A PRELIMINARY STATEMENT ABOUT QUARRYING ACTIVITY AT FLATTOP MESA

by
Sally T. Greiser
Historical Research Associates

The Flattop Mesa chalcedony quarry (5L034), located north of Sterling, Colorado (Fig. 1) has been reported in the literature by Carlson and Peacock (1974), who compiled brief descriptions of known lithic sources in and around the state of Nebraska.

In 1976, when faced with developing a research topic for a graduate seminar in lithic analysis, I chose this quarry in order to enhance my understanding of the spectrum of aboriginal activities in the Central High Plains. Given my naiveté about the requirements of quarry testing, the absence of funds, shortage of time, and the weather on the High Plains in February, this study is of a preliminary nature.

I became interested in the Flattop Mesa quarry after noting its prehistoric popularity as represented in a number of Paleo-Indian collections from Colorado, Kansas, and Wyoming. Subsequent examination of local collections throughout Colorado attests to the material's continued popularity throughout prehistory. We assume that the chalcedony observed in archaeological collections is from the primary deposit at Flattop Mesa because many specimens retain the characteristic chalky cortex. Presumably this would not be the case if the source had been secondary gravels. The identification of a major quarry source such as this provides archaeologists with an opportunity to view a wide spectrum of aboriginal activities. Particularly, it allows us to fill in some of the gaps about lithic procurement, reduction, and distribution. Furthermore, the potential for obtaining information concerning trade routes, trade items, quarry specialists and specialization, territorial patterns, and so on, is intriguing.

THE FLATTOP MESA QUARRY AND CHALCEDONY

This quarry is in the form of bedded chalcedony within the limestone caprock which forms the mesa (Fig. 2). This caprock is of the Chadron Formation in Oligocene deposits. The term chalcedony is used loosely here—referring to a microcrystaline, translucent silicate.

Macroscopically, the chalcedony ranges from opaque white to translucent lavender with occasional hues of pink and blue. Munsell colors range from 10R hue with 4-6 value and 1-3 chroma to 10YR 7-1 and 8-1. The material is smooth and slightly waxy with a dull luster. Heat treatment increases the sheen and waxiness in addition to improving the already excellent flaking qualities. Lavender specimens often have sub-translucent white intrusions. The cortex is a hard, white or light gray limestone.

Petrographic analysis tells us this is a silica replacement of freshwater limestone. The degree of silicification is highly variable throughout the deposit. Known outcrops of similar materials, also of the Chadron Member, occur in northwestern Nebraska and southwestern South Dakota as reported by Ahler (1977) and Nowak and Hannus (1981). Ahler reports that the chalcedony seems to become more brown and less red or purple in color as one moves from south to north along its outcrop area. Although an occasional piece may be confused from one outcrop to the next, these materials are generally distinguishable on the basis of color.

The surface of Flattop Mesa is littered with hundreds of thousands of flakes (Fig. 3) as well as cores, some finished tools, many preforms and hammerstones. Some discrete activity areas are observable. Although chalcedony is available around the edges where the caprock is exposed by erosion, it appears that much

