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Hetty Jo Brumbach

Abstract

A federally sponsored cultural resource management survey undertaken by Hartgen Archeological Associates (1983) recovered artifacts, cores, and debitage of chert along the east bank of the Hudson River within the small community of Pleasantdale, New York (Figure 1). More intensive field and lab work, carried out in 1983 and 1984 by Rensselaer Polytechnic Institute, produced additional artifacts and debitage and identified the lithic source as a large and previously undocumented chert outcrop and quarry (Brumbach and Zitzler 1983; Brumbach 1985a). Petrographic thin-section and x-ray fluoresence trace element analyses were used to characterize the chert, which has been identified as part of the Late Medial Ordivician Mount Merino Formation. Since most of the cultural material was recovered from undisturbed contexts it is believed that assemblage composition has not been depleted or biased by collector activity. The site thus presents an informative picture of the kinds of materials deposited on quarry/workshop loci. In addition, study of the lithic tools turned up a surprising number of utilized, but otherwise unfinished, cores and bifaces — suggesting that the quarry was also a processing station where discarded lithic artifacts were recycled (Schiffer 1972) to carry out a range of on-site processing tasks.

Introduction

The hamlet of Pleasantdale and its archeological site are located on the east bank of the Hudson River in Rensselaer County, New York, about 600 meters north of the Troy city limits. In this part of the valley, the generally north-south flowing Hudson River makes a broad swing to the west and then turns south again, leaving Pleasantdale on the outside of the resultant curve. One cause of this divergence is a nearly conical hill on the east side of the river, which was found to contain exposures of white-weathering Mount Merino chert and siliceous shale (Figures 2 and 3). Archeological material was recovered from several loci on the hill, along the shore of the Hudson River a distance of 725 meters to the north, and up to 180 meters inland from the river. Additional artifacts ("arrowheads") have been recovered south of the hill in the past.

Today, Pleasantdale consists of small one and two-story, early to mid-twentieth century cottages, originally constructed as summer residences and in recent years winterized for year-round occupation. Modern vegetation includes lawns and gardens around houses, and shrubs, underbrush, and secondary growth trees along the river, small streams, and larger house lots.

The soils in the eastern half of the site away from the chert outcrop consist of finer clays and silts while the soils in the western half are predominantly coarser silts and sands with gravel, pebbles, and cobbles. A typical eastern soil profile consists of an upper level of very dark greyish brown (Munsell 10YR 3/2) silty clay with fine sand up to 26 cm thick overlying a middle level of dark brown (10YR 3/3,3/4) silty clay up to 18 cm thick, and a basal level of yellowish-brown (10YR 5/4) clay with cobbles. Cultural material was recovered at depths up to 45 cm below present ground surface. The subsurface stratigraphy in the western part of the site within the curve caused by the resistant chert outcrop consists of an upper level of dark yellowish brown (10YR 4/4) silt with pebbles up to 18 cm thick, a second level of yellowish brown (10YR 5/8) sandy silt with gravel, pebbles, and small cobbles which ranges between 22 and 26 cm thick, and a basal level of dark yellowish brown (10YR 3/4) fine sand with gravel, pebbles, and cobbles. Prehistoric cultural material was recovered at depths up to 65 cm below the original land surface, which has been partially obscured by road construction and fill.

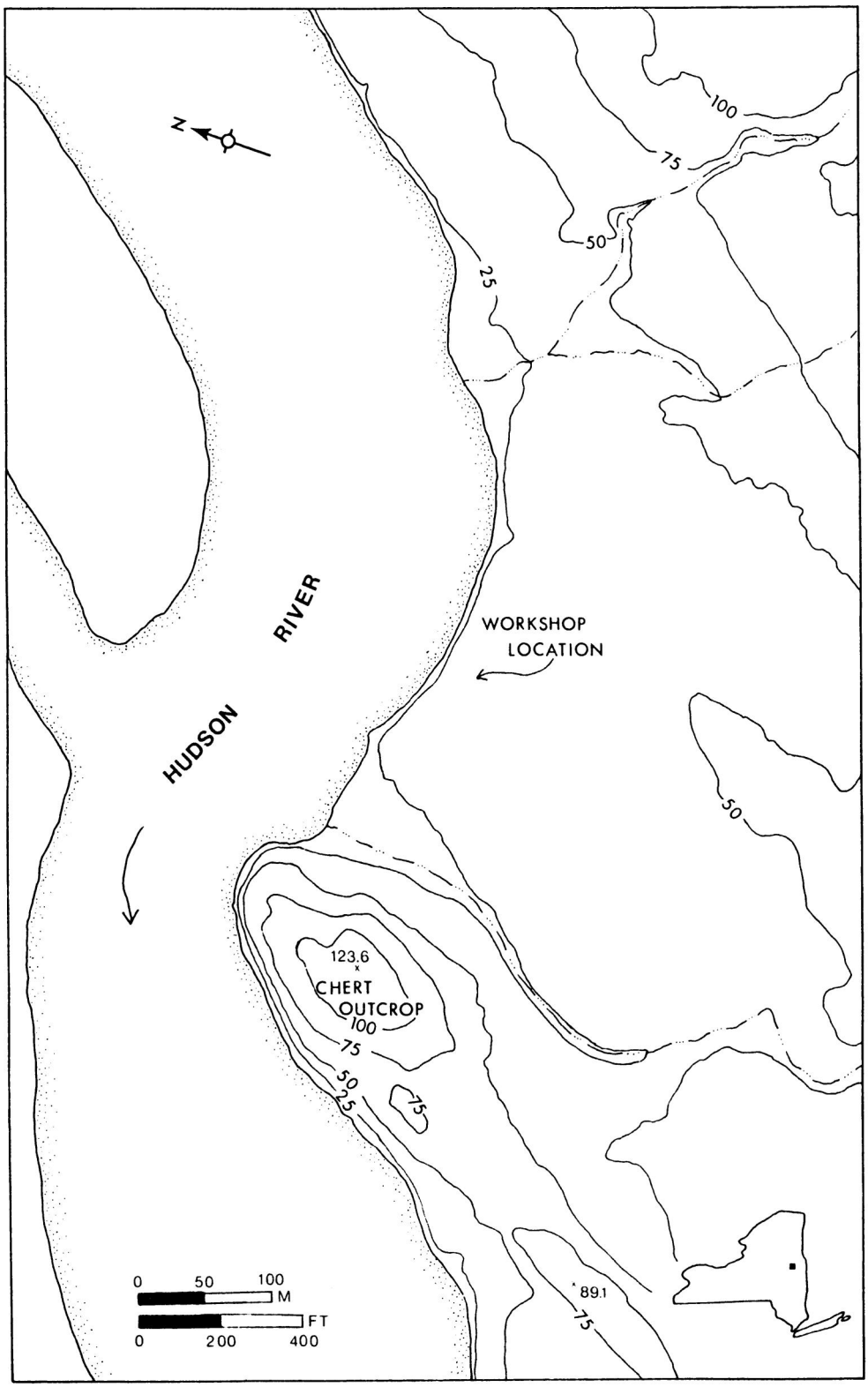

FIGURE 1. Location of chert outcrop hill and workshop on east side of Hudson River in Pleasantdale, New York. Contour intervals are in feet.

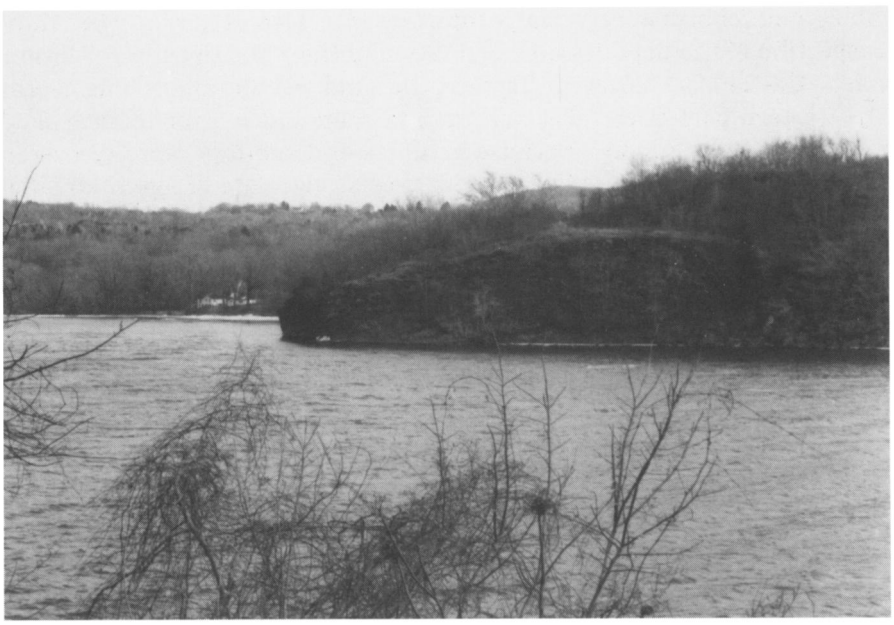

FIGURE 2. Outcrop hill from west side of Hudson River.

FIGURE 3. Exposure of chert outcropping on west face of hill.

The gravels, pebbles, and cobbles were initially interpreted as glacial in origin but this was later revised. Based on a closer inspection of the deposits and evaluation of their stratigraphic relationship to identified glacial features, such as the 220-foot Coveville Terrace, the sand, pebble, and cobble deposits revealed in excavation units in the western part of the site were re-interpreted as a river terrace or terraces laid down after the draining of glacial Lake Albany. Because artifacts and debitage were recovered from within the terrace deposits, attempts were made to obtain a more precise estimate of age than simply "post-glacial".

