THE BEAVER CREEK SITE:

A PREHISTORIC STONE QUARRY ON SYNCRUDE LEASE #22

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ERRATA

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Please note the following changes:

p. 1	line 13	roughts	should read	roughouts
p. 8	line 17	Ellice	should read	Ellis
p. 9	line 4	process	should read	processes.
p. 31	line 5	entier	should read	entire
p. 36	line 26	rejuvination	should read	rejuvenation
p. 38	line 19	at	should read	of
p. 63	line 9	Spacial	should read	Spatial
p. 70	line 11,24,26	Homes	should read	Holmes
p. 74	line 31	David	should read	Davis
p. 86	line 24	has	should read	have
p. 89	line 28	1940 Flint-Working	should read	1965 Flint-Working
p. 94	line 12	Speciments	should read	Specimens
p. 95	line 17,20	Speciments	should read	Specimens
p. 106	line 2	was	should read	were
p. 108	line 16	Rejuvination	should read	Rejuvenation

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NOTE: The policy of Syncrude Canada Ltd. is to make available to the scientific community and the public at large ecological baseline information as it relates to developments in the Athabasca Tar Sands. We feel this responsibility to contribute to the body of knowledge necessary for an orderly development of the Tar Sands, in order to minimize damage and to carry out the studies required to maintain the ecological integrity of the area.

PREFACE

Stone tools are among the commonest class of artifacts to be recovered and dealt with in Northern Alberta archaeology. These tools or stone assemblages consist of artifacts such as lance points, arrow tips, knives, scrapers, drills, and any number of other cutting, scraping and chopping tools. For each finished tool recovered, there exists scores of waste flakes or chipping detritus left behind as by-products of stone tool manufacture. Taken together, finished tools and objective pieces, plus waste flakes and detritus constitute a body of evidence pertaining to a total technological process carried out at some remote time period.

Stone artifacts including the detrital by-products of stone tool manufacture can serve a number of purposes in reconstructing prehistoric lifeways. For example, identification of characteristic technological processes may aid in defining a regional group or society in both time and space. Determination of the functional purposes to which a given stone tool assemblage was applied can be useful in assessing the mode of subsistence adaptation practiced by a prehistoric society; practices such as hunting, fishing, foraging, etc. Finally, artifacts such as stone tools may be viewed as a record of technological change and may be employed as an indicator of social or natural environmental shifts. It is primarily for these reasons that archaeological reconstruction of the lifeways of prehistoric Northern peoples rests heavily on knowledge of extinct technologies.

Technology and Subsistence: The idea that primitive technology is closely linked to subsistence practices of human societies forwarded by Steward (1955) has achieved general acceptance among archaeologists and prehistorians. Furthermore, it is thought that both social and religious structures are generated from the technological base and function primarily to organize human societies so that they may operate effectively. It is, of course, a very difficult if not impossible task to reconstruct extinct socio-religious practices solely from a known technological base. On the other hand, since primitive technologies are primarily directed toward subsistence, technology becomes essentially a survival mechanism.

For a human society to prosper i.e. obtain food and shelter, produce offspring, etc., its subsistence technology must be *adaptive*. That is; it must remain effective and be capable of responding to the exigencies of the natural environment to which it is applied. If for some reason a subsistence technology becomes mal-adaptive, it must be susceptive to change in order to meet new demands which may derive from changing social or environmental factors. Should the subsistence technology become inflexible, extinction of the society involved will result.

Defining Technological Traditions: Stone assemblages recovered from archaeological sites may aid formal interpretation of extinct prehistoric societies at a number of different levels. The basic unit with which an archaeologist must begin interpretation is the *component*. A component is defined as "...the (archaeological) focus as represented at a site, and serves to distinguish between a site, which may bear evidence of several occupations, each foreign to the other, and a single specialized manifestation at the site." (McKern quoted in Willey & Phillips, 1958:21.). Thus stone tool assemblages may be employed to define the content of a component in order to ascertain the full range of activities carried out at the site. Furthermore, the stone assemblage may be used to compile the attributes characteristic of a particular technological process practiced by the site occupants.

At the very broadest level, archaeologists are concerned with "Archaeological Traditions" which are generally thought of as "...a temporal continuity represented by persistent configurations in single technologies or other systems of related forms." (ibid:37). The concept of the archaeological tradition may be given spatial dimensions by referring to "areal traditions" or "regional traditions". A "region" may be thought of as very roughly equivalent to the geographical space occupied by a "tribe" or society. Ultimately, archaeologists hope to link the archaeological traditions of extinct societies with those of historically known groups. Only then will it be possible to assign ethnic identity to extinct archaeological societies.

It is apparent that in order to define an archaeological tradition, scores and perhaps hundreds of "components" would have to be excavated. Even then a necessary prerequisite would be the recovery of not only finished tools, but waste flakes, preforms, unfinished tools, and other objective pieces related to the total technological processes responsible for finished tool forms. With the accumulation of this kind of data, we could begin to reconstruct a technological tradition. Identification of specific technological traditions has only been accomplished in a very few regions of North America; and more often using ceramic than lithic assemblages.

Recognition of a technological tradition based on excavation of archaeological components alone is complicated by a number of extraneous variables. For example, certain stone materials may require particular techniques for flaking and still belong to a single broad tradition. Changes in seasonal food-getting patterns may require concommittant shifts in the stone tool inventory which may disguise it as being an altogether different tradition. There may be more than one group exploiting a given regional environment which may or may not possess similar technologies. The list can, of course, be extended considerably but it is only intended here to show that innumerable archaeological sites, both single and multi-component, would have to be found and excavated to define a particular technological tradition.

In attempting to define the archaeological boundaries of a region through analyses of lithic assemblages, a major question claims attention. That is, HOW were the stone tools made? We need to know and be able to recognize characteristic styles and attributes of a particular technological tradition in order to define it. Once this can be accomplished, attention can be turned to problems of establishing the time/space dimensions of that tradition.

About Quarry Sites: Of all the various types of archaeological sites known to exist, such as hunting stations, fishing sites, habitation sites, lookout points, etc., one particular kind of site stands out as particularly well suited to the enquiries discussed in the foregoing section. This type of site is known as the "artifactory" or stone quarry. A quarry site is a location at which a suitable stone source has been aboriginally mined or quarried for the purpose of manufacturing stone tools and objects for human use. At such sites are found great quantities of stone tools, detritus, and objective pieces resulting from a specific technological process; namely stone technology. Among the artifacts normally recovered from a quarry site are objects such as cores from which flakes are struck, tools in various stages of completion, objects discarded due to some flaw or breakage in the material, and preforms and specialized cores which are often transported to adjacent areas for finishing or used in trade with peoples of other regions. Occasionally, picks and hammerstones used to quarry and shape the raw material are also recovered.

Thus, a quarry site is an "encapsulization" of nearly all of the processes which comprise a technological tradition. Such deposits are often vast being measureable in hundreds of feet and occasionally miles! The size and extent of a stone quarry depends on the amount and quality of the raw material. A quarry site is rarely a single component site for if the stone source is extensive, it may have been operated throughout an entire series of technological developments and changes experienced by a number of societies. Hence, utilization of a stone resource by primitive peoples may well exceed generations of time while deposits accumulated in the process become increasingly complex.

The complexity of stone quarry deposits may be one reason for the dearth of archaeological studies concerning them. Another reason is no doubt the relative scarceness of such sites since the establishment of a quarry often depends on a natural exposure of the material. Further, a single stone deposit might be utilized for long periods of time with material being dispersed over large areas through trade.

One of the real values of archaeological research into aboriginal quarries lies in the potential of establishing the existence of ancient trade networks and inter-group contact by tracing the spatial distribution of a particular stone type from a single known source. Trade networks, in addition to their function in the distribution of raw materials, are implicit lines of communication along which ideas and technological innovations may be transmitted. They may ultimately be of great value in explaining the sudden appearance of new styles sometimes observed in archaeological societies.

Quarry sites are generally defined as "extractive" primitive industries (Holmes, 1897). The major activity at these sites is often directed toward the manufacture of preforms sometimes referred to as "blades" or blanks (Cf. Holmes, 1897, Bryan & Touhy, 1960, Losey, 1971). There are those researchers who disagree with this idea (Cf. Bryan, 1950) and feel that the manufacture of various small tools is an equally important function of aboriginal quarries. Nevertheless, the so-called "blades" which usually take the form of large bifacially flaked leaf-shaped objects, are often found in great profusion in many of the large quarries (Holmes, 1897, 1919, Bryan & Touhy, 1960). In addition, the biface "blades" are often found *en cache* at varying distances from the stone source suggesting that this form was produced merely for storage purposes or for use in trade. Extremely large bi-face "blades" have been recovered in northern Montana which, through association with other artifacts, are thought to be early post-glacial times, i.e. 10,000 to 12,000 years ago (Bonnichsen, personal communication). The practice of producing the bifacially flaked core or preform, therefore, appears to have considerable time depth in North America.