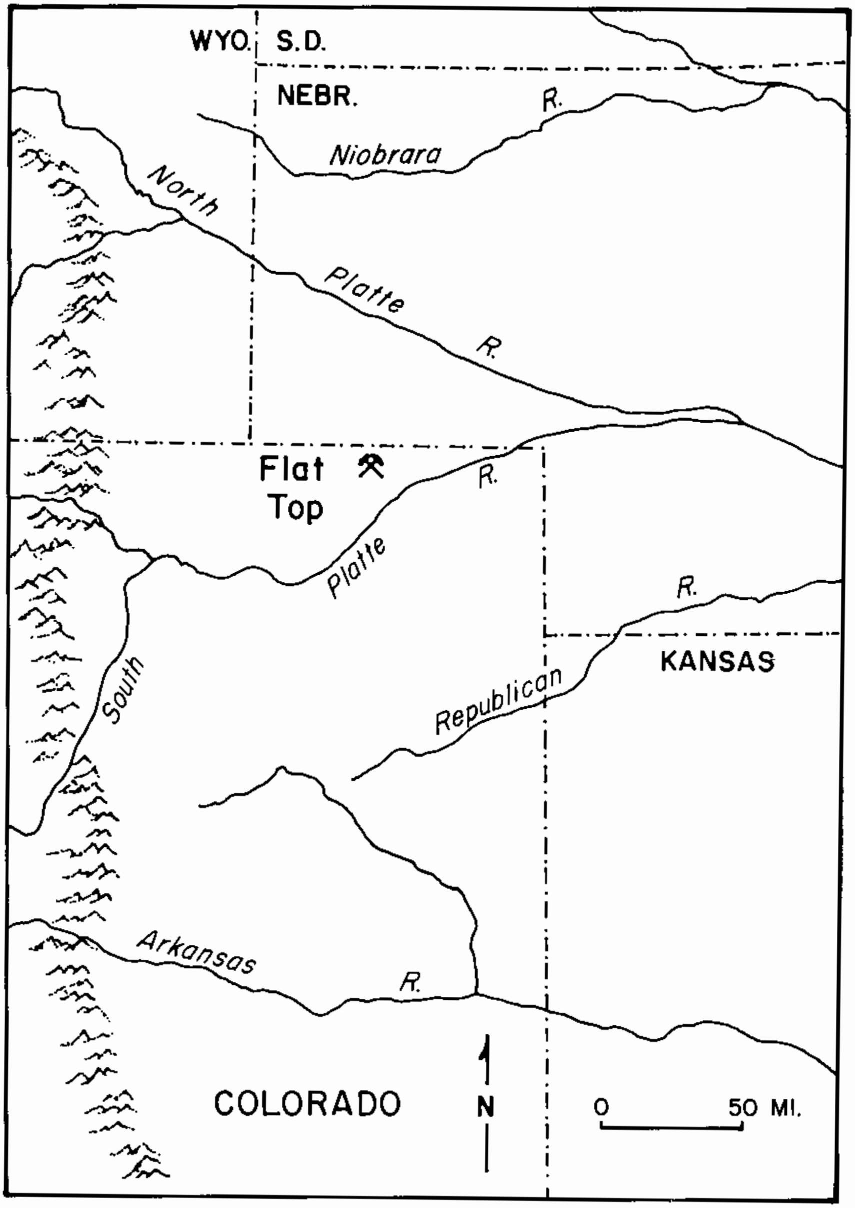

FIGURE 1. Map showing the location of Flattop Mesa in northeastern Colorado.

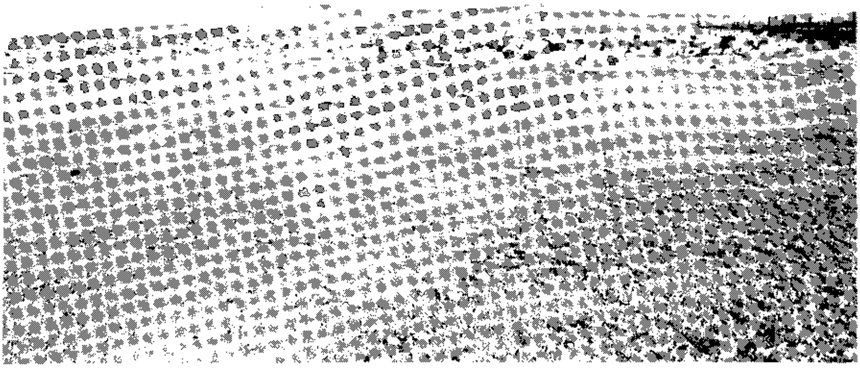

FIGURE 2. View of Flattop Mesa from the southeast.

of the chalcedony was removed by digging into the deposit from the top.