Consulting geologist Robert LaFleur (Department of Geology, Rensselaer Polytechnic Institute) identified the material as part of the Hoosic River lithology. Deposits of this origin can be very recent but the naturally formed and oxidized soils within and above the terrace suggest an age of at least 2000-3000 B.P. The best estimate at this time is that the lower levels of the terrace were formed perhaps as early as 7-8000 years ago with the upper, more recent deposits being laid down as overbank flooding from the Hudson River or from erosion of the higher elevations to the east and south of the site within the past 2-3000 years (LaFleur, personal communication).

The Chert Quarry

The hill comprising the quarry has a maximum elevation of 37.5 m (123.6 feet on the USGS Troy North Quadrangle, 7.5 minute series) placing it a little more than 30 meters above the Hudson River, which is at or below the 6.1 m (20 foot contour) at this location. The most prominent part of the hill measures 90 by 185 meters. To the south, lower outcrops of shale continue along the river for at least another 400 meters.

Surface examination revealed both naturally broken rock and chipped stone blocks, cores, thinning flakes, and unfinished tools; hammerstones and large quarry tools or picks; and several chert outcrops including at least three worked faces or mines. Shovel test pits were excavated to sample subsurface debitage and quarry debris and to recover diagnostic, and therefore potentially datable, artifacts. After three unsuccessful attempts to locate undisturbed deposits along the base of the hill, a 50-cm by one-meter square was opened at the top. Excavation proceeded through an upper silt and a lower sandy silt level to a depth of 72 cm reached at bedrock. Except for the soil, all contents were retained after screening. Level 1 produced two hammerstones and 104.1 kg of flakes, blocks, cores, and waste of chert, siliceous shale or shaley-chert, and shale matrix. Level 2 produced six hammerstones and 71.1 kg of lithic material.

Chert can be observed outcropping in a number of places and at least three worked quarry loci were identified. The largest, located at the base of the hill on its east side, measures several meters in height and width. Recent construction activities associated with road and house building have damaged part of the quarry face and removed subsurface material down to bedrock. A second quarry face was located on the west side of the hill about 10 meters above the level of the Hudson River. In configuration the quarry resembles a rockshelter, measuring three to four meters across and at least two meters high, with a flat floor and shallow overhang created by digging into the outcrop above the floor. Shovel testing revealed a subsurface packed with chert and broken-up shale. The quarry is clearly visible from the channel and west bank of the Hudson River.

A third chert mine is located in a small dip or ravine on the north face of the hill. Lithic materials, including fragments of a red-brown chert, were observed on the ground but none could be found in situ in the adjacent bedrock. A small amount of debitage and artifacts of similar-appearing material was recovered from the excavation units and it is believed that it originated in the chert hill, possibly as a weathered rind. The original size of the quarry is unknown. Part of it was dug out and enlarged in recent years to accommodate a building foundation.

Excavation Units

Shovel test pits and one-meter square excavation units were opened within selected areas of Pleasantdale to identify site boundaries and to recover a representative sample of artifacts and features. Because the project was sponsored in part by the United States Environmental Protection Agency, attention was concentrated in areas affected by construction of a wastewater collection system. Eight of the 17 squares excavated off the chert outcrop and three deep backhoe trenches were placed under roadways where collection sewers would also be installed. The remaining nine squares were located in lawns or wooded areas.

All prehistoric artifacts were of chert or other lithic material. Despite careful screening of backdirt, no artifacts of bone, shell, or ceramic were recovered. In addition, the absence of domestic debris, midden concentrations, house patterns, and features (but see below) suggests the site was not occupied as a habitation locus, but primarily as a quarry/workshop. However this conclusion may be difficult to support since consulting geologist LaFleur believes that the deposits containing the artifacts were laid down as an active beach terrace(s). If this were the case, the absence of some classes of artifacts as well as intact features and house patterns may be due in part to their disturbance and destruction in the past from beach action. With the data at hand, it is difficult to resolve these differences of interpretation.

Features

Features include the three chert mines already described, a workshop area, and a concentration of stained soil, identified by Hartgen Archeological Associates (1983:4-5) as a possible prehistoric hearth. Charcoal for dating purposes could not be recovered.

Four of the excavation units closest to the chert outcrop produced a disproportionate amount of chipped stone artifacts, especially when compared with the most distant four squares (Table 1). The workshop squares (three contiguous and one adjacent) are 175 meters from the edge of the hill while the four non-workshop (non-contiguous) squares average 615 meters distant. The decreases in count (from 1905 to 240) and average weight of debitage (from 3.2 to 2.7 g) and counts of unifacial and bifacial tools are expected drop-offs as distance to source increases. The seemingly contradictory increase in fire-cracked rock and hammerstones (although slight) may be explained by observation error and the nature of the matrix soil. The subsurface closer to the chert outcrop is characterized by large amounts of pebbles and cobbles (some broken) which are difficult to distinguish from fire-cracked rock and hammerstones while the subsurface in the northeast part of the site is composed of finer deposits with a much lower natural pebble content. The size of the lithic workshop is unknown but it appears to measure at least five meters in diameter and possibly more. A square placed on the lawn of an adjacent house produced similar counts and weights of lithic material.

Trace Element Analysis of Pleasantdale Mount Merino Chert

Samples of the chert artifacts and quarry material from the outcrop and excavation units were submitted for more specialized studies. One set was analyzed for trace element content by Robert Kuhn, Department of Anthropology, State University of New York at Albany, and a second set was thin-sectioned and studied for lithography by Professor Robert LaFleur, Rensselaer Polytechnic Institute. The purpose of these studies was two-fold: to contribute to a growing body of data on Hudson Valley chert and chert acquisition and to establish a standard for Pleasantdale chert so that material recovered at other sites could be compared and possibly identified.

Macroscopically, chert from Pleasantdale is very similar to the type Normanskill, which also outcrops in shale. Like Normanskill, the range of colors includes grey, greyish-green, greyish-blue, and dark grey to

TABLE 1.
Cultural material from four workshop squares and four non-workshop squares.

	Workshop squares	Non-workshop squares
Debitage, cores	1905	240
Debitage - weight (g)	6109.7	637.7
Debitage - average weight (g)	3.2	2.7
Bifacial tools	45	3
Unifacial tools	33	7
Hammerstones	1	2
Other rough stone tools	3	0
Fire-cracked rock	5	27

black, but appears to lack the characteristic bright green shades, except in thin-section. Some specimens have alternating sections of grainy, dark grey to reddish brown, banded and mottled material and a more homogeneous, lustrous, darker hued chert. Surfaces of both Normanskill and Pleasantdale Mount Merino chert are white to grey-green weathering, often with a brown patination between the weathered and fresh rock (Hammer 1976:50). Iron inclusions and pits formed by weathered rhombs of dolomite are visible in Pleasantdale specimens (LaFleur 1985:124-125).

In a previous study of the chemical composition of eastern New York State cherts, Kuhn and Lanford (n.d.) analyzed specimens from three regional groups: Heldeberg, Beekmantown, and Normanskill. X-ray induced x-ray fluoresence was used to measure the trace element content of each sample converted into ratios between elements: iron/rubidium, rubidium/strontium, and strontium/zirconium. Analysis of variance indicated that significant differences existed between the sample means for the three variables. These data were used to generate classification functions for the chert groups. When the original samples were classified according to the discriminant functions, 88.3% of the Normanskill specimens and over 90.0% of the collection as a whole was classified correctly.

In the next step, chert from the Pleasantdale outcrop was added to the Normanskill sample, which Kuhn previously defined as including the Mount Merino Formation, and the procedure was repeated. According to the resulting classification, chert from Pleasantdale could be subsumed under the Normanskill group. When the Pleasantdale specimens were added to the sample, the accuracy of the discriminant function dropped slightly from 90.3% to 88.9%, which was not considered a substantial decrease in accuracy. However, the analysis does not make it clear if the reduction in accuracy resulted from the original Normanskill specimens being incorrectly classified or from the Pleasantdale specimens being incorrectly classified as Heldeberg and/or Beekmantown chert.

In the final grouping, the Pleasantdale specimens were compared with cherts from two well-known Normanskill outcrops — Flint Mine Hill and West Athens Hill — located on the west side of the Hudson River about 80 km south of Pleasantdale. Enough differences exist between the two groups so that the discriminant function was able to correctly classify 88.7% of the specimens. A higher percentage of Pleasantdale specimens was misclassified than Flint Mine Hill-West Athens Hill chert, suggesting that separation is not complete. These data make it clear that Mount Merino and Normanskill chert are macroscopically and chemically very similar. However, thin-section study was found to be more effective in source identification in this case.

Lithology of Pleasantdale Chert

A second set of specimens was studied by Robert LaFleur (1985:124-125) who carried out macroscopic and petrographic microscope characterizations and comparisons. Chert from nine outcrop loci along the crest and west and northwest faces of the hill were selected for thin-sectioning. For comparative purposes, samples of debitage and artifacts recovered in excavation were also thin-sectioned and studied. Analysis demonstrated (1) that two chert lithologies, varying mainly in the color of the fresh and weathered rock surfaces, were identified from the outcrop. The color was found to be imparted by abundance of either orbs of blue-green microcrystalline quartz and rare chalcedony or a brown carbonaceous or ferrugenous stain that pervades the groundmass. Also, (2) all but one of the 12 chert specimens selected to provide a good variety of rock types from the excavation units were found to correspond to one of the two lithologic classes defined by the outcrop specimens. Thus, most of the worked chert recovered in excavation can be securely identified as originating from an outcrop of the Late Medial Ordivician Mount Merino Formation. While it seems most probable that the source location is the adjacent Pleasantdale outcrop (and this paper makes this assumption), it should still be emphasized that the lithologic identification is specific only to formation and not to outcrop.

