, caramel and red colors and mottled combinations are occasionally or rarely represented, and there is an uncommon colorless translucent variety liberally dotted with small white inclusions (microlites) and bubbles. Totally opaque obsidian is extremely rare. Obsidian pebbles and decortication flakes exhibit various surface or cortex textures which may be categorized as frosted, pitted, fractured or fissured, silvery with fused edges, and smooth, but intergrades and combinations occur on many specimens. In a preliminary study of surface texture we found that some sites and site clusters are distinctively characterized by one or another cortex variety.

It may be of interest to note that Batza Tena also has the major red-paint-stone source reported to us for the Koyukuk area. We have as yet, however, to examine the outcrop on Little Indian River and no red-paint-stone was found at the flaking stations.

THE SITES

Many sites have the same characteristics which can be described summarily. They are now covered with a relatively

sparse growth of small or scrub trees, primarily aspen but also birch, spruce, and alder, with an under-cover, largely burned off at the time of the survey, of bushes, sphagnum moss, cladonia and leaf litter. Most sites simply are tucked away in the forest on slightly elevated flat spots, benches, and knolls along the ridges. With the forest cover present few sites provide any kind of view, but without the forest cover it would in most cases be possible to see from these sites much of the surrounding terrain — flats, valleys, and lakes. At Batzatiga several sites are situated along lake shores and they provide a more restricted perspective. Conditions there also differ from that just described in that this hill was not affected by the 1968 burn.

The soil is sparse and contains considerable stone derived from bedrock which is exposed at some sites. Significantly, however, the area was not covered by late Pleistocene Wisconsin-stage glaciers (Hamilton 1969; maps) and the poor development of soil may be explained by slopewash and solifluction operating in conjunction with frost riving, stirring, and sorting which are evident at Batza Tena. Surface finds constitute a very substantial part of the collections, but at several sites heavy flake concentrations extend into the stony soil to depths of approximately two to six inches. No buried or stratified sites were located. In some cases the flakes appear to have been disturbed and redistributed by soil creep, and in other cases they have been concentrated in the depressed margins between frost hummocks or boils, often in a light colored clay matrix, but there are many striking examples of apparently undisturbed surficial flake concentrations. Some of these undisturbed concentrations may represent camps even though no hearths or structural features are recognized. No organic material was recovered with the exception of a few fragments of burned bone in one site.

The greater part of the collection recovered at Batzatiga in 1970 was picked up on sandy beaches. In two cases the beach sites are correlated with sites on adjacent knolls and possibly represent reworked material that has crept downslope. The origin of other beach occurrences is not adequately accounted for at present.

COLLECTIONS

Most significant among the artifacts are 33 projectile point bases or complete points, more than 150 biface blades and fragments, 50 end scrapers, 18 side scrapers, nearly 100 utilized flakes, a notched pebble, a heavy graywacke mattock or axe with a chipped edge and pecked notches, a ground adze blade, several cores of microblades, cores for flakes and blade-like flakes and numerous amorphous items. A few large flakes have been retouched along one edge to serve as knives apparently comparable to the Eskimo ulo.

Indicative of the overwhelming emphasis upon obsidian for artifact production, there are in the 1969 collection 12 chert flakes, 37 chips of basaltic rock, and 22,440 obsidian flakes. Of the last, 180 and 760 flakes belong respectively to the minor speckled and colored varieties. Silicic rock of volcanic origin, other than obsidian is under-represented judging from the recovery of 24 artifacts of this material in the combined 1969-1970 collections. These statistics are not surprising considering that many sites probably were chipping stations owing their existence to the proximity of the obsidian source.

The classification and inventory of the collections is given in Table I. No total is provided inasmuch as many of the artifacts are of such amorphous, unfinished or fragmentary nature that they are of relatively little utility in helping to define the several complexes represented. We will not discuss here the amorphous categories, which would have to be described in detail, or ubiquitous classes such as the retouched and utilized flakes although several specimens not described are illustrated (Fig. 5 E-G; 6 A-B, D).