The top of the mesa is marked by approximately 200 depressions which represent the aboriginal quarry pits (Fig. 4). The pits are easily detected, as they are defined by mounds of refuse. The diameters of these circular depressions vary in size from approximately two to 10 meters.

FIGURE 3. Profile of a cutbank showing near-surface quarry debris.

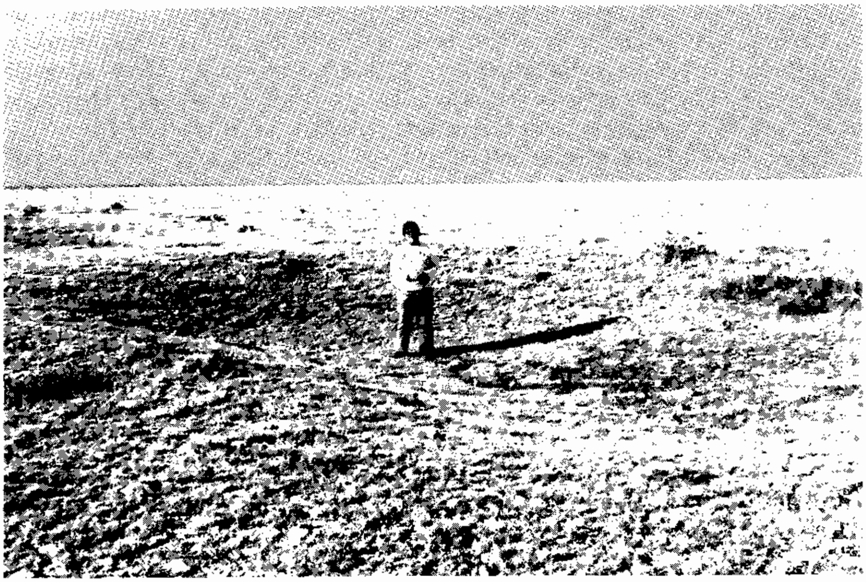

FIGURE 4. The mesa top, with an individual standing in recessed, aboriginal quarry pit.

Although this has not been formally investigated, the distribution of quarry pits appears nonrandom. Aeriel photos taken in May or June would allow for proper investigation of this patterning because of vegetational differences in these depressions. The depth of the quarry pits is variable; this could be a result of the distribution of the caprock across the mesa. Another explanation is that the deepest pits are the most recent. If this is the case, and the pits gradually filled in through time, it is possible that some seemingly undisturbed areas actually were exploited thousands of years ago.

INVESTIGATIONS DURING 1976

Investigations at the mesa consisted of two separate, although related phases. First, a test trench was excavated through an aboriginal quarry pit in search of evidence of quarrying techniques. Second, a seemingly undisturbed area was excavated using replicated quarry tools. I recognize that such limited testing severely restricts the conclusions I can draw concerning the methods of extraction; any data reflecting change through time in quarrying techniques is also restricted. My intent was to acquire preliminary information which would guide further, larger-scale research.

Testing in the quarry pit consisted of excavating a 6m x 0.5m trench through the center of the pit including a section of the refuse mound on the edge of the quarry pit. Shovels were initially used to break sod and remove the overburden, but frozen ground hindered significant progress. Picks were used to break through this top soil, then were replaced by trowels when cultural material was exposed. Approximately 50 cm of "fill" was removed from the central portion of the pit before reaching a heavy concentration of limestone. The limestone continued for at least another 40 cm.

The fill was composed of scattered flakes and nondescript "chunks" of chalcedony. These pieces were not cores, but appeared to have been broken away from a larger mass and discarded—probably because they were too small and improperly proportioned to be usable. This conclusion was reached because, when tested, the material was internally consistent and very flakable.

Below this fill the limestone appeared to be in the approximate position of the aboriginal caprock deposit, but the fractured nature of the limestone suggested that it had been disturbed (Fig. 5). The "chunks" of chalcedony mentioned were interspersed among the limestone as well as in the fill. No large, usable blocks of chalcedony were discovered in this pit.