Artifacts

The Pleasantdale assemblage includes finished artifacts, artifacts in process, and flake and block debitage (Table 2). The predominant raw material is the local chert. However, a higher percentage of the finished bifaces were made of non-local chert (identified by macroscopic methods) than were the early stage bifaces or debitage. Of 249 chipped stone artifacts (other than debitage or utilized flakes), 89.6% are made of the local chert,

TABLE 2.
Counts and weights of prehistoric artifacts

	Count	Weight (g)
Chipped stone tools		
Projectile points	5	
Biface blades or knives	10	
Biface drills	2	
Broken bifaces or fragments	24	
Bifaces in process	38	
Bifaces in process, utilized	23	
Cores	41	
Cores, utilized	7	
Unifaces and retouched flake tools	49	
Retouched flakes	43	
Utilized flakes	35	
Other tools	7	
Chert flat flakes	5201	11,027.0
Chert block flakes	275	7,255.6
Other flat flakes	10	196.7
Other block flakes	45	614.5
Shale debitage	225	912.1
Quarry material		175.2 kg
Rough and ground stone tools	28	
Fire-cracked rock	378	
Miscellaneous	5	

5.6% may be local chert but could not be positively identified, and 4.8% are of other lithic materials. In contrast, the debitage from one representative provenience unit was found to include 446 pieces (99.6%) of local chert or shaley-chert matrix and only 2 pieces (0.4%) of non-local material. The recovery of tools of non-local lithic material at quarry sites has been discussed by Gramly (1980a;1980b) in his papers on the New Hampshire Mt. Jasper Quarry. In that study, the finished but heavily worn tools of exotic stones were interpreted as having been depleted from tasks carried out elsewhere and subsequently discarded at the Mt. Jasper lithic source as replacements were manufactured. At Pleasantdale, this activity does not seem to have been as pronounced, although the occurrence of a small number of finished and utilized tools of exotic stones suggests at least some refurbishing of tool kits. The wide-spread distribution of cherts in the Hudson Valley may account for this difference.

The site also produced a high frequency of utilized and/or retouched unifaces and bifaces. Of 61 bifaces in process (defined as artifacts bifacially worked but not yet finished), 23 were found to have been removed from the biface production process and utilized or retouched to create specialized tools with which to carry out other manufacturing activities. It is likely that more than stone tools were made at the site and that the occupants took advantage of discarded artifacts to fashion equipment of wood, bone, plant fiber, and other materials.

After assessing the chipped stone assemblage, a system of classification and nomenclature which would most accurately characterize the kinds of materials recovered was selected. Initially, classification was based solely on core reduction and tool production (i.e. "core", "biface in proces", etc.), but as described above systematic inspection of edge retouch and use-wear indicated that following removal from the production sequence many of the in-process lithics were modified to produce specialization tools. Because of this, the nomenclature was revised to reflect functional categories as well as those relating to production and morphology. While this revision seeks to better describe the assemblage, it is admittedly arbitrary and problematic. Thus, the same artifact can be correctly identified as a "biface in process" by one researcher and is a "biface chopper", or simply as a "chopper", by another, depending on which variables are considered important.

In another study (Brumbach et al. 1982; Brumbach 1985b), ethnoarcheological research carried out among contemporary and recent populations in north-central Saskatchewan demonstrated that cultural materials could be differentially categorized depending on the researcher's orientation: one perspective identified primarily European manufactured trade goods while a second and more ethnocentric view documented the process through which raw materials (including the trade goods themselves) were modified and recycled for secondary, native defined tasks. Applying this analogy to the Pleasantdale quarry and workshop assemblage, it is possible to identify (1) products and rejects of the manufacturing process and (2) retouched and utilized tools secondarily recycled to carry out processing tasks. In order to bring about a compromise between the morphological and functional approaches, artifacts were initially classified according to formal characteristics and then examined for edge modification and use-wear with low-power magnification. Information on shape, length, and edge angle of modified or utilized surfaces was recorded. Cores and bifaces were also assessed for stage of manufacture using a system developed by Callahan (1979). These stages are steps in the process of core preparation and reduction and are defined by width/thickness ratio, edge angle, degree of edging, primary and secondary thinning, and shaping (Table 3).

TABLE 3.
Stages of biface manufacture (from Callahan 1979)

Stage	Description	Width/thicknes Ratio	Edge angles
1	Core, split cobble, chunk, nodule, etc.		
2	Initial edging	2.00+	55-75°
3	Primary thinning	3.00−4.00	40-60°
4	Secondary thinning	4.00+	25-45°
5	Shaping	4.00−6.00+	

Projectile Points

The 1983 and 1984 excavations produced three finished and two in-process projectile points. A sixth was recovered during the cultural resource survey and a seventh was found by a resident when the foundation for his house was dug. All have been tentatively assigned to the Archiac period, four to the Late Archaic.

The broken base and haft element of a projectile point identified as the type Brewerton Side-notched (Figure 4, top, second from right) was recovered from a test pit on the easternmost part of the site. Points of this type are characteristic of the Brewerton Phase of the New York State Late Archaic (Ritchie 1971:19-20; 1969:89-96), dated ca. 2200-2500 B.C. The raw material is a low lustre, red-brown chert which derives from Pleasantdale or another outcrop of the Mount Merino Formation. A second point (Figure 4, top left) bears some resemblance to the type Brewerton Side-notched but could also date to the later ceramic period. It measures 39 mm long with a slight break at the tip, 21 mm wide at the shoulder, and 7 mm thick. The blade is plano-convex in cross-section and has some edge retouch. The stem is side-notched but not basally expanded and the base is slightly convex. The material is a medium lustre, mottled dark grey to blue-grey, white-weathering Mount Merino chert.

A complete specimen of a small stemmed projectile point (Figure 4, top, second from left) identified as a Lamoka type, characteristic of the Late Archaic Lamoka Phase (Ritchie 1971:29-30) dated between 1800 and 2500 B.C. (Funk and Rippeteau 1977:30), was recovered from underlying Level 2 of the square that contained the side-notched point. The raw material is the local, medium lustre, mottled dark grey to blue-black chert with some iron impurities and minute holes left by weathered rhombs of dolomite. The point measures 40 mm long, 17 mm wide at the shoulder, and 8 mm thick. It is biconvex in cross-section with a distinct median ridge, slightly side-notched, and has an unfinished base.

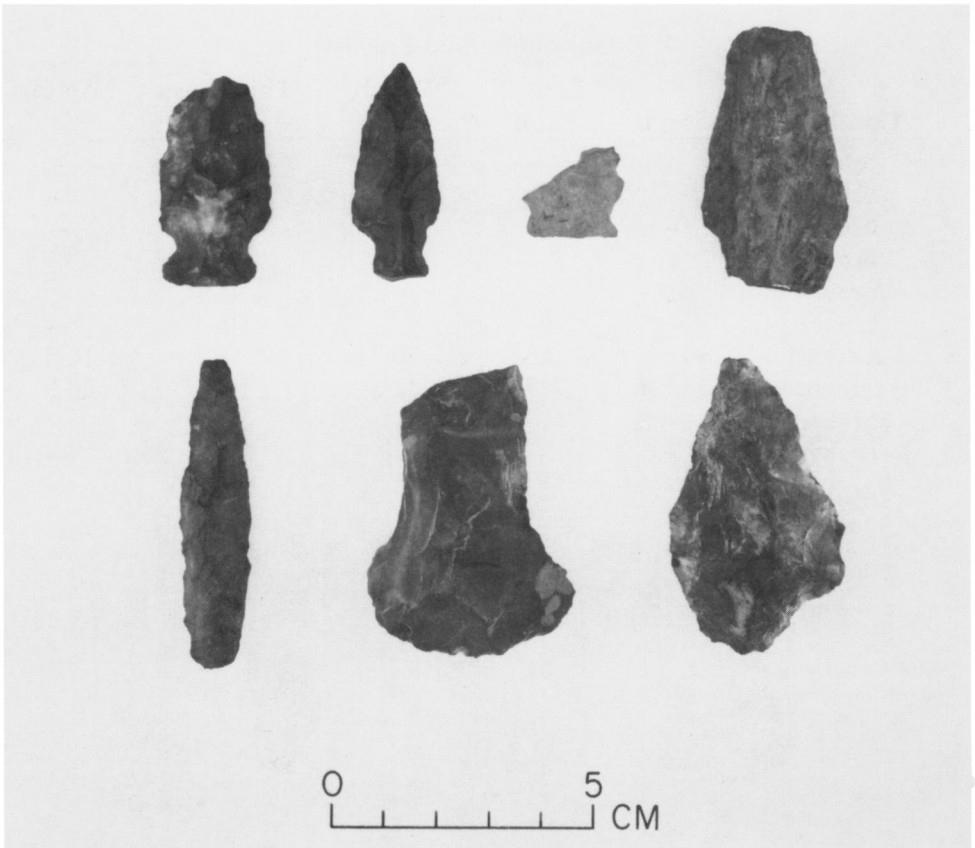

FIGURE 4. Projectile points and drills. Top, left to right: side-notched point, Lamoka point, base of probable Brewerton Side-notched point, unfinished stemmed point (Snook Kill type?). Bottom, left to right: biface drill, expanding-base biface drill, unfinished stemmed projectile point (Snook Kill type?).

Although unfinished, a stemmed biface in process (Figure 4, bottom right) from a surface collection in the eastern part of the site bears some resemblance to the type Snook Kill (Ritchie 1971:47-48), diagnostic of the Late Archaic Snook Kill Phase (Ritchie and Funk 1973:342-344) dated ca. 1600-1700 B.C. (Funk 1976:259). It measures 55 mm long and 15 mm wide. The material is a low to medium lustre mottled grey, white weathering Mount Merino chert with iron inclusions, shaley impurities, and minute holes and is believed to be local in origin.