Attention is drawn, however, to the rough nature of a considerable part of the collection. This condition probably is the result of secondary retouch or major alteration and damage caused by the operation over a period of several thousand years of geomorphic processes which we may collectively term frost action, as well as by the trampling of men and animals. Furthermore, because of an abundance of raw material it was possible to reject malformed pieces at the chipping stations.

Two projectile point types, the side-notched or Tuktu point and particularly the fluted points, are of special interest.

The seven or eight fluted points include one specimen channeled on one side only (Fig. 2 C) and one complete point (Fig. 2 E). Both come from the same site which also yielded two notched points (Fig. 2 G) probably representing mixed components. Generally each fluted point has three channels or flutes on each face (Fig. 2A). The medial flute always was struck off last and the ears and basal concavity were prepared after the lateral flutes, and in part after the medial flutes, had been formed. The lower edges and base usually are lightly to moderately ground. These points differ from the established Clovis and related Paleo-Indian fluted points in that the third or medial flute on the Batza Tena point is relatively small and does not remove any very significant portion of the two lateral flutes. Two specimens from the Brooks Range however show stronger medial fluting (Alexander 1971). In more southerly examples the small lateral flutes are considered as guides and subsequently are largely removed by the main channel flake. The situation in regard to multiple fluted points in central North America is, however, not at all this simple. A definite relationship between the Batza Tena points and Clovis or Clovis-related points may be proposed from the constellation or technological attributes noted above.

TABLE I

CLASSIFICATION OF BATZA TENA ARTIFACTS

I. POINTS

1. Probable projectile points (33 specimens).
 - a. Fluted points (7-8) (Fig. 2 A-C, E).
 - b. Unfluted points with concave to wide, straight bases (807) (Fig. 2 F).
 - c. Leaf-shaped or lanceolate with highly rounded to narrow straight base (6) (Fig. 2D).
 - d. Bipoints (4).
 - e. Side-notched points and variants (5) (Fig. 2 G).

Fig. 2. Projectile Points. A, fluted point 10:36; B, fluted point 1:49; C, fluted point 31:15; D, base of probable lanceolate point, chert, 24:6; E, fluted point 31:60; F, concave point base 28:9; G, side-notched point 31:55. The first component of the catalogue number identifies the site. All except D are obsidian.