In the refuse mound surrounding the pit several large masses of poor-grade chalcedony were discovered just below the sod. The position of this material revealed that it had been moved from its original context and abandoned in the refuse heap. Testing of this material for its flaking qualities proved that the chalcedony was riddled with inconsistencies which prevented controlled flaking.

In addition to these large rejects, hundreds of flakes were located. Some of these appeared to be the results of natural breakage because they lacked characteristics of intentional flakes (Crabtree 1972). They may have fractured irregularly when the excavator "tested" them for soundness. At least half of the flakes displayed signs of intentional flaking (such as definable striking platforms, bulbs, dorsal ridges, etc.). Many of these were primary and secondary decortication flakes which would be expected in this context.

Several core remnants also were discovered in the refuse area. Those cores were the results of core-flake percussion reduction. No biface "blanks" were discovered in the excavated area, but several were located on the surface surrounding the pit. These blanks were rejects with angles too obtuse to continue working. In all cases they revealed a thick cross section or an imperfection surrounded by hinge fractures.

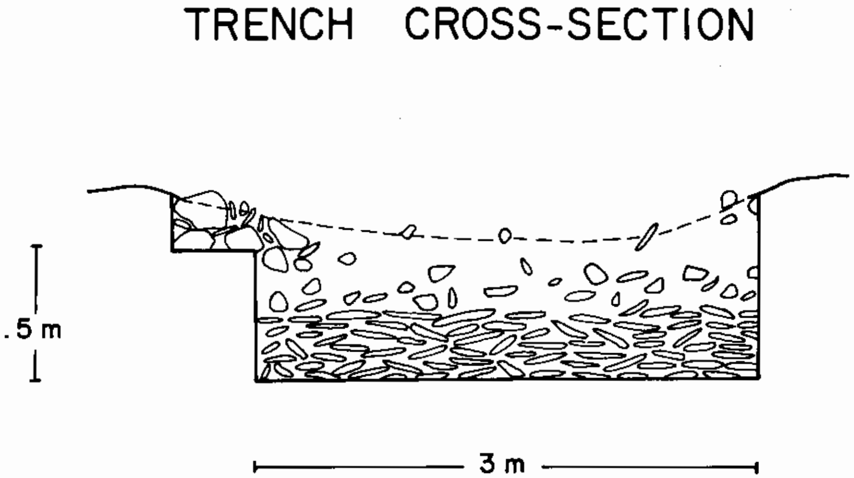

FIGURE 5. Schematic cross section of trench.

The refuse area also contained great quantities of broken limestone slabs which made excavation very difficult. Our trowels were abandoned for antler digging tools which greatly improved our progress. No discernible patterns were apparent within this mound—the composition of which was nearly identical to our own back-dirt piles. Thus, the assumption that these are refuse piles appears justified.

The replication experiments were divided into three basic activities: 1) penetrating and removing sod and fill, 2) exposing the stone, and 3) extracting the chalcedony. In general, the quarry literature contains references only to implements used in the actual extraction of the stone. As a result, for the first two categories the implements to be tested were chosen because of their use in similar contexts or because they seemed logical and would have been available to the persons exploiting the quarry.

QUARRY TOOLS

A review of the literature indicates that the most common implement recovered at quarry sites is the hammerstone (Holmes 1919; Parker 1925). These vary from walnut-sized for finishing work to huge boulders weighing to 100 pounds (Fowke 1888).

Tools for penetrating and removing sod and fill were tested at Flattop for their efficiency. These include 1) several wooden digging sticks of variable length and diameter, 2) a chert wedge, 3) lower legs of an elk and a deer with cloven hoofs attached, and 4) an elk antler tine. The chert wedge was shaped from a flattened river cobble, approximately 10 x 20 x 4 cm. A large flake was removed from each face at one end, creating a V-shaped working edge with a 30° angle. Each of these tools was functional to a certain degree. The antler tine proved excellent for penetrating the sod. The best digging tool by far was the elk leg which was held by the metapodial, using the cloven hoof to remove the dirt.