A second unfinished biface (Figure 4, top right) may also have been intended for a stemmed projectile point, or less likely for a knife. Like the previous artifact it has a weakly developed stem and shoulder and is made of the local, low lustre grey, white weathering chert with a shaley matrix. A thick median ridge and shaley inclusions may have made blade thinning and removal of irregularities impossible. The edges are crushed and retouched and the point area is blunted, suggesting modification for use after the artifact was first discarded.

Biface Blades, Knives, and Drills

The ten biface blades and knives listed in Table 4 and illustrated in Figure 5 are classified as finished tools, although only one is a Stage 4 or 5 biface. Use-wear where visible, occurs as edge blunting or crushing and is most pronounced close to the tip.

An expanding-base biface drill (Figure 4, bottom center) of local chert, consisting only of the base and part of the shaft, was recovered from the same level and within a few meters of the broken Brewerton Side-notched point. A second biface drill (Figure 4, bottom left), whole except for a small break at the tip, has a straight shaft with a distinct median ridge reminiscent of a Lamoka point. It measures 57 mm long

TABLE 4.
Biface blades and knives

Catalogue number	Condition	Stage	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Chert
11-3	broken	3	—	40+	11+	—	local
56-1	broken	3	88	47	14	62.6+	local
71-6	broken	—	—	—	—	—	non-local
78-19	broken	4	—	35+	8+	—	local
83-2	broken	4	—	—	—	—	local?
110-8	broken	4	—	—	10+	—	local
121-2 and 121-5	mended	3 or 4	58	30	9	14.3	non-local
138-1	whole	3 or 4	87	42	13	46.9	local
146-11	broken	4 or 5	—	—	7+	—	non-local
146-15	broken	3	—	—	—	—	local

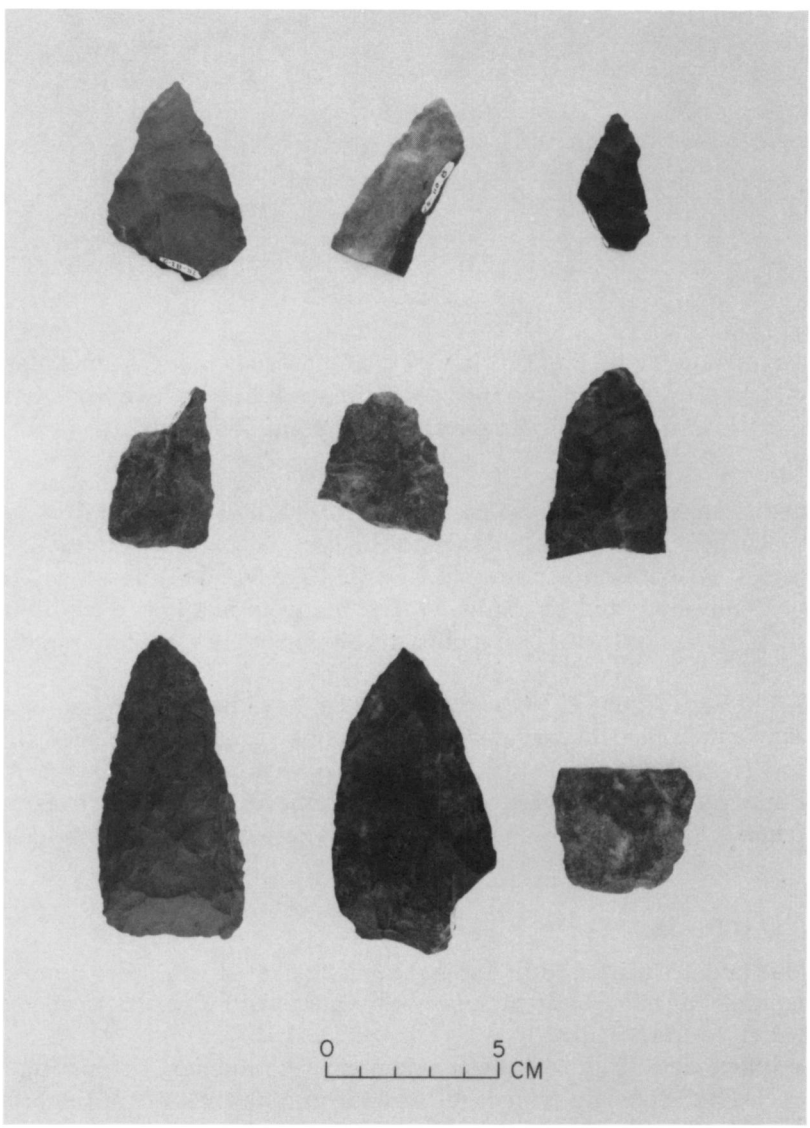

FIGURE 5. Biface blades and knives.

(estimated original length is 60 mm), 13 mm wide, and 10 mm thick. The material is the grey blue mottled and banded local Mount Merino chert with iron inclusions and small holes. The edges of the long shaft are crushed and utilized.

Cores

Forty-eight cores, not including the material from the top of the chert outcrop hill, were recovered (Figure 6). Forty-one show no signs of use other than the removal of cortex while seven were further modified for use as tools but were not edged or bifacially thinned. Of the 41 unmodified cores (Table 5), one is of quartz, 37 are local Mount Merino chert, and three may be local chert. Average weight is 74.0 g with a range of 13.0 to 307.9 g. The distribution is positively skewed by a few large pieces.

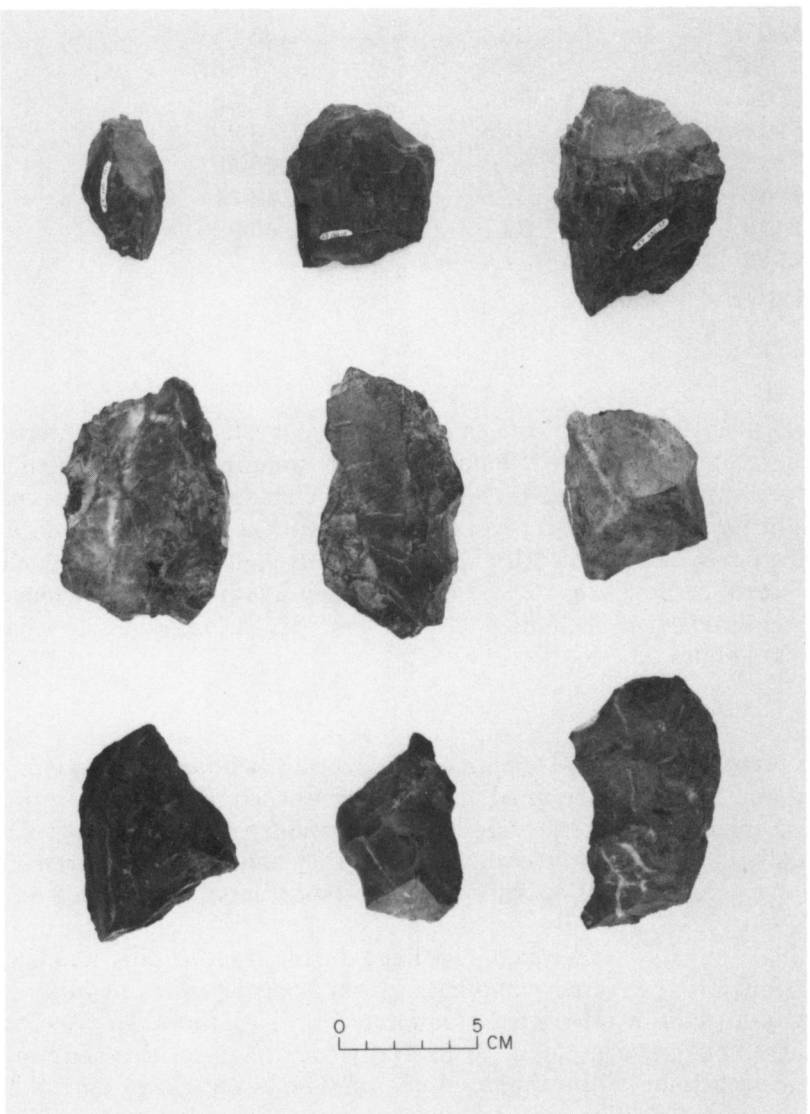

FIGURE 6. Cores.

TABLE 5.
Weights of non-utilized cores

Catalogue no.	Weight (g)	Catalogue no.	Weight (g)
6-5	38.4	145-50	183.6
82-14	21.5	145-51	34.7
91-2	89.7	145-53	67.0
110-10	44.5	145-54	39.1
113-9	37.8	145-55	27.8
113-10	77.9	145-56	57.3
120-13	95.5	145-57	94.0
121-13	307.9	145-59	72.1
124-11	84.0	145-60	66.3
124-12	79.4	145-61	81.0
127-6	33.0	145-62	24.4
133-14	13.0	145-63	130.6
133-16	18.5	145-64	118.4
133-17	20.1	145-65	168.3
137-14	175.6	145-66*	73.2
137-15	60.7	146-28	34.9
137-16	31.5	146-29	103.7
138-12	68.7	146-30	29.0
138-15	136.8	146-31	28.1
138-16	53.7	146-32	—
145-24	37.4		

*raw material = quartz

Utilized Cores

Seven cores, all of local chert, show utilization or retouch suggesting that they were moved from the biface production process and secondarily utilized. Some of the edge-wear may have resulted from grinding for platform preparation or mechanical breakage after discard and burial, but most of the wear appears to be purposeful. Average weight for the unbroken pieces is 60.5 g, with a range of 28.9 to 91.0 g (Table 6).

Visible edge utilization or retouch is difficult to categorize and the uses to which these tools were put are even harder to discern. Some pieces appear to have been heavy knives or choppers while others were retouched to create specialized edges, including "beaks" (convexities, projections, or small excurvate scrapers), chisels, and/or engraving spurs.