The Beaver Creek Quarry: The significance of the Beaver Creek Quarry site and the kinds of information we may expect to glean from it may now be enumerated. With reference to the recently published results of archaeological reconnaisance conducted on the Tar Sands Syncrude Lease #17 (Syncrude, 1973-d), it was noted that over 67% of the total stone assemblage recovered from 28 localities consists of quartzite derived from the Beaver Creek Quarry. It was also shown that the majority of the artifacts produced from Beaver Creek quartzite consists of flakes and detritus as opposed to finished tools. This in turn suggests that while the production of preforms at the quarry remains to be established, a significant amount of subsequent tool manufacture probably took place within a certain radius of quarry locale.

The quartzite exposed along the banks of Beaver Creek may represent a unique deposit in the region. Little, indeed, is known of potential aboriginal stone sources in northern Alberta. In the central region of the province, water-rolled quartzite pebbles and cobbles found along streams and river beds is the ubiquitous stone type. North of the Tar Sands region lies the Canadian Shield which offers a variety of quartz minerals but in difficult to extract seams and veins. Some beds of chert are known to occur in the Paleozoic formations which border the pre-cambrian platform. To the west, near Peace River, Alberta dark volcanics are found in sites and *en cache* that were apparently traded in from aboriginal British Columbia. Should the Beaver Creek quartzite turn out to be a unique deposit in the Athabasca region, it offers an ideal opportunity to trace its dispersion and perhaps aboriginal trade networks as well.

The value of being able to reconstruct a total technological process with an eye to defining an archaeological tradition has already been discussed. The potential of the Beaver Creek Quarry in this respect should be obvious. It is most opportune that this site exists and that it was located early in the archaeological research of the region. Once we have been able to define the technological tradition(s) contained in the Beaver Creek Quarry Site, attention may be turned to details regarding specific subsistence activities, seasonal cycles of food-getting, and the temporal aspects of technological traditions defined within the quarry deposit. The quarry site may constitute the basic reference from which interpretation of adjacent satellite sites will proceed. Thus adequate excavation and proper analysis of materials at the Beaver Creek Quarry may well play a key role in unraveling the prehistory of the Tar Sands region of northeastern Alberta.

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ABSTRACT

Archaeological Investigation of the Beaver Creek Quarry Site is prefaced by a general discussion of the special-function stone quarry or "artifactory" and of stone tool manufacture. The continuum of manufacturing procedure is discussed with reference to five stages including (1) material procurement (2) fabricator selection (3) Cortex removal (4) section reduction and (5) shaping, edge shaping and hafting.

A detailed study of the artifacts recovered from the quarry site is introduced with a consideration of the natural setting, excavation procedure and sampling technique. The 30,075 item artifact inventory is dealt with in terms of 28 artifact types synthesised from an exhaustive review of other quarry site studies. The types range from "roughts", uniface and biface tools to specialised flake types and non-diagnostic shatter.

The total artifact sample obtained from 40 five foot excavation units is tested for randomness by computing an Index of Dispersion. Negative results were obtained. The total artifact population is estimated at between 2,600 and 121,600 items using a non-parametric statistical technique. The Beaver Creek Quarry is interpreted as having operated as early as A.D. 300-400 as indicated by the style of recovered projectile points.

Site function is seen as directed primarily toward production of biface preforms although consideration of edge angles of other tools suggests that perhaps bone, wood and antler was also worked at the site. A study of flake types suggests that various forms of percussion flaking using both hard and soft hammers as well as pressure flaking was employed by prehistoric operators of the quarry.

1. INTRODUCTION

1.1 Introduction to the Study

This study was commissioned to examine a locality on Syncrude Canada Ltd.'s Athabasca Tar Sands Lease #22. The examination was conducted because evidence of the activities of prehistoric peoples had been found at this locality. The locality, which is here referred to as an *archaeological site*, was discovered during an archaeological survey of Syncrude's Lease #17 in 1973 (Syncrude 1973d:87-9).

The superficial evidence recorded upon the discovery of the site indicated that this area was used in prehistoric times as a "quarry" or source of stone. The material appeared to have been either gathered or mined at this site to be fashioned into implements. The accessible outcrop of workable stone next to the banks of Beaver Creek were apparently attractive enough to draw aboriginal peoples repeatedly to this locality.

It was recognized that any disturbance of an archaeological site (be it by construction equipment or trained archaeologists) is destructive. It was therefore felt that excavations should be undertaken at the site only with good reason. The scarcity of known archaeological sites in the lower Athabasca River drainage, the vulnerability of the location of the Beaver Creek Quarry with reference to future development of the tar sands, and the rare opportunity to study stone tool manufacture in the Boreal Forest, lead to the decision to excavate a portion of the site.

The analysis presented in this report involves an attempt to ascertain the spacial extent of the site and its approximate composition. Also, because this site was apparently a quarry, it offers the opportunity to study the manufacturing techniques used to produce stone implements. To this end the collection obtained from the Beaver Creek Quarry is here examined and then compared to collections from other areas.

For the purposes of the above analysis, a set of "attributes" and "artifact types", thought to be indicative of certain kinds of manufacturing processes, were identified. In this report an *attribute* is considered to be "a discrete category that expresses but a single element of form" (Sackett 1966:256) and "any object modified by a set of humanly imposed attributes" (Clarke 1968:665) is considered an *artifact*. For example a "knife" would be an artifact and the knife's length would be an attribute of this artifact.

An *artifact type*, on the other hand, is here defined as a particular pattern of attributes. Such patterns of attributes are chosen for a specific historical purpose. In the present case the patterns of attributes presented in this report were defined to examine the extent and content of an archaeological site as well as the manufacturing techniques used to produce stone implements. As will be seen, these attribute patterns were derived from a consideration of the nature of chipped stone implement manufacture.

The study was entered into with a number of explicit preconceived notions of what would be found. These notions were based on first observations of the site, knowledge of ethnographic accounts of aboriginal peoples in northern Alberta and familiarity with other quarry sites in North America.

It was expected that the site, which first impressions told was very large, represented an area repeatedly visited by small groups of hunting and fishing peoples. This was assumed through an analogy with the aboriginal peoples (Athapaskans) of this area who were typically organized into very mobile independent bands. The size of these individual "local bands" fluctuated according to the season and the available resources (Helm 1968:118-25). The total population of the various Athapaskan groups in general, however, was never very large (Jenness 1967:377-99). The subsistence of these people at the time of the coming of the white man can be characterized as being a generalized hunting and fishing economy. This economy varied with the environmental opportunities of any particular locality. In some areas fishing was of primary importance whereas in others hare or caribou were the most important food supply (Osgood 1931; Birket-Smith 1930).

It was assumed (by analogy with historic native peoples of the area) that the site was visited for only short periods at a time. This was concluded because the area around the Beaver Creek Quarry was not sufficiently endowed with natural resources to sustain a population of hunters and fishers for a very long period (except through greater difficulty and effort than would be necessary in more productive areas).

A third assumption which was made upon beginning work at the Beaver Creek Site was that it was indeed a quarry site. This was determined from the large amounts of waste material initially found at the site. This waste material was presumably the by-product of stone mining and the manufacture of stone tools. The material appeared to be of the same type as the stone which formed the bedrock in the area and which outcropped on the site.

Kirk Bryan (1950:33) has stated that the artifact content of a quarry should be composed of waste rock, implements used for quarrying, used and retouched waste rock, implements roughly shaped and utilized (e.g. scrapers), cores, flakes systematically produced and utilized and implements partially worked and discarded as "failures". Bryan determined this particular composition of quarries through his work with archaeological sites and with analogies with living stone workers. This, if the Beaver Creek Site is actually a quarry, the artifact composition can be expected to be made up of the above categories.

It was further expected that the major product of the quarry would be an artifact type called a "biface". This artifact type resembles, in general form, an ax head (though it probably did not often function as one). W.H. Holmes (e.g. 1897 and 1919) was of the opinion that bifacially chipped stone projectile points were made from "bifaces" which were in turn derived from pieces of raw material. He examined a large number of aboriginal stone quarries in North America and found that the main product of all of them appeared to be bifaces. In his view the prehistoric groups that worked these quarries first extracted the workable material and reduced it to the form of bifaces. They then took these bifaces to camp sites to be finished into projectile points (Holmes 1919: 162-5).