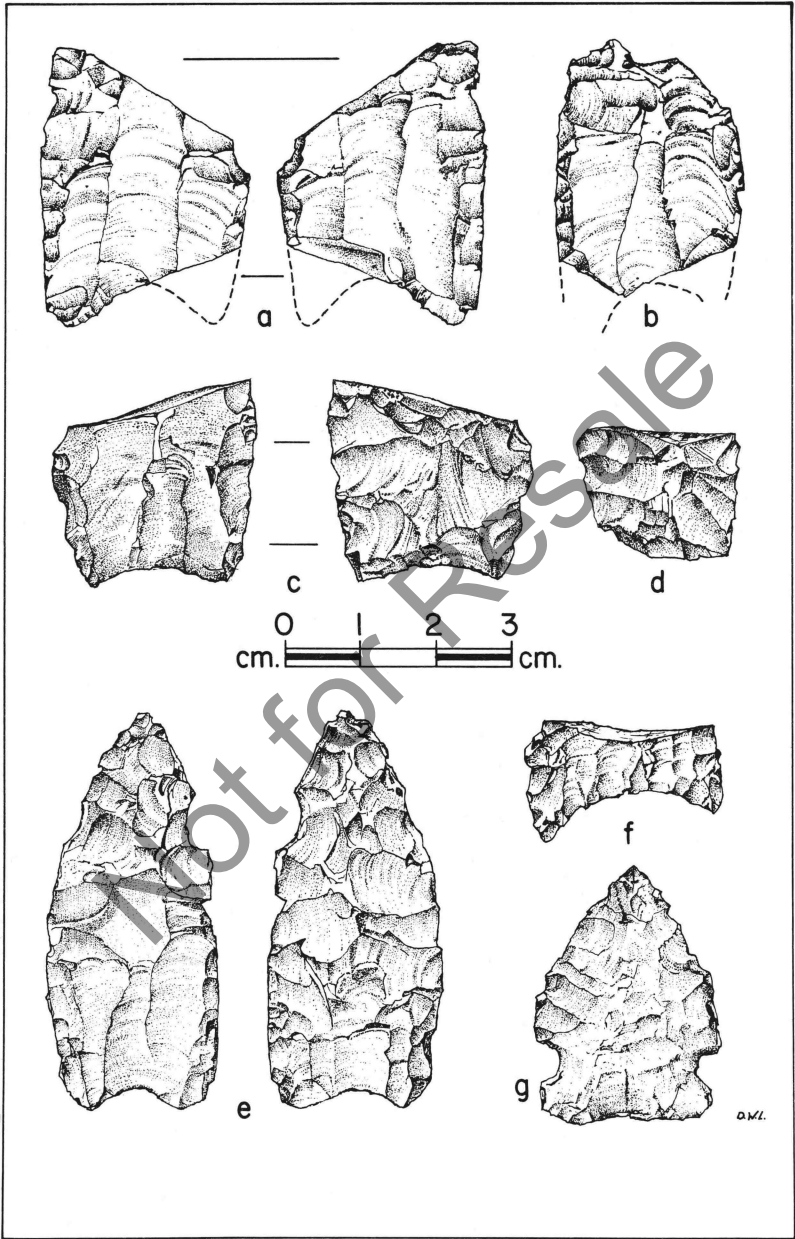


Fig. 2

- f. Square stemmed with shoulders (1).
 - g. Unclassified points (2).
 - h. Fragments (4).
2. Small leaf-shaped bifaces (4).

II. MICROBLADE INDUSTRY

1. Microblade cores (9) (Fig. 3 A-B).
2. Microblades (uncommon *ca* 20 specimens).
3. Core platform tablets and other products of microblade industry (5 tablets and other).

III. CORES, CORE-BIFACE, RETOUCHE SPLIT PEBBLE, AND BIFACE INDUSTRIES

1. Cores for flakes and blade-like flakes (41).
 - a. Platform cores (23) (Fig. 3 C).
Probable split platform cores (5).
 - b. Flat-faced cores (9?) (Fig. 3 D).
 - c. Apparent blade cores (3).
 - d. “V”-shaped core (1) (Fig. 4).
 - e. Amorphous cores, core fragments, shattered and split pebbles (not counted, *ca* 100).
2. Core-like Objects.
 - a. Rough biface pebble choppers or cores (8).
 - b. Trimmed pebbles (9).
 - i. Naturally flat pebbles (3).
 - ii. Split pebbles (6).
3. Plano-convex objects (“Turtle backs”, biface intergrades, and unfinished implements or blanks) (10).
 - a. Undifferentiated plano-convex objects (10) (Fig. 5 E).
4. Biface blades (164)
 - a. Possible biface roughouts, early stages (16) (Fig. 6 D).
 - b. Biface blades, various forms and degree of preparation (20).
 - i. Leaf-shaped to ovoid pointed bifaces and semi-unifaces (9) (Fig. 6 C).
 - ii. Sub-elliptical biface (1).
 - iii. Single-edged implements
 - iv. Blunt-ended implements (2).
 - v. “Kayuk” blunt-ended knives (2) (Fig. 5 C).
 - vi. Thin asymmetrical side blade (1).
 - vii. Unclassified with sinuous edge (1).