Bifaces in Process

Bifaces in process represent middle stages in core reduction or biface production. All or most of the cortex has been removed and the edges trimmed or bifacially worked for the edging process (Table 7, Figure 7). Only a few of the 61 bifaces in process evidence any secondary retouch. Thirty-eight are not considered to have been additionally utilized after discard, although they exhibit some degree of edge crushing or battering which may be due to platform preparation or post-depositional breakage. The remaining 23 present edge wear suggestive of re-use.

Discard seems to have resulted either from breakage during the thinning and edging processes or from the inability of the manufacturer to remove impurities (iron oxide deposited in joints or shaley or silty inclusions), lumps, or a median ridge, or otherwise adequately thin both faces. Thirty of the non-utilized pieces were identified as Stage 2 bifaces (completely or partially edged but not thinned); seven were identified as Stage 3 (discarded during primary thinning), and one may be either Stage 2 or 3. The average weight of 16 unbroken pieces (all Stage 2) is 77.5 g, which appears to be unusually high since average weight of non-utilized cores is only 74.0 g. However, the difference can be attributed to an average weight for bifaces in

TABLE 6.
Utilized cores

Catalogue number	Measurements (mm)	Weight (g)	Utilization
120-11	63x59x25	91.0	Unifacial retouch for cutting/chopping
120-12	88x54x16	69.5	(1) utilized/dulled cutting edge (2) peaked projection
124-10	58x47x20	39.1	(1) retouched/utilized beak edge (2) edge battering from use as a chisel or small chopper?
138-5	43x27x19	28.9	Unifacial retouch
138-11	70x44x26	59.3	Utilized edge, chisel or engraver?
145-49	76x50x12	fragment	Unifacial retouch and edge crushing
145-52	80x36x24	75.3	Edge battering, wedge/chopper?

process calculated on unbroken pieces while the average for cores was calculated on both broken and unbroken pieces. This was done because it is easier to determine if a biface is broken than if a core is broken. The range of weights on the 16 pieces is 14.1 to 208.6 g.

Utilized Bifaces in Process

Twenty-three of the bifaces in process were reworked to create specialized edges (Table 8). Recycling occurred after the artifact was removed from the biface production process, but whether this took place immediately or years (or millenia) later cannot be determined. The most common edge configuration, with at least 13 examples, was a retouched chopping or rough cutting surface. Other bifaces were refitted with more specialized edges — "spokeshaves" or concave scrapers (at least two), "denticulates" or toothed or serrated knives or scrapers (at least two), burins and/or engraving spurs (five), and "beaks" (at least two). These edges or surfaces are difficult to differentiate and quantify because they tend to intergrade with each other and some bifaces had multiple areas of use. Average weight of the 23 pieces is 61.9 g, with a range of 11.3 to 175.0 g. Average weight of the 12 unbroken specimens alone is 83.9 g with a range of 14.0 to 175.0 g. All are made of local chert.

Artifact 25-22-6 (Figure 8, bottom center), a biface made from a large flake of banded Mount Merino chert was steeply retouched along one convex edge for a length of 38 mm. Retouch was mostly unificial although a few flakes were removed from the opposite face to form an edge angle of 65-75°. The tool appears to have been used as a chopper and/or scraper. Artifact 25-138-21 (Figure 8, top right) was discarded as a biface preform because impurities hindered controlled flaking. Subsequently, one surface was either unifacially retouched or heavily utilized for a length of 21 mm to create a straight edge with an angle of about 40°. The tool could have been used as a light chopper or knife. At the end of one of the working edges, an engraving spur or dulled point was shaped and retouched, also to an angle of 40°. Finally, artifact 25-145-11 (not illustrated), probably abandoned because impurities and thick edges impeded thinning, was battered or retouched for a length of 88 mm along one edge. The result is a "denticulate" or serrated cutting/chopping tool with an edge angle of 60-70°.

Miscellaneous and Broken Bifaces

Seven chipped stone artifacts were classified as "other" because they exhibit the characteristics of several tool classes (Table 9). Most appear to have been made on discarded cores or bifaces in process subsequently retouched for specialized use.

The collection also includes 24 broken bifaces or fragments too small to be assigned with confidence to other classes (Table 10). Of the 24, 21 are of the local chert and three, identified as deriving from Stage 4 or 5 bifaces, are non-local on the basis of color, texture, and inclusions. At least eight are fragments of finished tools which were probably discarded after breakage. Several suggest recycling and reutilization after the first phase of usage.

TABLE 7.
Data on bifaces in process, non-utilized

Catalogue number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Stage	Chert
21-1	78	63	28	139.6	2	local
56-2	86	66	29	141.3	2	local
71-7	—	—	—	—	3	non-local?
71-8	49	24	10	14.1	2	local
82-9	—	—	—	—	2	local
82-10	—	—	—	—	2	local
83-3	69	50	17	55.3	2	local
83-4	—	—	—	—	3	
84-21	—	40	8	—	3	local
92-1	64	57	25	124.1	2	local
92-4	—	—	—	—	2	local
120-3	48	36	18	31.1	2	local
120-5	—	—	—	—	2	local
120-6	—	—	—	—	2	local
121-6	93	54	25	126.8	2	local
121-8	50	24	16	19.7	2	local
126-1	—	—	—	—	3	local
133-15	40	33	13	24.3	2	local
137-10	—	—	—	—	3	local?
137-13	—	—	—	—	2	local
138-2	55	30	12	21.0	2	local
138-4	—	—	—	—	2 or 3	local
138-7	—	—	—	—	2	local
138-9	—	—	—	—	2	local
143-3	95	65	36	208.6	2	local
144-1	—	—	20	—	2	local
145-9	—	—	—	—	2	local
145-10	66	49	32	100.8	2	local
145-12	—	—	—	—	2	local
145-15	77	55	19	84.5	2	local
145-16	—	—	—	—	3	local
145-17	45	28	16	21.4	2	local?
145-19	—	—	—	—	2	local?
145-20	—	—	—	—	2	local
145-21	—	—	—	—	2	local
145-67	62	20	20	42.1	2	local
146-14	—	42	12	—	3	local
146-16	55	51	23	85.9	2	local

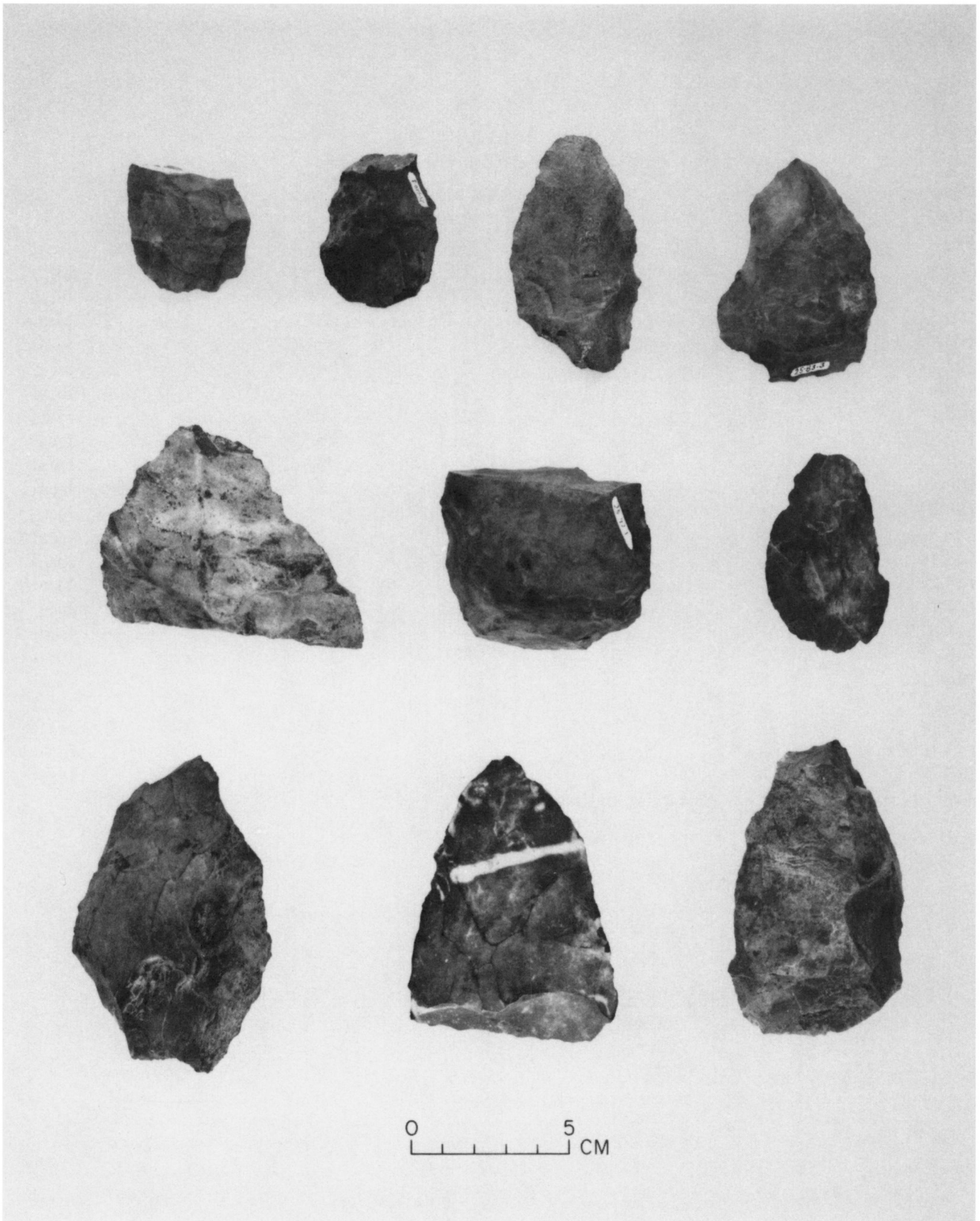

FIGURE 7. Bifaces in process, not utilized.