The data obtained at the Beaver Creek Quarry Site is compared in this report to the data expected from the site. Through this comparison views of northern Alberta prehistory can hopefully be adjusted so that the assumptions account for an increasingly greater body of facts.

The introduction to the study may be concluded with a general statement of objectives.

1. To delineate the extent of stone quarry activity at the site both through time and over space.

2. To investigate possible techniques employed by aboriginal operators of the quarry to extract stone materials.

3. To identify technological processes used to manufacture stone tools and/or tool preforms at the site.

4. To determine the degree of technological change, if any, through time as a method of giving temporal placement to undated satellite habitation sites.

5. To define the full range of mineralogic variability of the quarry stone in order to trace its ultimate dispersion due to aboriginal activity or trade.

6. To obtain and preserve for the benefit of future archaeological endeavors in the Tar Sands region any and all information available from the site in question.

1.2 Introduction to Chipped Stone Tool Manufacture

In order to understand what activities were conducted at the Beaver Creek Quarry Site it is necessary to first have some understanding of how chipped stone implements are manufactured. The process of chipped stone tool manufacture is basically the reduction of raw stone material into usable tools. Douglas Bucy (1974:4) has characterized this process, explaining that

> ...a piece of material is formed into a tool by removing pieces from it until the desired form and edge characteristics necessary to perform the work, have been achieved.

Raw material is shaped into the desired form by a series of controlled fractures. These fractures are controllable because of the consistent manner in which certain stone reacts when force is applied to it. Stone used by prehistoric tool makers was characteristically brittle solids. Such materials can be fractured by striking them with sufficient force as to tear or rip apart the particles making up the brittle solids (Bonnichsen 1974:96).

When force is applied to stone it is deflected radially from the area of impact between 50° and 76° (Pond 1930:51). This deflection means that the force is dissipated *conically* through the material. If the force is strong enough and the material consistent enough, a conical fracture occurs.

By adjusting the direction of force, it is possible to change the direction of the fracture (Leakey 1960:29ff.). By preparing the impact area or *platform*, in conjunction with a controlled direction of force, it is possible to control the size and location of the fracture. The amount and direction of force required to make a fracture is "material specific". That is, different types of stone require different angles and amounts of force to fracture them.

The pieces removed from a mass of raw material are generally in the form of *flakes*. These pieces are struck off by using an edge or a surface adjacent to an edge as a platform. The force applied to such a platform can only be deflected partially into the mass of material. The rest of the radially deflected force will be deflected beyond the edge away from the object being worked. The force which is deflected into the material predictably produces a fracture resembling the longitudinal section of a complete conical fracture. This fracture is generally referred to as a "conchoidal" fracture because of its "sea shell-like" appearance (Crabtree 1972a:54).

The way in which chipped stone artifacts are ultimately manufactured is individually, culturally, and environmentally determined. Each artisan brings to the task of stone tool production his cultural heritage and his own individual motor skills. Insofar as raw material varies in its availability and suitability for stone tool manufacture, it also affects the specific nature of the manufacturing process.

As a result of these variables it is often difficult to conceptualize how a given group of chipped stone artifacts were produced. Fortunately it is possible to construct generalized sequences for manufacturing processes. Davis (1972:24) has pointed out that

> ...production of an object may be operationally described in terms of selection, sequence, and process. When an individual makes an artifact, he is motivated by a material need or want for a specific tool, ornament, weapon,

> or whatever. He selects, in sequence, material, shape, and decoration, if desired, and concomitantly, methods of processing, fabrication, and design application.

Such "operational descriptions" of the sequence of chipped stone implement manufacture have been proposed by a number of investigators including Holmes (1919), Sharrock (1966), Skinner (1971), Muto (1971), Bonnichsen (1974), and Callahan (1974) to name just a few. In general manufacturing begins with the selection of raw material and the selection of implements needed to work this raw material. Then the processing begins with the removal of any weathered or "cortex" surface from the raw material. During and after the removal of the cortex, emphasis is placed on thinning in transverse and longitudinal sections what has been referred to as the "objective piece" (Ellice 1965:50). As the desired sections are approached, the outline is finished to its final form. The finishing touches include the sharpening of the edges and in some cases providing a hafting mechanism (Holmes 1919:165).

The manufacturing of chipped stone implements therefore appears to follow the sequence of raw material selection, fabricator selection, cortex removal, longitudinal and transverse section reduction, outline finishing, edge sharpening, and hafting (see Muto 1971).

An objective piece which is discarded before completion of the entire manufacturing process would not in reality represent a stage of manufacture, but a frozen element in a continuum (skinner 1971:74). It should be possible therefore to group together similar elements from sites like the Beaver Creek Quarry. These groups should be distributed along lines indicating the processes taking place in tool production from beginning to end.

Each process in the production of chipped stone implements is characterized by certain patterns of attributes which should allow them to be distinguished archaeologically.

Thus through the definition of these patterns of attributes it is possible to distinguish artifact types which are indicative of particular manufacturing processes. The following is a discussion of each of the process of interest in this study and the attributes which characterize them.

Material Procurement. The raw material used to make chipped stone tools have a number of common attributes. Some of the particularly instructive attributes of lithic material pointed out by Crabtree (1967a:22-4) include: the variety of material, its natural geographical and geological occurrence, the character of its unaltered surfaces or "cortex", and the presence of thermal alteration. The notation of the geographical and geological occurrence of stone materials is useful in showing some of the difficulties which the occupants of any locality had in obtaining these materials. The character of the weathered or cortex surface covering the raw material can give an investigator an indication of the specific sources of the material (i.e. alluvial deposit, bedrock formation, etc.).

Thermal alteration or heat treatment of materials can "change their original structure to one that will lend itself favorably to the production of certain stone implements" (Crabtree 1967a:24). The occurrence of heat treated specimens in an archaeological site could represent a refinement in technology which is potentially traceable not only through time but also through the sequence of manufacture of chipped stone tools.

Heat treatment can be identified because it causes changes in surface texture and luster of stone materials. Overheated specimens become fractured and very brittle and in most heat treated rock the luster changes from dull to greasy. Caution, however, must be exercised when identifying heat treatment in archaeological materials. Less drastically altered specimens will not be fractured and brittle and a greasy luster can occur naturally. Also thermal alteration can occur accidentally (i.e. by having fires unintentionally built over stone tools or waste material, by forest fires on archaeological sites, etc.). It is therefore mandatory in studies of heat treatment that the context in which the artifacts are found and the number of heat treated specimens within the population of artifacts as a whole be carefully considered.

Fabricator Selection. The selection of a fabricator for chipped stone tool manufacture was undoubtedly the result of a combination of individual preference, cultural heritage, material workability, desired final tool form, and fabricator availability. Crabtree (1967b:60-70) has outlined the variety of possible fabricator types, including direct percussion, indirect percussion, and pressure implements. It is clear that the difficulties in distinguishing the work of these types of fabricators is yet to be overcome. However, there are a number of attributes which, when present in a population of artifacts, have been claimed to indicate the type of fabricator that produced them (Ellis 1965, Crabtree 1967b, 1969, 1972a, Muto 1971, Knowles 1953, Bryan 1960).

The use of direct percussion fabricators (those fabricators which are used to strike the raw material directly) are said to produce somewhat distinctive flakes. Hammers which are softer than the material they are fracturing require a large area of platform contact. This in turn produces a less distinct conical dispersion of force on the area below the platform. This area is known as the *bulb of force* and can be visualized as the reflection of the radial dissipation of force and resembles a longitudinally split cone (Crabtree 1972a:54). This is mentioned because some feel that "hard hammers" (those harder than the material being worked) produce a very distinct bulb of force. This is said to be the case because such hammers require smaller areas of platform contact than do soft hammers. The flakes driven from raw material with hard hammers are claimed to be generally curving and thick on the terminal end, whereas soft hammer flakes are seen as relatively straight and usually having a thin terminal end. The use of a soft hammer is also supposed to produce an overhang or "lip" on the ventral edge of the platform of a flake. The mechanics which produce these lips is not very well understood, but their occurrence on flakes struck off with hard hammers is said to be relatively rare (Crabtree 1969:367; Knowles 1953:77-9).