Tools which were tested for their efficiency in exposing the stone so that extraction would be possible include the elk antler tine, a moose antler, the chert wedge, and several wooden wedges. Digging implements are very rare at quarry sites.* This is probably because they are of perishable materials such as wood, bone, or antler. Holmes (1919) cites various digging implements such as stone hoes and wooden, antler, and bone digging sticks. These latter tools were inferred from analogous situations. Stone picks have been cited in the literature but generally have not been pictured or described (Bryan 1938).

Stone wedges have also been located at quarry sites in Oklahoma and New Mexico (Larry Banks 1976: personal communication). These are described as being tabular pieces of chert approximately 6 cm x 3 cm with one worked edge. Parker (1925) refers to a disk-shaped hammerstone which was artificially shaped like a large lens with sharp edges. He determined that the wear patterns were different than on most hammerstones; they had battered edges rather than the

---

*Since conducting this research I have become familiar with the notable investigations at the Schmitt Mine site in southwestern Montana (Davis 1982). Davis has recovered hundreds of quarry tools from this extensive site, made primarily from bone and antler. The results of this long-term investigation should revolutionize quarry studies.

normal "pitting." These disks may actually be wedges which could have been inserted into cracks between blocks of stone and then pounded with a hammerstone in order to loosen the stones.

The wooden wedges for our experiment were prepared from cottonwood branches, averaging 4 cm in diameter. The V-shaped working edge angles ranged from 30° to 45° and from 5 to 10 cm wide. The antlers proved by far the most efficient. The pointed tines were excellent for digging around blocks of stone. The moose antler had the additional shovel-like extensions which could be used to remove the loosened dirt. The stone and wooden wedges again proved to be inefficient digging implements. Their blocky shape prohibited us from working closely around the chalcedony debris.

The antler tine, the chert and wooden wedges, a digging stick, and a large hammerstone were used to extract large blocks of stone from the caprock deposit. Both wedges and the antler tine made efficient tools for loosening the block from its matrix. This was accomplished by driving the wedge into a crack between blocks of stone and tapping it with the large hammerstone. Both the digging stick and the antler could then be inserted below the edge of the stone and used as levers to remove the block. The natural curve of the antler proved maximally efficient and useful. The antler was the most necessary although the wedges were occasionally useful. Admittedly, we eventually resorted to the shovel.

As mentioned, the most common tool located at quarry sites is the hammerstone. In some cases large boulders were used to knock blocks of flint away from the parent material. Larger hammerstones may also have been used as anvils for the primary reduction of these large blocks of chalcedony. Specifically, at Flattop, only small hammerstones which would have been used for tool manufacture have been found. None of the large boulders discussed in the literature were apparent. Large hammerstones were tested at Flattop for extracting usable pieces of chalcedony. Several of these hammerstones were broken in this process. It would seem that broken hammerstones would be common in the refuse piles if they were used for extracting the stone. No hammerstones or hammerstone fragments were located in the test pit or the refuse mound.

Ellis (1939:45) states that in virtually all the pits excavated by Fowke, hammerstones and mauls of various shapes and sizes were found, "indicating that at this site direct percussion played the largest part in preliminary breakage." Henry Irwin (1968) discovered hammerstone fragments and flat slabs of dolomite within a test trench (similar to our test at Flattop) at the Osborne Quarry at Spanish Diggings. Based on the lack of hammerstone evidence within the tested quarry pit at Flattop, coupled with the efficiency of the wedges and antler tools, it seems likely that large hammerstones were not used as extracting tools in this situation. Again, with the limited testing, this is not a conclusion but rather a suggestion based on the available evidence.