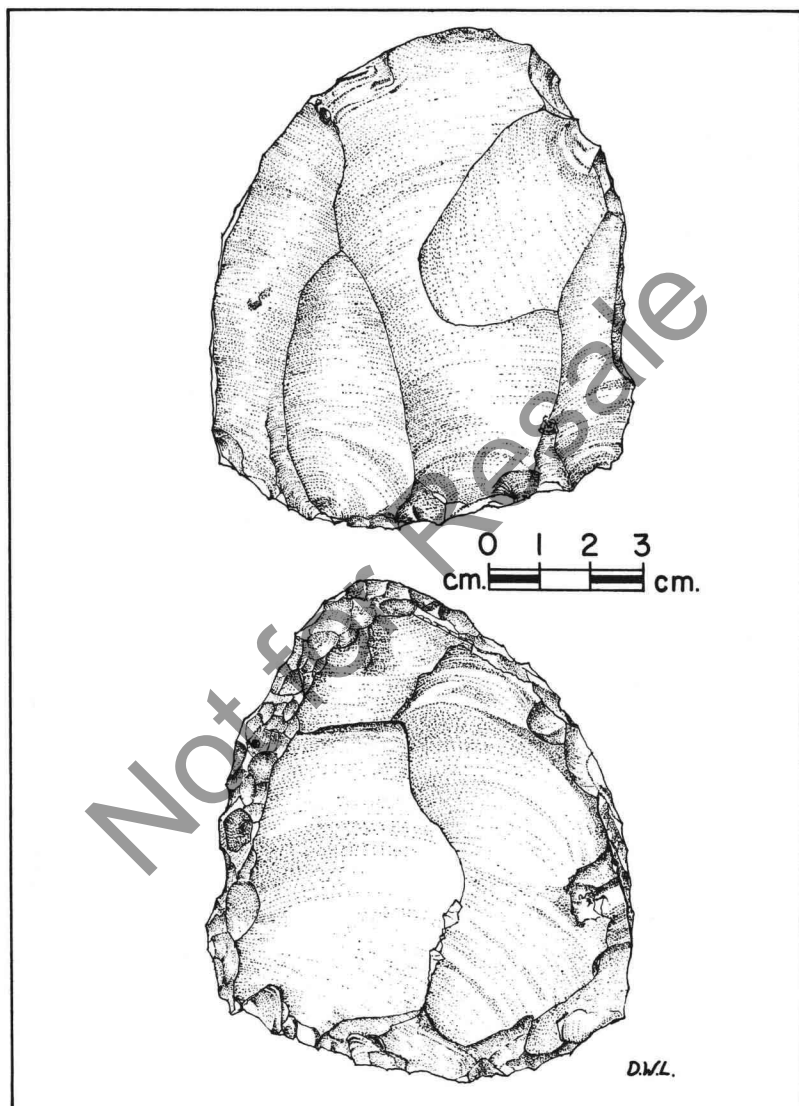


Fig. 4. V-Shaped Core 1:83; Obsidian.

- c. Fragments of biface blades (128 exclusive of v & vi).
 - i. Sub-rectangular and rounded end fragments (73).
 - ii. Semi-pointed ends (44).
 - iii. Sharply pointed ends (5).
 - iv. Midsections (6).
 - v. Small fragments not classified (25).
 - vi. Hinged biface and core edge fragments (*ca* 80).

IV. FLAKES AND FLAKE TOOLS

- 1. End scrapers (with convergent scrapers) (50) (Fig. 5 A-B).
- 2. Heavily retouched flakes and unifaces (43).
 - a. High-angle unifacial retouch, thick (scrapers) (16) (Fig. 5 D).
 - a-b. Intergrades (2).
 - b. Low-angle or thin retouch (25).
 - i. Unifacially flaked or retouched (12) (Fig. 6 B)
 - ii. Bifacially retouched (knives) (12).
- 3. Utilized or lightly retouched flakes (47 worn+ 77 equivocal).
 - a. Concave working edge (11 worn+ 5 equivocal).
 - b. All other forms (36 worn+ 72 equivocal).
- 4. Blades and blade-like flakes (121).
 - a. Blades (1?).
 - b. Blade-like flakes (120).
 - i. Smoothed through use (5).
 - ii. Possibly retouched but not smoothed (14) (Fig. 5 F-G).
 - iii. No retouch or smoothing; or retouching probably due to natural causes (101).
- 5. Flakes, not intentionally retouched or utilized (*ca* 40,000).

V. PECKED AND GROUND ARTIFACTS MISCELLANEOUS

- 1. Adze blade (1).
- 2. Mattock or axe (1).
- 3. Notched pebbles (2) (Fig. 6 A).
- 4. Hammerstones (1 + 1).
- 5. Boulder flakes and related implements (3 equivocal).
- 6. Other amorphous flaked stone (40).

Three principal types of microblade cores were distinguished in the preliminary analysis of the collections.