Claims for the identification of the indirect percussion method of flaking are even more subjective. This method involves a hammer striking a punch which is set on the object being worked. This method has experimentally produced very straight flakes with distinct bulbs of force, small platforms and thin terminal ends (Crabtree 1967b:64).

The identification of pressure flaking is probably the most subjective. The method involves a tool being pressed against an objective piece with enough force to fracture it. This method allows the flintworker to exercise a great deal of control over the direction and size of the fractures he makes. Well controlled, finely patterned flaking, serration, and deep narrow notching are therefore said to be indicators of the use of the pressure flaking method (Bryan 1960:30).

In this report the above attributes are evaluated according to their usefulness in determining the type of fabricators used at the Beaver Creek Quarry. From this examination it is hoped that some suggestions can be made as to what kinds of attributes archaeologists should look for in this type of study.

Cortex Removal. The natural surface of a piece of raw material is often riddled with small fractures, abrasions and other flaws. These imperfections weaken the surface area and make it difficult to detach controlled flakes from it. Before such controlled flaking can begin, therefore, this original surface or cortex must be removed.

The amount of cortex on any objective piece should be, to a certain degree, in direct relation to the extent it has undergone the various processes of manufacture. This, of course, will vary with the variety and source of the raw material. The area of remnant cortex on any objective piece can therefore be a useful instrument to measure the extent of manufacture.

<u>Section Reduction</u>. Certainly fundamental in chipped stone tool manufacture is the reduction of mass of an object being worked as it is shaped into the desired form. Mass should therefore be a particularly instructive attribute when groups of objective pieces are compared.

The mass of an objective piece should logically be related to its state of manufacture, the intended finished product, and the nature of the original source material. Populations of objective pieces of the same material should logically show a progressive mass reduction along a line or lines toward finished forms.

Of central importance in mass reduction is the necessity to reduce a piece of material to the desired longitudinal and transverse sections. The result of this operation is that the overall reduction in the length and width is generally kept to a minimum while the thickness is reduced. Thus, the thickness of an objective piece, in relation to the width and length, should indicate again the state of manufacture of populations of similar objective pieces. Thus when a large population of similar objective pieces are plotted in this way, they should fall along the line or lines of production. The significance of such a graph can be tested statistically by such methods as linear regression.

<u>Shaping, Edge Sharpening, and Hafting</u>. The operations which can be thought of as the finishing touches in chipped stone implement manufacture are finishing the outline, edge sharpening and hafting. These operations are also identifiable attributes and their presence should generally indicate a finished tool. On many tools the finished outline is symmetrical

and the edge sharpening process has removed all prepared striking platform remnants.

In regard to the last operation Binford and Papworth (1963:114) have stated that

> the dominant factor involved in hafting points of all kinds is the material selected for the haft. The width of the shaft or handle dictates the necessary width between the notches, otherwise the lashing attachment will simply not be secure or durable. Notching would seem, in most cases, to be the final step in the preparation of the tool and was accomplished as the tool was mounted for use.

Summary. Using the attributes of cortex cover, material variety, geographical and geological occurrence of raw material, presence of thermally altered specimens, lipped platforms, distinct bulbs of force, manner of flake termination, thickness in relation to length and width, outline, edge sharpness and the presence of a hafting mechanism, it should be possible to interrelate a collection of flaked artifacts. The degree to which such an interrelationship is accomplished would show the adequacy and usefulness of some of the assumptions with which this study was begun.

2. THE SETTING AND THE SITE

2.1 The Setting

The Beaver Creek Quarry Site is located on the lower drainage of the Athabasca River in northeastern Alberta. This area is characterized by glaciated plains with few prominent topographic features (Hunt 1974:332). The exposed geological deposits in the area are dominated by massive outcrops of Cretaceous tar sand referred to as the McMurray Formation. These sediments are often overlain by Cretaceous shales and thin interbedded sandstones (Ells 1926:18-19,39).

Beneath the tar sand are shales and limestones of Devonian age. Near the mouth of the Beaver Creek and along the Athabasca River, these limestones are exposed and are usually composed of "hard massive bands alternating with rubbly and highly argillaceous strata" (Ells 1926:18).

The area is within the "southern fringe zone" of the permafrost region. It is typified by a dry subhumid climate with approximately 160 to 180 growing season days a year (Rowe 1972:154-6).

The site is situated within the "Mixedwood Section" of the Boreal Forest. In well drained areas this forest consists of a combination of trembling aspen, balsam fir, balsam poplar, white spruce, and white birch. By far the dominant tree species in these areas is the trembling aspen. In sandy areas and on drier glacial till soils jack pine is generally dominant. Low lying areas on the other hand are generally characterized by impeded drainage where willow muskeg, black spruce muskeg and marsh tend to develop (Rowe 1972:36).

Among the most common animals in the area surrounding the Beaver Creek Quarry Site are moose, black bear, beaver, hare, lynx, porcupine, muskrat and various species of birds. Caribou previously inhabited the area and mule deer have recently moved into the region. There are numbers of fish species in the lakes and streams including lake chub, white sucker, Arctic grayling, burbot, slimy sculpin and northern pike (Syncrude 1973b:23).

The soils in the area are largely organic soils derived from the accumulation of peat in muskeg communities. In drier areas the soils are of the "Dark Grey Wooded" and "Grey Wooded" types (Syncrude 1973a:8).

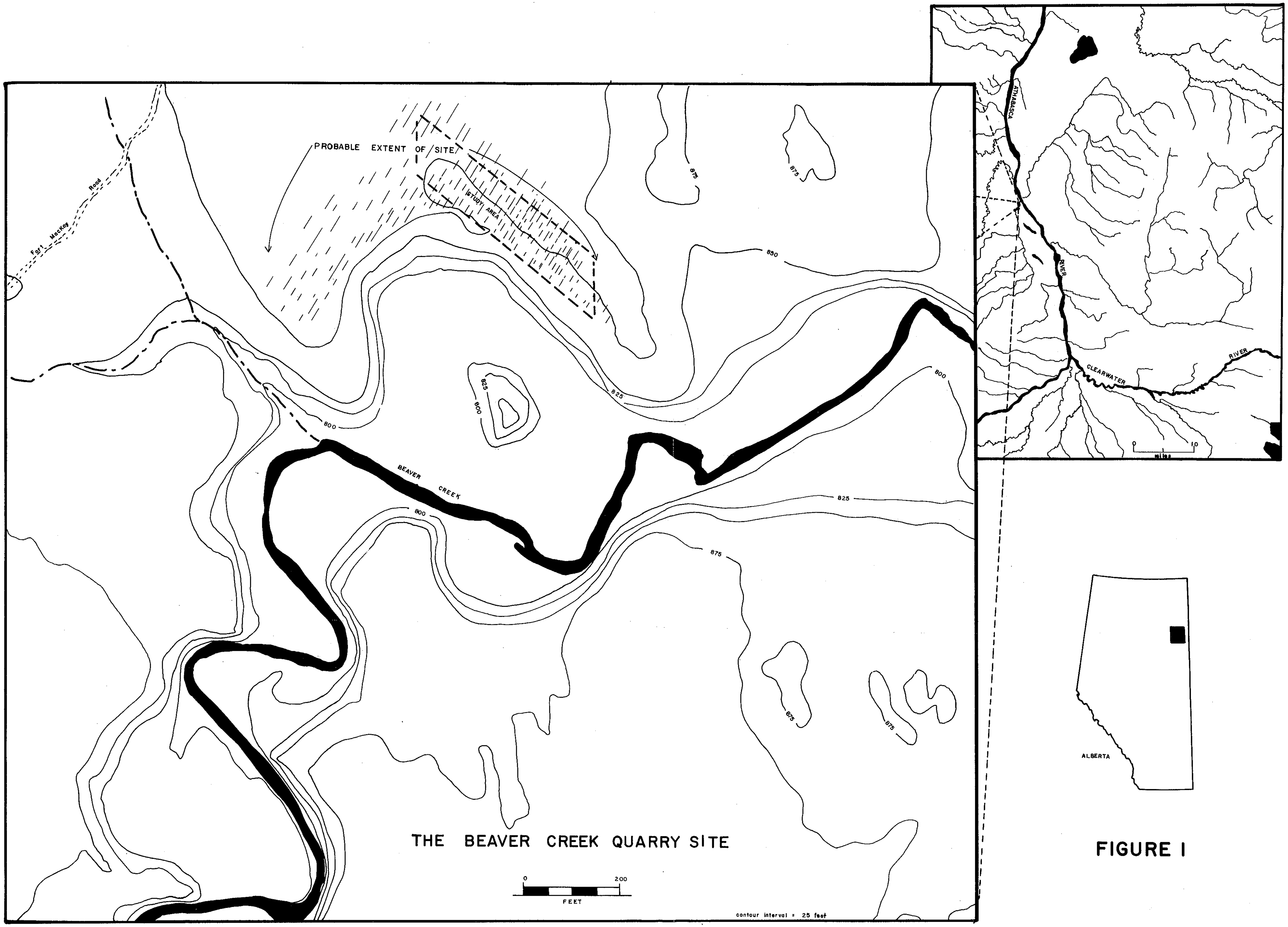
2.2 The Site

The Beaver Creek Quarry Site is situated on the north side of an abandoned channel of Beaver Creek. It is approximately 750 to 1000 feet north of the present channel of the creek and approximately 100 feet above the creek bed. A small island separates the old channel from the present one. The Beaver Creek drains an area situated between the McKay and Athabasca Rivers and eventually empties into the Athabasca River.