TABLE 8.
Data on bifaces in process, utilized

Catalogue number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Stage	Chert
22-6	81	54	30	156.3	2	local
84-22	—	29	12	(18.8)	2	local
120-2	77	52	27	109.3	2	local
120-4	—	—	—	(53.5)	1	local
120-7	—	30	12	(17.0)	2	local
121-7	46	40	21	42.2	2	local
124-9	83	51	23	95.4	2	local
130-1	73	44	25	84.2	2	local
133-10	—	47	21	(56.3)	2 or 3	local
137-11	—	—	—	(64.4)	2	local
138-3	54	30	20	36.8	2	local
138-6	70	—	—	(31.7)	2 or 3	local
138-8	60	33	15	32.7	2	local
138-10	—	—	—	(11.3)	1	local
138-21	39	30	11	14.0	2	local
144-1	76	44	15	39.9	3	local
144-6	—	—	—	(43.1)	2	local
145-8	105	52	33	175.0	2	local
145-11	89	52	22	106.0	2	local
145-13	61	56	24	115.5	2	local
145-14	—	40	11	(34.1)	3	local
145-18	—	52	23	(65.2)	3	local
146-17	—	—	—	(21.7)	2	local

(weights in parentheses are on broken artifacts)

TABLE 9.
Other chipped stone tools

Cat. No.	Measurements (mm)	Weight (g)	Utilization	Chert
54-5	67x42x22	50.1	Knife/chopper	local
120-15	78x59x20	79.4	Scraper/knife	local
137-5	33x21x19	10.9	?	non-local
137-8	—	—	?	local?
137-12	31x26x20	17.7	?	local
144-5	56x26x22	36.6	Chopper?	local
146-12	—	—	?	local?

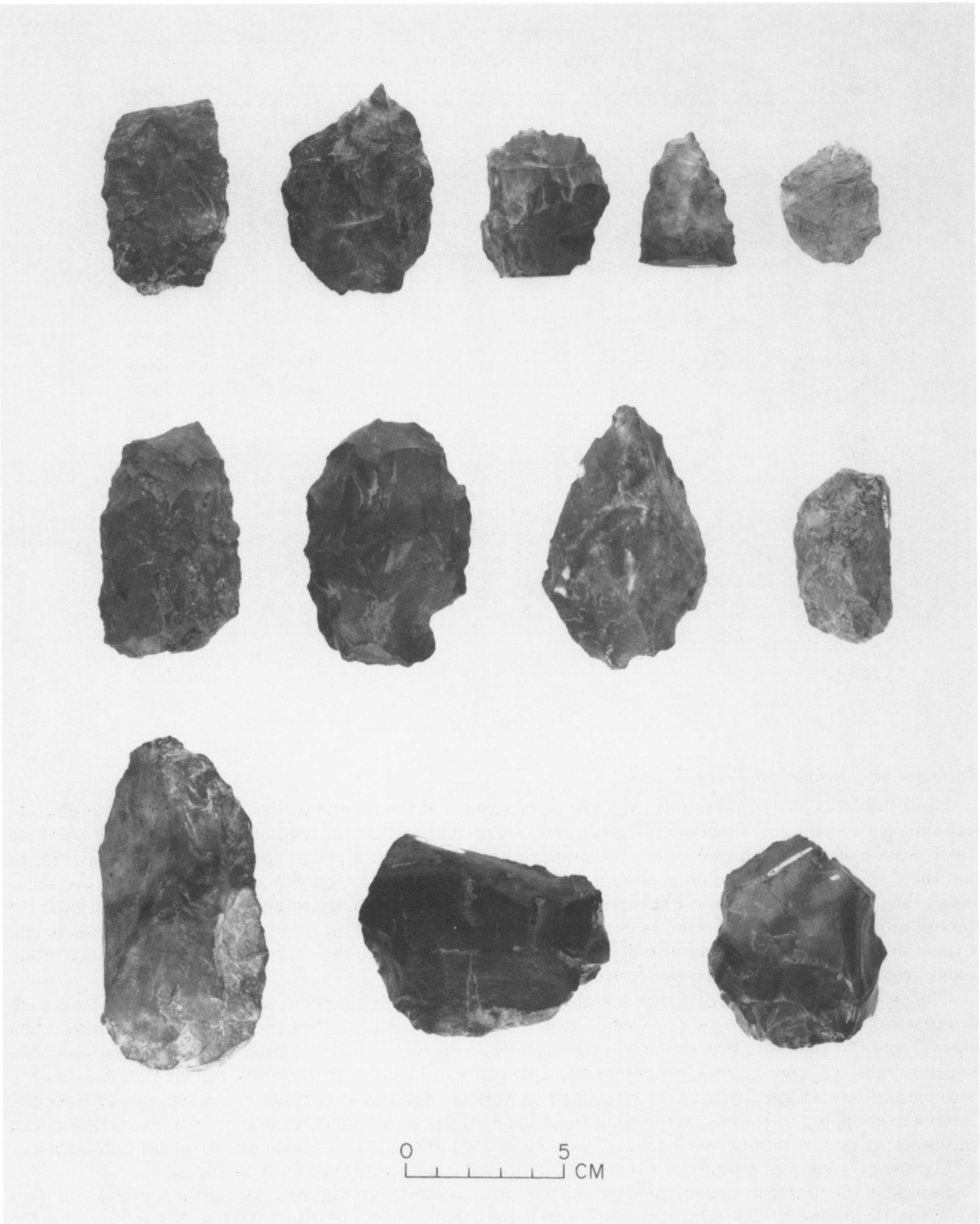

FIGURE 8. Bifaces in process, utilized.

TABLE 10.
Broken and fragmentary bifaces

Cat. no.	Identification	Stage	Chert
23-3	—	—	local
79-1	Point tip	4 or 5	non-local
113-8	—	2 or 3	local
118-4	—	3	local
120-1	Blade	3 or 3	local
120-8	—	—	local
121-3	Base of stemmed or notched biface	4	non-local
121-4	Blade	4	non-local
121-9	—	3	local
124-6	—	3	local
133-11	Base	2 or 3	local
133-12	—	2 or 3	local
133-13	—	—	local
137-6	Blade	—	local
137-7	—	3	local
142-1	—	2	local
143-4	—	—	local
144-2	—	3	local
145-2	—	2	local
145-3	—	2	local
145-4	—	3 or 4	local
145-5	—	—	local
145-6	—	2	local
146-13	—	—	local

Unifacial and Retouched Flake Tools

Unifacial tools, including retouched flake tools, retouched flakes, and utilized flakes, represent discrete steps along a continuum of tool manufacture and use. As these terms are used here, *unifacial tools* are those which were modified or shaped before the preparation of the working edge. *Retouched flake tools* differ in that there was a reduced amount of shaping afforded to the body or haft before the preparation of the working surface. A *retouched flake* might receive no shaping before final edge retouch, while the least modified class of unifaces, the *utilized flake,* is not shaped or retouched at all before use. Assigning unifaces to one of these discrete categories is admittedly worker-ideosyncratic, since the degree of utilization and/or intentional preparation may be hard to determine and differentiate.

The 49 unifacial artifacts comprise a highly variable class, including both easily recognizable tools such as unifacial "thumbnail" scrapers, as well as more enigmatic pieces exhibiting multiple retouched or modified edges (Table 11). In addition to unifacial end and side scrapers, there are at least 25 other edges retouched for scraper use, 13 "spokeshaves" or notched scrapers, and 12 "beaks" or retouched convexities. All "beaks" were found in association with other retouched or worked edges, most commonly a scraper or spokeshave. Cutting or chopping edges, engraving spurs, and one drill tip were also identified. Finally, four edges which exhibited extreme battering were noted. These have been identified variously as "strike-a-lights", chisels, or "clammers". Average weight for the 49 pieces is 12.3 g with a range of 1.5 to 45.9 g.

Several of the unifacial and retouched flake tools are illustrated in Figure 9. Two of the unifacial scrapers are of the "thumbnail" type which, according to Robert Funk, New York State Archaeologist, resemble the thumbnail scrapers of the Paleo-Indian period. Artifact 25-92-2 (Figure 9, top, second from right) is a unifacial end and side scraper, 35 mm long, 26 mm wide, and 10 mm thick, manufactured from a large percussion

TABLE 11.
Unifaces and retouched flake tools

Cat. no.	Primary identification	Weight (g)	Chert
33-3	Specialized scraper	3.0	local
43-6	"Thumbnail" end and side scraper	3.9	non-local
67-9	Multi-purpose scraper	17.1	local
83-5	Knife	6.6	local
83-5	Scaper and/or knife	15.6	local
86-14	Scraper	4.2	local
86-15	Notched scraper?	3.1	local
87-1	Scraper	40.5	local
92-2	"Thumbnail" end and side scraper	8.6	local?
92-3	Knife	27.3	local
115-17	Serrated edge scraper	9.8	local
119-2	Chisel? Strike-a-light?	11.5	local
120-9	End and side scraper	17.4	local?
120-10	End scraper	41.7	local
121-10	Multi-purpose tool	7.5	local
121-11	Scraper and/or spokeshave	11.8	local
122-1	Multi-purpose tool	10.0	local
123-1	Scraper	3.2	local
124-7	Multi-purpose tool	6.7	local
124-8	Scraper?	3.4	local
127-7	Spokeshave	2.1	local
137-22	Drill	10.6	local
138-14	Multi-purpose tool	24.4	local
138-17	Multi-purpose tool	26.4	local
138-18	Scraper and awl	6.1	local
138-19	"Denticulate" or serrated edge tool	1.5	local
138-20	Spokeshave scraper or knife	10.3	local
138-22	Side scraper or knife	27.5	local
143-5	Beaked scraper?	13.7	local
143-6	Scraper	4.6	local?
143-7	Spokeshave?	2.8	local
143-8	End scraper	2.0	local
143-9	Edn scraper	6.0	local
145-22	End and side scraper	28.0	non-local
145-23	End and side scraper	10.2	local
145-26	Multi-purpose tool	1.7	local
145-28	Beaked tool	23.1	local
145-34	Multi-purpose tool	5.7	local
145-58	Multi-purpose tool	45.9	local
146-18	End and side scraper	8.4	local
146-19	End scraper and knife?	6.9	local
146-20	End scraper	9.5	local
146-21	End scraper	9.3	local
146-22	Spokeshave and beak	21.1	local
146-23	Spokeshave and beak	7.2	local
146-24	Spokeshave	7.1	local
146-25	Scraper and beak	3.1	local
146-26	Knife	9.6	local
146-27	Spokeshave	16.7	local