- (1) A distinctive keeled wedge-shaped core, possibly related to Campus cores but of a greater width and

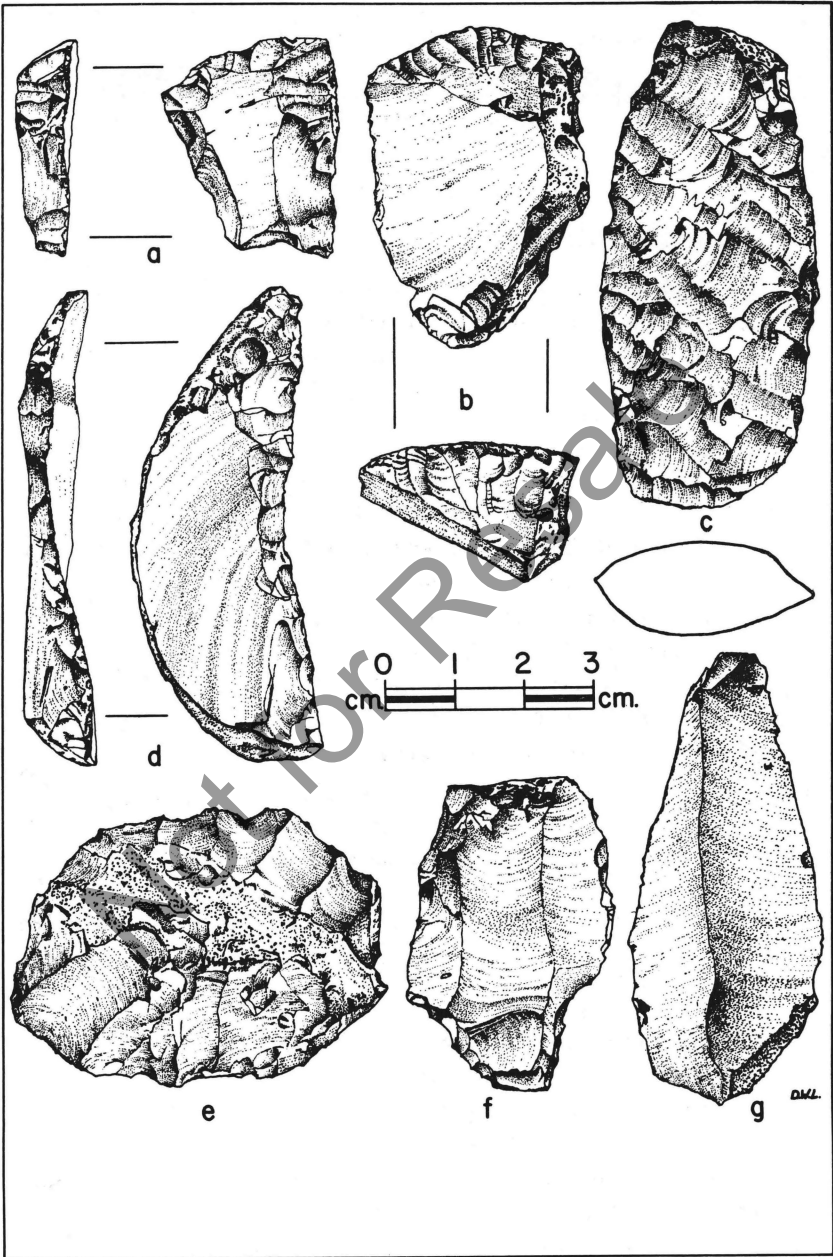


Fig. 5

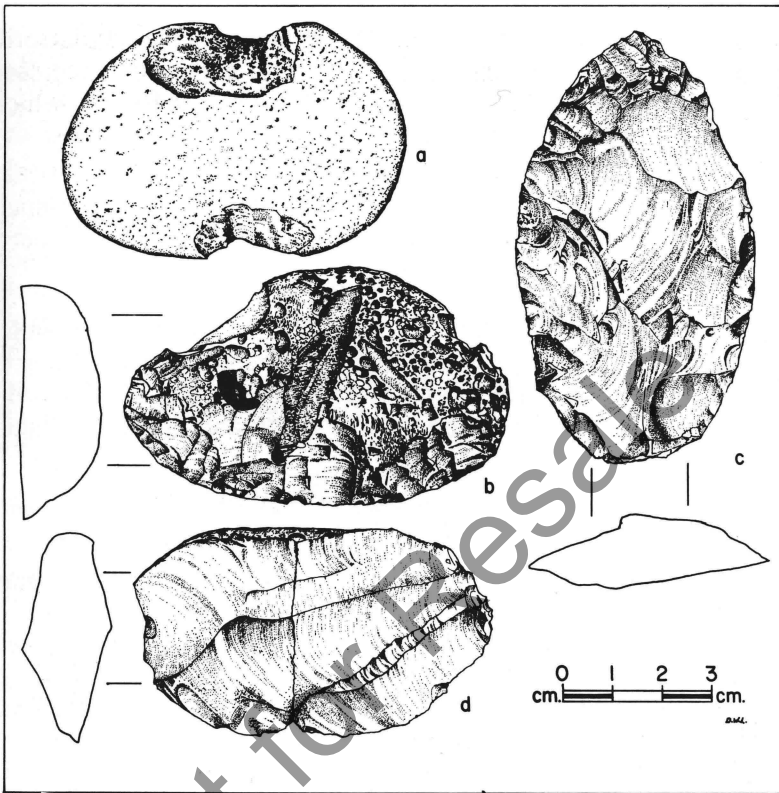


Fig. 6. Knives and Other Artifacts. A, notched pebble 32:52; B, unifacially retouched flake, knife, 46:12; C, leaf-shaped "biface" (primarily unifacial) 2:9; D, probable biface knife blank 12:8. All except A are obsidian.

significantly different in its having an acute platform angle, which yielded very narrow microblades (one specimen, Fig. 3 A).

- (2a) Less distinctive small tabular Tuktu cores, with flat to curved fluted faces (Fig. 3 B). The specimens in this group intergrade with item 2b below.

Fig. 5. Scrapers, Utilized Flakes and Other Objects. A, end scraper 5:10; B, end scraper 5:9; C, "Kayuk" knife 37:17; D, plano-convex object 18:1; F, blade-like flake, utilized, 13:14; G, blade-like flake, probably utilized, 29:4. All except A are obsidian.

- (2b) Pebbles prepared only at the angled faceted platform (three specimens). There is one apparent blade core or unfinished core blank also of this format which appears to grade into angled platform flake cores.
- (3) Platform cores (decapitated pebbles lacking other preparation with horizontal platforms from which variable sized microblades and small blades have been struck (two specimens).

There are many additional larger platform cores, cobbles prepared only through detachment of a single flake or cap to form a platform, with horizontal to highly angled platforms apparently used in the production of flakes and blade-like flakes (Fig. 3 C).

A flat-faced core with relatively large flake facets is shown (Fig. 3 D) as also is a unique V-shaped flake core (Fig. 4).

The majority of the bifaces are fragmentary but it appears that this most numerous artifact usually had a sub-rectangular to rounded base and a more highly rounded end. Pointed symmetrical leaf-shaped bifaces evidently were uncommon (Fig. 7 C). Some specimens of this class are essentially unifaces. Two nearly parallel sided blunt ended specimens with approximate parallel-oblique flaking (Fig. 5 C) are comparable to specimens from the Kayuk complex of Anaktuvuk Pass (Campbell 1962: Pl. 2 16).

Most end scrapers are made from obsidian (Fig. 5 B) but proportionately we find more non-obsidian artifacts (Fig. 5 A) in this class than in any other major class of implement. Scrapers are prepared only at the working edge but a few convergent scrapers have a second working edge and others are trimmed along the sides. None of the eleven non-obsidian end scrapers have cortical dorsal surfaces but of the remaining 39 specimens there are 18 with full cortex (excluding retouch) and 13 with partial cortex. Burinated scrapers and true graver spurs at the corners appear to be lacking although some specimens are distinctively cornered at the ends of the working edge.

No burins of any kind were recovered, however, one would not expect burins on obsidian artifacts.