The map coordinates for the site are the SE¼ of the SE¼ of Section 1, Township 94, Range 11. It lies approximately one mile west of the mouth of the Beaver Creek and four miles south of the mouth of the McKay River. The site is at an elevation of between 875 to 900 feet above sea level.

The site consists of large numbers of stone artifacts concentrated in the first 6 inches below surface. The extent of the site is approximately 1000 feet from east to west and 300 to 500 feet from north to south.

The Beaver Creek Quarry is situated on an outcrop of quartzite bedrock which is overlain by a few feet of sand and gravelly sediments. There are areas however where



PROBABLE EXTENT OF SITE
STUDY AREA
Fort MacKay Road
BEAVER CREEK
875
850
825
800
THE BEAVER CREEK QUARRY SITE
0
200
FEET
contour interval = 25 feet
ATHABASCA
RIVER
CLEARWATER
RIVER
0
10
miles
ALBERTA

FIGURE I

FIGURE 2
THE BEAVER CREEK QUARRY SITE

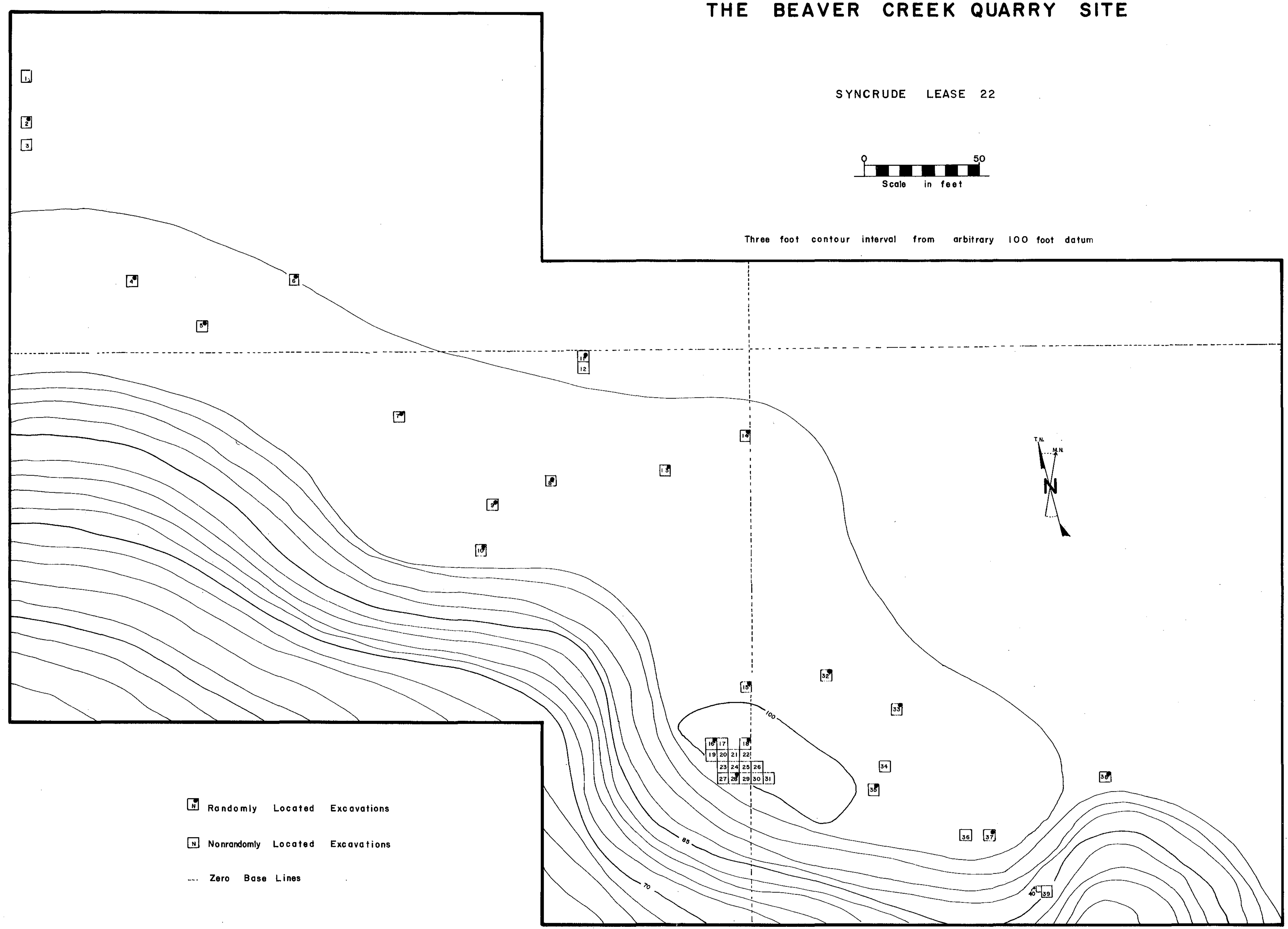


Figure 3

INFRARED AERIAL PHOTOGRAPH OF BEAVER CREEK SITE
(STUDY AREA IN CIRCLE)

bedrock occurs on the surface of the site.

White spruce dominates the vegetation on the site. This stand is mixed with numbers of trembling aspen and jack pine. The understory consists primarily of small white spruce saplings, wild rose and bearberry bushes as well as a variety of grasses and forbes. There was dead fall covering the site. The root masses of many of the trees have disturbed portions of the site where dead trees have overturned.

2.3 The Plan of Excavation

The excavations at the Beaver Creek Quarry were carried out during a two and a half month period beginning May 4, 1974 and ending on July 13, 1974. Approximately 1500 man hours were spent excavating the site.

Initially, it was decided to concentrate on several of the most productive localities in the site. These areas were found by examining the root masses of overturned trees. Nineteen five-foot square units and one two and one-half foot square unit were excavated in areas thought to be the most productive. Coincident with excavations in areas of concentration was a random sampling of approximately one-half of the site. This random sampling was accomplished with the aid of a table of random numbers. The site was grided in 10-foot square blocks. These blocks were each subsequently divided into four five-foot square quadrants: northwest, northeast, southwest, and southeast. For the purposes of sampling these five foot square quadrants were numbered in the section of the site to be sampled. Twenty consecutive numbers in the table of random numbers were obtained and used to determine the location of twenty random quadrants. The random excavations were placed not over 15 feet from coordinates obtained from the table.

All of the blocks were numbered with reference to a single central datum point. This point was established in a convenient clearing approximately 200 feet north of the escarpment which descends to the abandoned creek bed. Two base lines were established through this datum zero, a north/south baseline running 10° west of north and an east/west baseline running 80° east of north. All excavated units were designated by their distance from these two baselines. The corner of a block nearest to datum zero was used to label the block. For example, a stake 180 feet south of the east/west baseline and 50 feet east of the north/south baseline was referred to as stake 180S/50E. This stake would be the northwest corner of block 180S/50E. The stake nearest datum zero in each block was used as the datum for the block. In the example above stake 180S/50E would be the datum stake for block 180S/50E.

While the above system is ideal for field work purposes, it is somewhat cumbersome in a written report. Numbers one through forty have therefore been substituted in place of the grid system in the following pages. To convert these numbers to field designations the reader is referred to Table I.