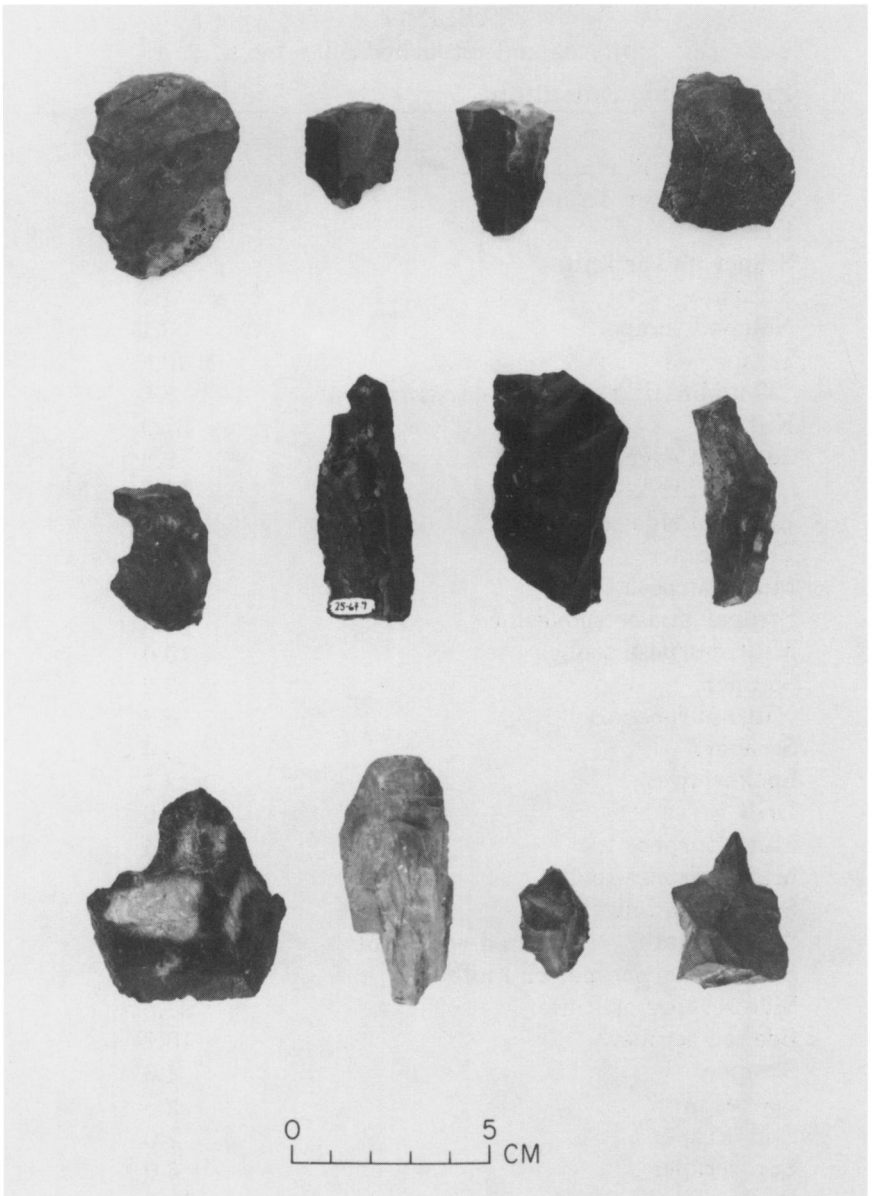

FIGURE 9. Unifacial tools.

flake of either Normanskill or Mount Merino chert shortened at the distal end. The end and both sides have been steeply retouched to a working edge of 70-75° and there are two weakly developed corner engraving spurs. The second thumbnail scraper, artifact 25-43-6 (Figure 9, top, second from left), measures 27 mm long (broken), 22 mm wide, and 7 mm thick. It was made on a percussion flake of a non-local, mottled grey-blue chert with a glossy texture, steepened at one end to create a working edge with an angle of 60-70°.

Artifact 25-67-9 (Figure 9, center, second from left), a multi-purpose scraper, measures 62 mm long, 23 mm wide, and 12 mm thick. The raw material is the local, banded and mottled, medium to high lustre grey to blue-black chert. The flake is triangular in cross-section with joints forming two of the faces. There are three retouched edges: (1) a slightly excurvate scraping edge, 41 mm long, unifacially retouched to an angle of 65-75°; (2) a second area of scraper retouch measuring 18 mm long on the opposite face with an edge angle of about 65°; and (3) a retouched notch forming a spokeshave or concave scraper, 6 mm across, at the distal end.

Artifact 25-138-14 (Figure 9, bottom, second from left) is made on a flake of local, medium lustre, banded beige-grey white-weathering chert. The flake measures 61 mm long, 28 mm wide, and 14 mm thick. One face has been battered, especially around the striking platform, probably due to repeated unsuccessful attempts to thin the dorsal face or perhaps from use. The proximal end of the flake appears to have been heavily utilized as a chisel, wedge, or similar kind of tool.

Artifact 25-138-18 (Figure 9, bottom right), a thin and delicately retouched scraper and awl with a working edge only 3 mm thick, was probably intended for use on soft materials rather than on bone, wood, or other resistant surfaces. The raw material is the low lustre, mottled, white weathering Mount Merino chert. The ventral surface of the flake was not further modified while the dorsal surface was retouched for the scraper and awl edges. A point 13 mm long and one straight-to-concave edge were retouched to an angle of 10-20°.

A final example of a specialized edge appears on artifact 25-145-28 (Figure 9, bottom left), a retouched flake with a "beak" edge and possible engraving spur. The flake measures 53 mm by 50 mm and 11 mm thick and is made of local, low to medium lustre, grey to dark grey, white weathering chert. One edge was unifacially retouched to create a convexity or "beak" which measures 23 mm across with an edge angle of 60-70°. In the center of the beak is a sharp projection or engraving spur.

Retouched flakes, defined as flat or block flakes shaped only along the working edge or edges, numbered 43. Average weight for both groups is 10.1 g, while average weight for the 36 retouched flat flakes is 6.9 and average weight for the seven retouched block flakes is 26.3 g. Of the 43 items, one was found to be made of non-local material, a second could not be positively identified, and the remaining 41 consist of the local chert.

Utilized flakes were not prepared prior to use but were selected because they already offered a suitable shape or working edge. Edge wear or damage is believed to be use-related although some heavily utilized flakes present edges which differ only slightly, if at all, from those of retouched flakes. Average weight for 35 utilized flakes is 5.9 g. Most are of Mount Merino chert.

Rough and Ground Stone Tools

Hammerstones, the most common form of rough and ground stone tools, were concentrated in the area of the chert outcrop (Table 12). Eight were recovered from the half-meter square on top of the hill and others were observed on the slopes although only one, found in association with the large quarry hammers or picks, was collected. The remaining three were found in the excavation units east and northeast of the hill. Average weight of 13 hammers is 315 g with a range of 94 to 864 g.

Several of the heavy tools used to loosen and break-up the outcropping chert were recovered from the west face of the hill. Four picks or large hammerstones consisting of split and pecked water-worn quartzite cobbles weigh between 0.91 and 7.73 kg (2 and 17 pounds). Two of the these were found on the west slope of the hill within a few meters of each other (Figure 10, bottom row). Both are split oval-to-round cobbles with battered and flaked edges and are similar in size: one measures 19.1 by 16.7 by 6.2 cm and weighs 2.17 kg; the second measures 15.7 by 14.4 by 6.0 cm and weights 1.78 kg. A third quarry tool was recovered from the west face of the hill above one of the worked chert outcrops. Made on an oval to pear-shaped split quartzite cobble, it measures 28.5 cm long, 22.5 cm wide, and 8.8 cm thick and weighs 7.73 kg (17 pounds). Several edges are battered and flaked. The source of these quarry tools does not appear to be the outcrop hill itself since a further inspection of the hill failed to reveal naturally occurring cobbles of this size and lithology. They could have been collected from the Hudson River and carried to the quarry outcrops.

Several rough and ground stone artifacts appear to have been used for purposes other than quarrying and the production of stone tools but most are too fragmentary to positively identify. A broken sandstone pebble may have been used as a pestle to process food material and several other fragments present evidence of wear not usually associated with stone tool manufacture.

Age of the Pleasantdale Site

The recovered diagnostic artifacts suggest the site was most heavily utilized during the Late Archaic period, ca. 1600-3000 B.C. According to State Archaeologist Robert Funk, who reviewed some of the artifacts, one of the side-notched points could date as recently as the Middle Woodland Stage (A.D. 100-900) while the two thumbnail scrapers bear morphological similarities to those recovered from Paleo-Indian components.