SUMMARY AND CONCLUSIONS

The most significant result of this preliminary investigation is my own realization of how difficult and time consuming the extraction of this chalcedony can be. The work demands great energy over extended periods of time. The omnipresent wind accentuates the difficulty of the work. The people who exploited this quarry and other similar quarries must have been prepared for several days' work whenever they went for raw material. This is based on our own excavations: our single trench took six people six hours to dig; this was with the aid of picks and shovels rather than bone or wooden digging sticks. Admittedly, we were novice quarriers and the ground was frozen.

Estimates for the ration of usable material to the total quantity of extracted material are not available for Flattop. In reference to Flint Ridge, Ohio, Fowke (1928) guessed that 9/10 of the extracted flint was rejected. This calculation was based on his analysis of the amount of material which was left behind at the "blocking-out" areas where material was tested for soundness. At the Great Algonkin Flint Mines in New York, the rubbish showed that only about 1/10 of 1% of the material removed was flint that could be used (Parker 1925). Naturally, the percentage of usable material would vary greatly from quarry to quarry. Based on the former, more liberal estimate by Fowke, 1/10 of the material removed from three square meters, such as we excavated, would produce 30 square cm of chalcedony which varies from approximately 1 to 10 cm in thickness.

Putting this into the perspective of the quantity of tools and debris found at transient camps and at kill and butchering sites, quarrying was a significant part of the annual round about which we know relatively little. For this reason we archaeologists should avoid the phenomenon of "psychic numbing" which occurs whenever we are faced with the seemingly insurmountable task of quarry investigations.

ACKNOWLEDGMENTS

I was ably assisted with the 1976 fieldwork by Thomas Lennon, Charles Wheeler, T. Weber Greiser, Vincent McGlone, and Eladia Rivera—fellow students at the University of Colorado. Special thanks go to *Croissant Bros.,* who gave permission for the investigations on their land. Finally, Tommy Fulgham and Ann Johnson took the photographs.

REFERENCES CITED

Ahler, Stanley A.
1977 Lithic resource utilization patterns in the Middle Missouri Subarea. In "Trends in Middle Missouri Prehistory," *Plains Anthropologist Memoir* No. 13.

Bryan, K.
1938 Prehistoric quarries and implements of Pre-Amerindian aspects in New Mexico. *Science* 87(2259):343-346.

Carlson, Gayle and Curtis Peacock
1974 Lithic distribution in Nebraska. Manuscript on file at the Nebraska State Historical Society, Lincoln.

Crabtree, Don
1972 An introduction to flintworking. *Occasional Papers of the Idaho State University Museum* No. 28.

Davis, Leslie B.
1982 Archaeology and geology of the Schmitt chert mine, Missouri headwaters. Geological Survey of America *Field Trip Guidebook,* Montana State University.

Ellis, E. Holmes
1939 Flintworking techniques of the American Indians: An experimental study. *Ohio Historical Society,* Columbus.

Fowke, G.

1888 The manufacture and use of aboriginal stone implements. *Ohio State Archaeological and Historical Quarterly* 2:514-533.

1928 Archaeological investigations II. Aboriginal flint quarries. *Bureau of American Ethnology Annual Report* for 1926-1927, pp. 505-540.

Holmes, W. H.

1892 Modern quarry refuse and the Paleolithic theory. *Science* 20:295-297.

1919 Handbook of aboriginal American antiquities. Pt. I, Introductory, The lithic industries. *Bureau of American Ethnology,* Bulletin 60.

Irwin, Henry T. J.

1968 The Itama: early Late Pleistocene inhabitants of the plains of the United States and Canada and the American southwest. Dissertation, Harvard University.

Nowak, Timothy R. and L. Adrien Hannus

1981 Knife River flint—I know it when I see it—or do I? An alternate primary source from South Dakota. Paper presented at the 39th Annual Plains Conference, Bismarck, North Dakota.

Parker, Arthur C.

1925 The great Algonkin flint mines. *N. Y. State Archaeological Association, Researches and Transactions.*