The quadrants were excavated in 6 inch levels from ground surface. All the excavated earth was sifted through 1/4 inch screens. The procedure followed in excavation was to expose as much of the cultural material as possible in situ and then map it in place. After the artifacts were mapped and photographed they were removed and the artifacts beneath them exposed. This process was repeated until the level was completed. In quadrants where little or no cultural material was unearthed the sediments were shovelled and screened. Approximately half of the units excavated (20) were taken to a depth of 12 inches below surface. Eighteen other quadrants were excavated to a

TABLE I

FIELD DESIGNATIONS AND SQUARE NUMBERS

FIELD DESIGNATION	DESIGNATION USED IN THIS REPORT	FIELD DESIGNATION	DESIGNATION USED IN THIS REPORT
120 N/310 W/SE	1	170 S/ 0 W/SW	21
100 N/310 W/SE	2	170 S/ 0 W/SE	22
90 N/310 W/SE	3	180 S/ 10 W/NE	23
30 N/260 W/SE	4	180 S/ 0 W/NW	24
10 N/230 W/SW	5	180 S/ 0 W/NE	25
30 N/190 W/SW	6	180 S/ 0 E/NW	26
20 S/150 W/SE	7	180 S/ 10 W/SE	27
60 S/110 W/SE	8	180 S/ 0 W/SW	28
80 S/110 W/SW	9	180 S/ 0 W/SE	29
50 S/ 80 W/SW	10	180 S/ 0 E/SW	30
0 S/ 70 W/NW	11	180 S/ 0 E/SE	31
0 S/ 70 W/SW	12	140 S/ 30 E/NW	32
50 S/ 30 W/NW	13	150 S/ 60 E/NW	33
30 S/ 0 W/SE	14	180 S/ 50 E/NE	34
140 S/ 0 W/SE	15	190 S/ 50 E/NW	35
170 S/ 10 W/NW	16	210 S/ 90 E/NW	36
170 S/ 10 W/NE	17	210 S/100 E/NW	37
170 S/ 0 W/NE	18	180 S/150 E/SW	38
170 S/ 10 W/SW	19	230 S/120 E/SE	39
170 S/ 10 W/SE	20	230 S/120 E/SW	40

Figure 4

4 (a) VIEW TOWARD BEAVER CREEK SHOWING MAIN EXCAVATION AREA AT ESCARPMENT EDGE.

4 (b) SQUARE 30 LOOKING SOUTH SHOWING TOP OF LEVEL I.

depth of 6 inches below surface. One quadrant was taken to a depth of 36 inches. One 2½ x 2½ foot square was excavated to a depth of 6 inches in an effort to expose possible mining activities.

2.4 The Sediments and Stratigraphy

The sediments at the site were divided into three layers designated Layers I, II and III from top to bottom. These designations are simply numerical tags to differentiate the layers and are not to be confused with soil horizon classification systems.

No buried or "fossil" humus horizons were recognized during the excavations. No buried seeds or other plant material (other than charcoal from forest fires and tree roots) was found in the sediments at the study site. Bone was also completely absent in the areas excavated.

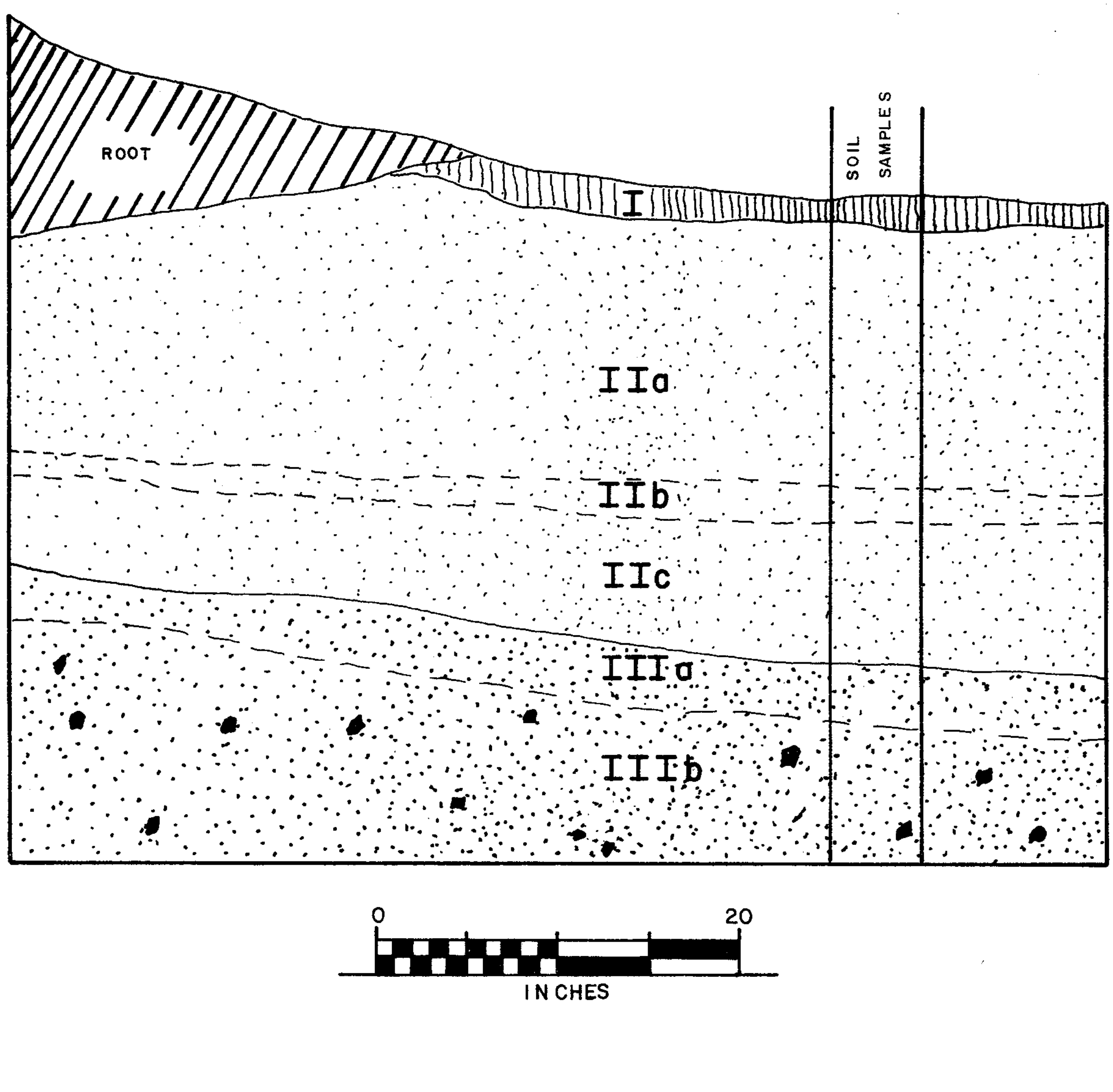
Layer I consists of a brownish gray silty-clay sand with a large number of roots and occasional angular particles. This layer is rarely over 2.5 inches in thickness.

Layer II consists of a silty-clay sand or clayey-silt sand varying from brown to yellowish brown to dull yellow-orange in color. This layer can in some areas be divided into at least three subdivisions, but is generally homogenous. This layer is generally 8 to 10 inches in thickness, but can reach thicknesses of 24 inches. It has occasional roots and rootlets in it and also occasional angular particles.

Layer III consists of a silty-clay coarse sand, brown to yellowish-brown in color. The lower member (IIIb) of this layer appears to always contain a good deal of gravel sized particles as well as lumps of Cretaceous tar sand. In some places this layer consists of only a thin layer on top of quartzite bedrock, but in most places it extends to unknown depths.

FIGURE 5

SOIL PROFILE OF EAST WALL OF SQUARE 14



To show the basis of the layer divisions made at the Beaver Creek Quarry Site, the texture of the sediments in the most deeply stratified excavation unit (Square #14) were analysed by the "Bouyoucos Method" (Royse 1970). Each sample was first poured through a 2.0 mm sieve to remove gravel sized particles. A 50 gram sample of the sediment and 0.6 grams of sodium oxalate releasing agent were then mixed and placed into a 1000 ml cylinder filled with distilled water. Readings showing the amount of particles in suspension were then taken with a hydrometer at forty seconds and again at the end of two hours. The resulting figures indicated the percent of sand, silt and clay making up each sample. The dry and wet color of the soil was determined by the use of the Standard Soil Color Charts (1967). The results of this analysis are contained within Table II.