TABLE 12.
Rough and ground stone tools

Cat. no.	Identification	Weight (g)
22-10	Hammerstone fragment	—
27-5	Ground stone	101
53-1	Hammerstone	174
67-13	Ground stone fragment	—
82-17	Ground stone, pestle fragment?	—
86-20	Hammer-anvilstone	290
91-7	Anvilstone	224
113-14	Hammerstone	127
114-6	Hammer-anvilstone	522
124-15	Rough stone tool fragment	—
124-16	Rough stone tool fragment	—
125-2	Rough stone tool fragment	—
131-1	Hammerstone	111
131-2	Hammerstone	864
132-1	Hammerstone	98
132-2	Hammerstone	423
132-3	Hammerstone	560
132-4	Hammerstone	456
132-5	Hammerstone	595
132-6	Hammerstone	199
138-28	Hammerstone	94
146-38	Rough stone tool fragment, anvilstone?	—
146-39	Rough stone tool fragment, anvilstone?	—
148-1	Quarry tool	1777
148-2	Quarry tool	910
148-3	Quarry tool	2173
148-4	Quarry tool	7730
148-5	Hammerstone	400

Based on the identified artifacts, the geologist's interpretation of the age of the terrace deposits, and the complete absence of Woodland period ceramics (despite the careful screening of all backdirt from undisturbed excavation units), the site is considered to date primarily from the Late Archaic with possible sporadic occupations occurring during both earlier and later time periods.

Discussion

Interpretation of the Pleasantdale site as a quarry/workshop and processing station was based on the identification of a large outcrop of chert with several worked faces and the recovery of artifacts, including cores and early stage bifaces, of this material. While most of the non-utilized debitage was not closely examined, inspection of one provenience unit revealed that 99.6% of the 448 pieces of flake and block debitage consists of the local chert or shaley-chert matrix. Lithic tool production overwhelmingly involved the local material, a medium quality chert of the Mount Merino Formation, which some researchers subsume within a "macro-Normanskill" group.

One test of the importance of quarry activity is average flake size. Sites close to a lithic source can be expected to contain more evidence of the initial stages of core reduction and tool manufacture, including larger flakes and blocks deriving from percussion flaking of cores, and a concomitant reduction in small and retouch flakes. Conversely, sites located farther from the source or sites occupied primarily as living and/or maintenance loci are expected to produce a higher frequency of small retouch flakes and finished tools.

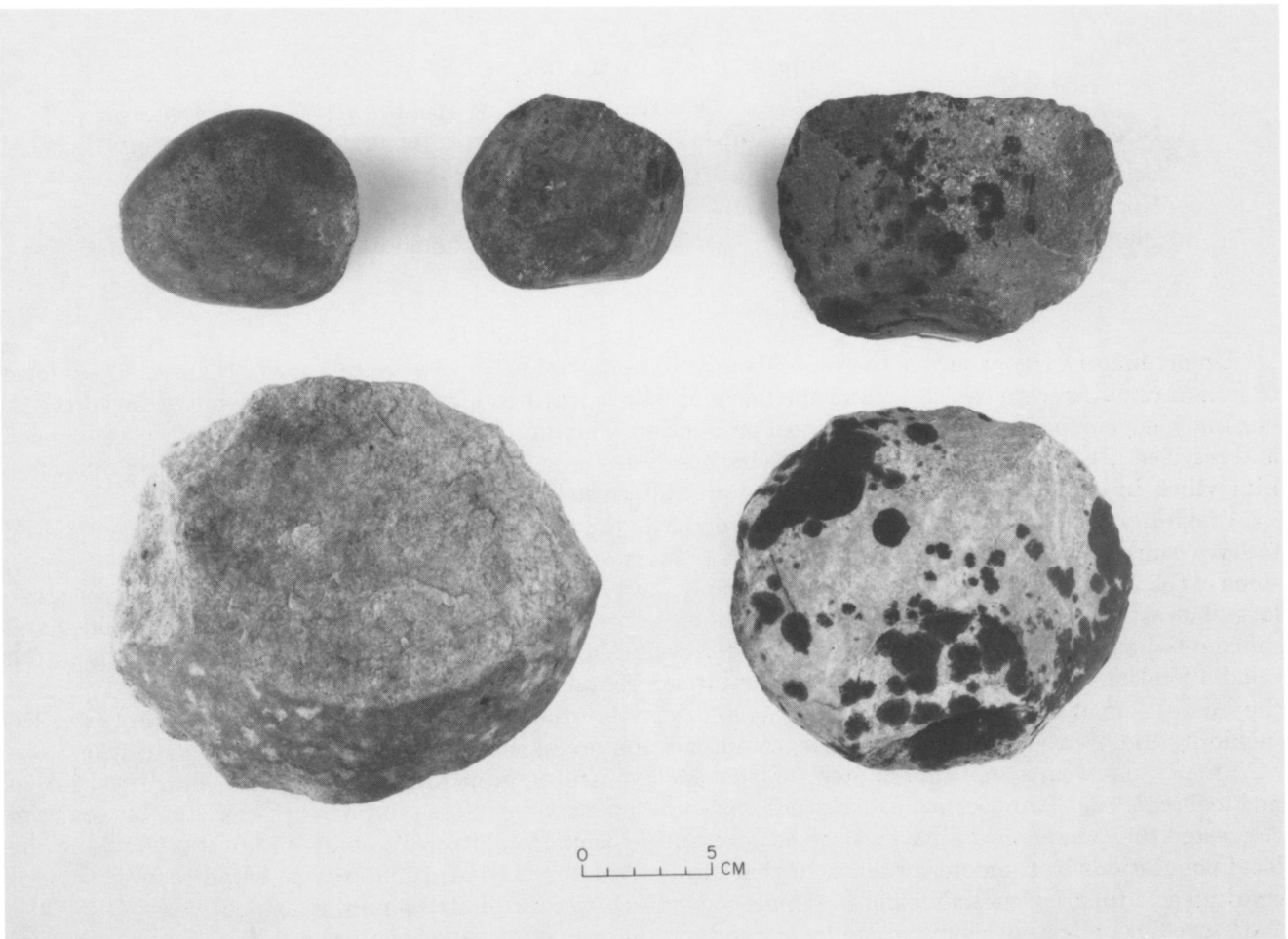

FIGURE 10. Top, left and center: hammerstones. Others: large quarry hammers or picks.

To compare the Pleasantdale collection, data from two other sites were examined. When compared for average weight, debitage from Pleasantdale was found to have the highest average weight per piece (Table 13). Schuylerville, a Middle Woodland occupation in Saratoga County, New York, has the lowest weight, which is to be expected from a semi-permanent village where a range of maintenance activities including tool re-working and re-sharpening was carried out. Much of the debitage at Schuylerville derived from tool use rather than tool production. The third location, North Greenbush Technology Park Site 9, a multi-component lithic scatter in Rensselaer County, New York, falls mid-way between the other two sites for this variable. Site 9 is believed to represent a number of short-term, overlapping encampments, primarily of the Archaic period. The differences in average flake size can not be attributed to recovery techniques — since all three excavations involved screening with quarter-inch mesh — but to differences in the on-site activities of the occupants.

In addition to the byproducts of quarry/workshop use, Pleasantdale provides evidence for the carrying out of other industrial and/or processing activities. The cores and early stage bifaces which were retouched or utilized, as well as the many unifacial and retouched flake tools, argue for the site's importance as a processing station. Examination of lithic artifacts revealed a number of retouched, utilized, battered, and crushed edges. Some edge damage can be attributed to natural or post-depositional factors (garden roto-tilling is a contemporary activity in Pleasantdale which could be expected to have an effect on stone tools) but a number of specialized tools recovered from undisturbed contexts have been identified in the collection. Among these are knives and/or choppers, scrapers, denticulates, spokeshaves, "beaks", burins, engravers, and drills, many evidencing repeated use.

TABLE 13.
Average debitage weight from three prehistoric sites

Site Name	Flake, block count	Total weight (g)	Average weight (g)
Schuylerville	13542	12929.0	0.95
North Greenbush, Site 9	313	644.8	2.06
Pleasantdale	5756	20006.0	3.48

Unfortunately, the nature of the processing and industrial activities are unknown. No associated floral or faunal remains were recovered and the few prehistoric features identified have contributed very little to our knowledge of activities other than tool production. The multiplicity of worked edges on the abandoned and recycled lithic tools suggests that some of these were used to manufacture the components of other tool kits which in turn were used in the acquisition and processing of locally available food resources.

Proximity of the chert outcrop to the Hudson River, an important waterway and food source, is believed to have contributed to the site's double role as a quarry/workshop and processing station. As an example, some of the larger bifaces or bifaces in process may have been intended for butchering sea sturgeon or other large fish which once inhabited the Hudson River. Large chipped stone bifaces termed Petalas blades and interpreted as serving for the butchering and dressing of sturgeon have been recovered from sites in the middle Hudson Valley which also produced sturgeon remains (Funk 1976:295). Before the construction of the federal dam at Troy, the freshwater portions of the river from Newburgh to above Albany (Boyle 1969:194), including the area around Pleasantdale, comprised the preferred spawning grounds of the sturgeon.

Finally, use-wear study contributed information concerning prehistoric patterns of resource utilization and tool recycling. Ethnoarcheological studies of contemporary native populations in Subarctic Canada have suggested that abandoned sites or sites not presently occupied continued to play an important role in the local populations' settlement systems. In that study (Brumbach et al. 1982), it was found that those sites continued to function as sources of raw materials which were exploited on an occasional basis. Objects or the byproducts of activities discarded by one individual were often recycled, either by the same or other individuals, at a later time to facilitate additional tasks. Sites, therefore, were rarely completely "abandoned" and artifacts were not genuinely "discarded" in the western sense of the term but could be considered "temporarily out of use". Pleasantdale may provide evidence for the prehistoric analogue of recycling behavior. The flakes, blocky shatter, discarded and broken cores, and early stage bifaces may have been recycled by later visitors who were attracted to the location by this material as much as by the raw chert in the outcrops.

Acknowledgements

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