DISCUSSION

Although a small number of artifacts flaked from chert and basalt was recovered (about 10 percent of the total artifacts and less than one percent of the flakes), it is apparent from the flake statistics given earlier that primarily obsidian was flaked in the area surveyed even though the basaltic rock and probably some poor grade chert also is available at Batza Tena. Furthermore, the concentration of sites or flaking stations as is found here has not been duplicated elsewhere in the Koyukuk area. Therefore, it appears that Batza Tena owes its existence as such to the proximity of a source of preferred raw material and many of the chipping stations may be analogous to quarry workshop sites.

Considering, however, the archaeological collections in their totality it is apparent from the ground adze, graywacke mattock, notched pebble, well worn scrapers and flake tools, and scattered finds of finished projectile points (not associated with any site) that the area provided something more than a source of stone to be made into implements or to be traded to adjacent regions. The area is moderately rich in game. During our two field trips we saw many moose, three black bear, and also otter, beaver, wolves, muskrat, and geese and various other fowl. Many other species of small game and fur-bearing animals as well as caribou reportedly are available here. Information obtained from informants at Allakaket, Hughes, and Huslia indicates that a full range of economic activities (hunting, caribou fence construction, trapping, salmon fishing, spring camp, winter house settlement, and trading) formerly was undertaken within the environs of Batza Tena and the adjacent reaches of the Koyukuk River. We suspect that the same situation prevailed in the more remote past.

From our description of the sites it would be apparent that many sites are likely to have mixed components. This situation seems to be borne out by the recovery of two notched points and two fluted points from one site. On the basis of an initial series of obsidian hydration measurements it even appears that flakes and artifacts of extremely diverse age have been brought together in some secondary flake clusters. Flakes from each of two concentrations which have yielded fluted points have been

dated from a few centuries to more than 12,000 years in age, using a non-linear hydration rate of 1.4 microns squared per 1000 years. The hydration program is being undertaken by Leslie B. Davis of Montana State University. Therefore all superficial or secondary artifact and flake concentrations are suspect and the basic unit of analysis becomes the individual artifact except for very obvious associations as for instance in the case of eleven end scrapers found in a single flake concentration, locus E of Site 1, or in the apparent cache of four basalt artifacts at Site 28.

We hope to find stratified or otherwise sealed sites and also features through future extensions of our surveys, but for Batza Tena proper we are relying heavily upon obsidian hydration measurements and typology to separate and date the mixed components and complexes.

Douglas Anderson briefly examined the artifacts recovered in 1969 and was very helpful in suggesting that with the exception of the fluted points they may relate to the 4500 year-old transition into the Portage Complex of the Onion Portage site on the Kobuk river. The recovery of various microblade cores, side notched points, "Kayuk" knives, a ground adze, and additional fluted points in 1970 has, however, widened the scope of the Batza Tena collections, although much of the material may still be encompassed within what Anderson (1968) has termed the Northern Archaic tradition. The side-notched points would date early in the tradition, to about 4000 B.C. in the Palisades complex although variant forms, also recovered at Batza Tena, may be younger but not as young as the Portage complex. In this context sites with microblades would not belong to the Northern Archaic tradition but would be of either a younger or an older age. In the Tuktu complex of Anaktuvuk Pass, dated to 4500 B.C. (SI-114, 6510 ± 55 BP), notched points, microblades and micro-cores, and certain other types common to Batza Tena are found in association (Campbell 1962), and the association of microblades and notched points also prevails in other Alaskan sites located east of the Koyukuk River (Cook and McKennan 1970). Presently, notched points and microblades have not been found together at Batza Tena but it would be advisable to obtain further substantive evidence of separate distributions

at Batza Tena before declaring for two different traditions on this basis.

Inasmuch as the Koyukuk Indians still possess a knowledge of the obsidian source, recognize it in their place names, and until recently used obsidian flakes to open blood vessels swollen by snow blindness, we also can expect to find late-prehistoric Koyukuk camps at Batza Tena. In addition, we have reliable reports of a small protohistoric and early historic village, appropriately named Batza Tena, which is located a short distance southwest of Batzatiga. At the present time, however, our definition of the cultural complexes represented in the collections has not progressed to the point of permitting us to recognize any late-prehistoric Koyukon complex. Furthermore, none of the preserved bone, stone slab hide scrapers, pottery, red paint stone, and large grooved adzes which we would expect to find in such a complex, on the basis of our ethnographic fieldwork and investigations of early historic or proto-historic houses, have been recovered at Batza Tena. This situation is considered to be an unfilled gap in our preliminary reconnaissance rather than an hiatus in the occupational history of the area.