TABLE II

SOIL TEXTURE BY THE BOUYOUCOS METHOD

* below surface

LAYER	DEPTH	COLOR DRY	COLOR WET	% SAND	% SILT	% CLAY
I	0-2.5 in. B.S.*	10 yr 5/1	10 yr 1.7/1	66	16.2	17.8
IIa	2.5-15 in. B.S.	10 yr 4/4	10 yr 5/8	62	17.2	20.8
IIb	15-16 in. B.S.	10 yr 6/3	10 yr 5/4	53.2	27.2	19.6
IIc	16-25 in. B.S.	10 yr 6/6	10 yr 5/6	56.4	14.0	21.6
IIIa	25-27 in. B.S.	10 yr 5/6	10 yr 4/6	47.6	14.8	37.6
IIIb	30-36 in. B.S.	10 yr 4/4	10 yr 4/6	45.2	21.2	33.6

3. THE ARTIFACTS

The artifact sample from the Beaver Creek Quarry Site includes 30075 artifacts. Of this sample 26813 (89.16%) are of broken flakes (proximal ends, distal ends, midsections and longitudinal sections) and non-diagnostic shatter. The other 3262 artifacts (10.94%) consist of unbroken flakes, unfinished tools and finished tools.

These artifacts were classified into 28 artifact types which may be described as follows:

1. <u>ROUGHOUT</u> (11 specimens)

   Irregular pieces of stone which have been worked in an irregular fashion. All of the specimens have been worked bifacially to some degree. The flaking is multi-directional and was very likely produced by the percussion technique.

2. <u>PRIMARY BIFACE</u> (21 complete, 14 fragmentary specimens)

   These bifaces are irregular in outline and in transverse section. They appear to have been manufactured mostly from natural blocks of stone or large pieces of shatter and large irregular flakes. On a number of specimens the original platform and bulb of percussion scar is still visible. They are thick in relation to width and seven specimens retain a small remnant of the stones original outer surface (cortex). The flaking is irregularly patterned and was probably executed by the percussion flaking technique.

3. SECONDARY BIFACES (8 complete, 27 fragmentary specimens)

These bifaces tend to be ovate in outline and generally lenticular in transverse section. These bifaces are relatively thin in relation to width in comparison to primary bifaces. No identifiable cortex remnants remain on these artifacts. The flaking is moderately well patterned and was probably executed by the percussion flaking technique.

4. UNIFACE (3 complete, 1 fragmentary specimen)

These specimens have been steeply flaked on one surface. They appear to be flakes which have had their dorsal or outer surfaces completely reworked. The specimens are triangular to subtriangular in outline and plano convex in transverse section. The flaking is moderately well patterned and was probably executed by the percussion flaking technique.

5. LANCEOLATE PROJECTILE POINT (1 specimen)

This projectile point has a lanceolate outline, which tapers to a point at the tip and to a straight base at the opposite end. The projectile point is lenticular in transverse and longitudinal sections. The edges of the blade are convex. The edges of the base are ground as well as of the blade, from the base to ¼ of the distance to the tip. The projectile point has well patterned diagonal flake scars running across both of its sides. The edges of the blade and the base have been finely retouched. The tip of this projectile point has been broken off. The flaking is most likely the result of the pressure flaking technique.

TABLE III

ARTIFACT DISTRIBUTIONS

SQUARE	LEVEL	SHATTER	PRIMARY	SECONDARY	NONCORTEX	THINNING	LANCEOLATE P.P.	CORNER NOTCHED P.P.	STEEP END	SIDE	FLAKE	TABULAR	SPALL SCRAPER	RETOUCHED FLAKES	RETOUCHED SHATTER	USED SHATTER	USED FLAKES	SPALLS	HAMMER-STONE	ANVIL	CORES	ROUGHOUTS	PRIMARY BIFACE	SECONDARY BIFACE	UNIFACE	SPECIALIZED FLAKES		TOTALS
SURFACE																			2		3		5	1				11
1	I	183	1	6	15						1			2				1	7		1							217
	II	3															1	1	2				1					8
2	I	1604	2	12	114	9			1												1		2					1745
	II	20		2	4	1																						27
3	I	529	2	8	51	3											2	1										596
	II	161		4	14	2											1		1									183
4	I																											
	II																											
5	I	2			2																							4
	II	1		2															1									4
6	I																											
	II																											
7	I																							1				1
	II				1	1																						2
8	I	9		1										1														11
	II	2			1																							3
9	I	1																										1
	II																											
10	I	701	1	25	81	5				1	1			4			1						2	7				829
	II	210		3	25																			1				239
11	I	2138	4	44	139	3			2					1			2		1		1	2	1	2	1			2341
	II	23		1	2																1							27
12	I	1749	6	48	156									1			2				1		1	1				1965
	II	171		15	28																							214
13	I	3																										3
	II																											
14	I	4																					1			1		6
	II	18																										18
	III	7			3																							10
	IV	8		1	1																							10
	V	1																										1
15	I	50	2	4	4													1	1		1		1					64
	II	26			4																							30
16	I	249	2	11	42					1							1	2										308
17	I	161	3	6	14	2															1		1					188
18	I	515		18	33									1			2	1	2					2				574
19	I	282	5	9	39						1	1	1	1			1	1			3	2	1					347
20	I	1063	4	27	80							1		1		1		2	3	1	1	2						1185
21	I	1123	1	15	54									3			3				5		1	4	1	1		1211
22	I	1221	4	33	93	3				1				1					1		1							1358
23	I	1324	3	22	94	2		2						2				1/2	1		2							1452 1/2
	II	482	3	11	38	1			1					1			1	1/2								1		539 1/2
24	I	1014	1	23	71				2	1							1	1	3		1		4					1122
	II	166	2	11	20	1											1							1		3		205
25	I	1116	6	42	108	1					1	1		1			4	4	3		1	1	1	6		2		1298
	II	95		3	7	1												1										107
26	I	777	3	22	45									1			1	1	2			1						853
27	I	876	4	28	69	2					1					1		1	1			1	1					985
28	I	1349	4	35	74				1										2		2	1	1		1	1		1471
	II	261		12	12									1				1	1									288
29	I	857	2	35	56						1	1		1			3	1	2		3		2	1				976
	II	231		6	13									1			1	1								1		254
30	I	2244	4	35	149	1								1			2	1	3		3		1			1		2445
31	I	328		12	30	2													2		1		1	1				377
32	I	251		8	43	1						1				1	1						2			1		309
	II	231		9	51	2									2		1	1			2							299
33	I	6			1														1			1						9
	II						1																					1
34	I	213		5	10	1										2	1						1					233
35	I	52	1	4	6	2								1		1								1				68
36	I	1013	2	23	58												1	1			1		2	1				1102
37	I	1171	5	45	96	3			1					1			1	2	2		2		2	5	1			1337
	II	41		6	18																							65
38	I	400	2	12	42	1											1		1		1							460
	II	12		2	5									1														20
39	I	3		1	1																							5
	II	20																										20
	III	27																										27
40	I	6																										6
TOTALS		26814	79	708	2117	50	1	2	8	4	6	5	1	28	2	6	37	26	45	1	39	11	35	35	4	12		30075

6. <u>CORNER-NOTCHED PROJECTILE POINT</u> (2 specimens)

These projectile points are triangular in outline and lenticular in transverse section. They have rounded shoulders and a slightly concave to slightly convex base. The edges of the blade are straight. The notches are of moderate depth. The edges of the notches and the base of the smaller specimens have been ground. Both specimens have broken tips. The flaking is moderately well patterned and could have been produced either by the pressure or percussion flaking techniques.

7. <u>HAMMERSTONE</u> (18 complete, 27 fragmentary specimens)

This artifact type includes small to medium sized water worn cobbles which have been battered on one or more ends.

8. <u>ANVIL</u> (1 specimen)

This artifact is a water worn cobble which has been battered on one surface. It is assumed that this battering resulted from something being set on it and subsequently being struck. Thus the term anvil is used to distinguish it.

9. <u>IRREGULAR MULTI-DIRECTIONAL CORE</u> (32 complete, 7 fragmentary specimens)

These artifacts are small to large irregular blocks of stone which have had large flakes driven from them. The flake scars run in many directions. The platforms are unprepared surfaces. Flaking was executed by the percussion technique.

10. STEEP-END SCRAPERS (8 specimens)

These scrapers are made on flakes which have been altered on one end to form a working edge. On seven of the specimens this working edge is on the distal end of the flake. On one specimen the working edge is on one of the longitudinal margins of the flake. One specimen has been retouched on three sides. All but two of the specimens exhibit polishing and fracturing along their working edges which probably resulted from use. The working edges are generally slightly convex but on one specimen it is nearly straight. The flaking is moderately well patterned and was probably executed by the percussion technique.