Probably the most significant aspect of our reconnaissance is its contribution to Paleo-Indian prehistory. To date Batza Tena has been one of the most prolific source for fluted points in Alaska. Other finds are a relatively small but complete specimen found by the U.S. Geological Survey on the Utukok River of northwestern Alaska in 1947 (Thompson 1948); an enigmatic specimen in the Denbigh Flint complex (Giddings 1964: 233); three additional fragmentary specimens, one being only a tip, found in the western and central Brooks Range by the U.S. Geological Survey in 1950 (Solecki 1951); two bases and several unfinished basal fragments also recovered from the Utukok in 1965 and 1966 (Humphrey 1966); two basally thinned points recovered at Healy Lake in 1970 (J. P. Cook, personal communication to A. McFadyen Clark); two fluted bases recovered also in 1970 from the Putu site of the north slope of the Brooks Range (Alexander 1971); a basally thinned obsidian point recovered from an eastern tributary of the Koyukuk during the course of a salvage survey in 1970 (Cook *et al* 1970: 25) and unpublished specimens reportedly from Bristol

Bay (Hall 1969; Lyons 1970:156). Earlier than any of these finds, however, is one from placer mines north of Fairbanks (Hibben 1943: 259 and PL. XV d) which has attracted little further notice, perhaps because of the shortness of the triple flutes or thinning flakes. Wormington (1957:109) has identified the last specimen as a Plainview point. Several of these points display double or triple channels and their relationship to the Batza Tena points need not be questioned.

Only three specimens have been found in dated stratigraphic contexts: that from the Denbigh Flint complex, *ca* 4000 years old, and the basally thinned Healy Lake specimens which were found in levels dated by radiocarbon approximately to 9,000 and to 10,500 or 11,000 years ago (Cook *et al* 1970:25, 115; J.p. Cook and R. McKennan personal communications to A. McFadyen Clark and D. Clark 1970 and 1971). Radiocarbon dating also is anticipated for the Putu site.

Prior to the several discoveries in 1969-70 there had been various opinions regarding the age of Alaskan fluted points (cf. Bryan 1969; Giddings 1964, Hall 1969; Haynes 1969a and 1969b; Humphrey 1966 and 1969). The available evidence (summarized by Hall 1969), but hardly the intuitive feeling of most archaeologists, tended to favor the association with the Denbigh Flint complex. The Batza Tena collections, in which there is no manifestation of the Denbigh Flint complex (Arctic Small Tool Tradition), should effectively demonstrate that these fluted points are not properly a part of the Arctic Small Tool Tradition inventory, while the Healy Lake finds suggest an alternate temporal placement for at least some of the Alaskan points. The basally thinned Healy Lake are not, however conclusively the same thing as the Batza Tena points and therefore are not necessarily of the same age. We anticipate that this dating will be reinforced by obsidian hydration measurements taken on the Koyukuk specimens. This temporal placement, which is only presently becoming available, restricts the theoretical viewpoints that have been based upon Alaskan fluted points from the central part of North America that the question of a southern or an Alaskan origin, and the subsequent direction of diffusion, remains open.

* A more substantive survey of the western part of the obsidian source area was undertaken by the writer and three assistants during the summer of 1971. This survey greatly increased the collections and number of known sites for Batza Tena but failed to produce any stratified sites. Most sites appear to be essentially flaking stations, although two living areas and a group of house pits were also located and excavated. Several additional fluted point fragments were recovered but no Paleo-Indian sites were recognized. Side notched points were recovered with a broad range of associations including late ceramics and microblades, however, it is likely that some of these associations will turn out to be invalid due to the mixture of components. The house pits which we excavated were located 35 miles southwest of Batza Tena and yielded artifacts showing cross-ties with Norton Culture.

Also subsequent to the preparation of this article a set of obsidian hydration measurements became available for the 1969-1970 collections. Certain of the results are at variance with the expected ages and more work will be done with this dating method before the results are used to periodize the collections.

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