11. SIDE SCRAPERS (4 specimens)

These scrapers are irregularly shaped flakes with at least one longitudinal edge having been retouched. This retouch is steep, well patterned and consists of a series of relatively small flake scars. All four specimens appear to have some form of wear (crushing, fracturing or polishing) on their working edges. The retouch was probably produced by the percussion flaking technique.

12. FLAKE SCRAPERS (6 specimens)

These scrapers are made on irregular flakes. They usually have one edge which has been retouched to strengthen and sharpen it. The retouch is poor to moderately well patterned and was probably produced by the percussion flaking technique. All the working edges show signs of wear (ie. fracturing, crushing and polishing). One specimen has been slightly trimmed around its entier margin.

13. TABULAR SCRAPERS (5 specimens)

Natural tabular pieces of stone and pieces of shatter which exhibit steep marginal retouch. This retouch is usually confined to a single side. All of the specimens exhibit signs of wear along the retouched margins. The retouch is irregularly patterned and was probably produced by the percussion technique.

14. COBBLE SPALL SCRAPER (1 specimen)

This artifact is a large flake taken from the surface of a large water worn cobble. It is plano-convex in transverse section and ovate in outline. It has been lightly trimmed around two thirds of its margin on the ventral surface. The dorsal surface is completely covered with the cortex. The working edge exhibits signs of wear (polishing).

15. USED FLAKE (37 specimens)

These artifacts are irregular flakes which exhibit signs of wear (fracturing, crushing and polishing). This wear is generally confined to a small area along the margin of the artifacts.

Figure 6a Artifacts: A, Lanceolate Projectile Point, B and C, Corner-notched Projectile Point, D and F, Side Scraper, E, End Scraper, G, Cobble Spall Scraper, H, I and K, Flake Scraper and J, Tabular Scraper

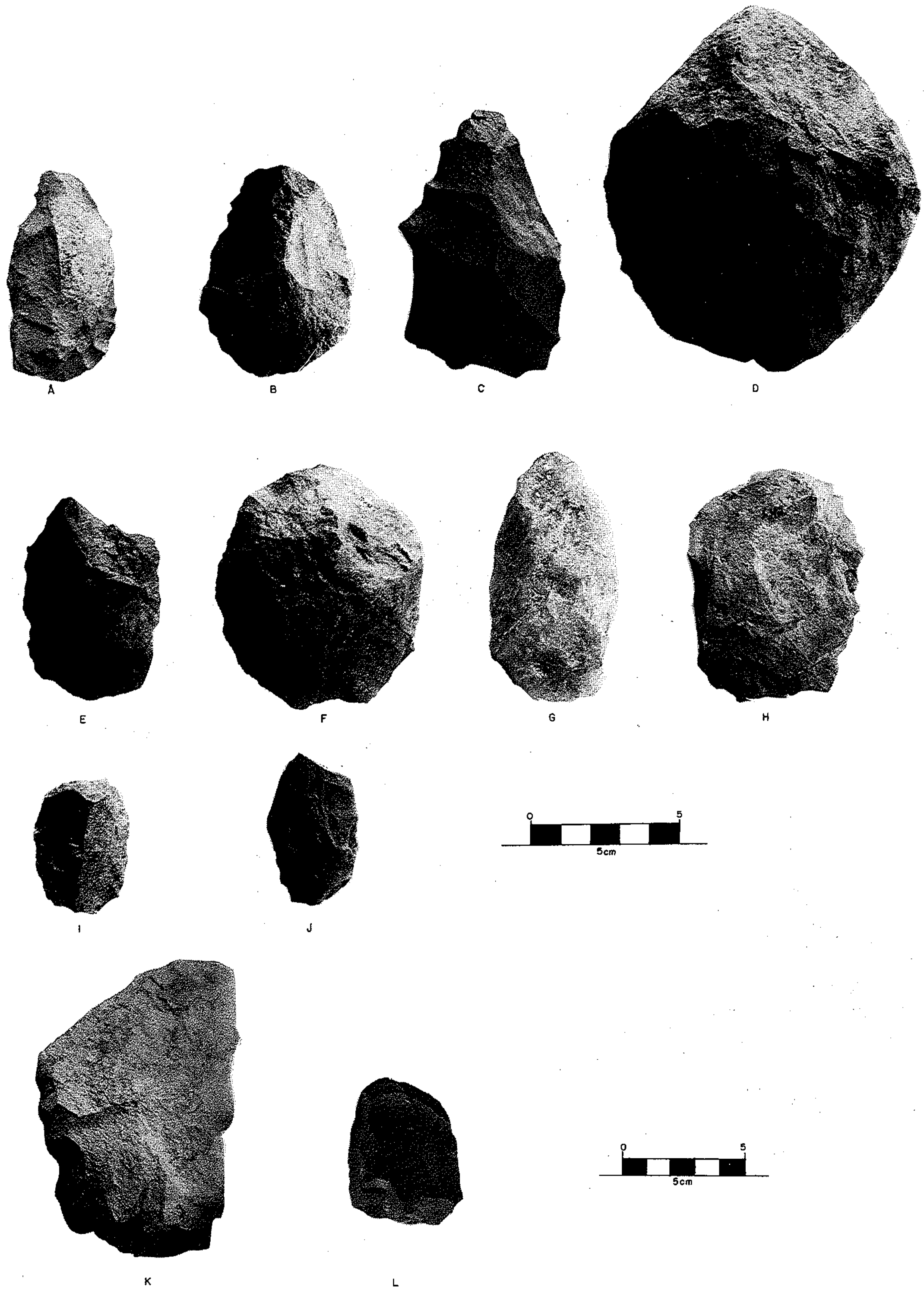


Figure 6b Artifacts: A, Uniface, B-F, I, and J, Secondary Biface, G, H, Primary Biface, K, L, Roughouts

Figure 6c Artifacts: A-C, Hammerstones, D, Outrepasse Flake, E, Possible Bipolar Flake and F, Multi-directional Core

16. <u>USED SHATTER</u> (6 specimens)

These artifacts are irregular pieces of shatter which exhibit signs of wear (fracturing, crushing and polishing). This wear is generally confined to a small area along the margin of the artifact.

17. <u>RETOUCHED FLAKE</u> (28 specimens)

These artifacts consist of flakes which have been retouched along one or more edges. This retouch usually consists of a number of small irregularly patterned flake scars. None of these specimens exhibit any signs of wear.

18. <u>RETOUCHED SHATTER</u> (2 specimens)

These two artifacts are irregular pieces of shatter with one area on their margin having been retouched. This retouch consists of irregularly patterned flake scars which was very likely produced by the percussion flaking technique. These specimens exhibit no identifiable signs of wear.

19. <u>BLADE-LIKE FLAKE</u> (4 specimens)

These flakes are small, with parallel to sub-parallel lateral edges and very small platforms. The platforms are lipped on the ventral edge. They are triangular in transverse section. One longitudinal ridge runs the length of each flake resulting from the previous removal of similar such flakes.

20. COBBLE SPALL (26 specimens)

These are flakes driven from water worn cobbles. As such they have a dorsal surface completely covered with cortex.

21. OUTREPASSE' BIFACE THINNING FLAKES (2 specimens)

Outrepasse' is said to mean, "over and beyond the opposite margin" (Crabtree 1972:80). As applied to thinning flakes, it refers to flakes that terminated by taking off the opposite margin of the bifacial object being worked. Such flakes exhibit the usual characteristics of thinning flakes including a curved longitudinal section, a platform which shows flake scars resulting from thinning flakes being removed from the opposite margin as well as these from the same margin. The platforms of these flakes are often prepared by a series of beveling flakes on the surface opposite the one the flake is to be removed.

22. POSSIBLE BI-POLAR FLAKE (2 specimen)

These flakes have attributes which suggest they were produced by the bi-polar flaking technique. These attributes include crushing and pitting on their distal ends.

23. CORE REJUVINATION FLAKE (4 specimens)

These flakes have attributes which suggest that they were taken from a core to either straighten the flaking surface or to remove some obstruction (eg. step fractures). The flakes generally have a large platform and have flake scars on their dorsal surfaces which indicate a number of flakes having been taken off from the same platform.

24. PRIMARY FLAKES (79 specimens)

These flakes have their dorsal surfaces completely covered with cortex.

25. SECONDARY FLAKES (708 specimens)

These flakes have their dorsal surfaces covered with more than 0%, but less than 100%, cortex.

26. NONCORTEX FLAKES (2117 specimens)

These flakes have no cortex remaining on their dorsal surfaces.

27. BIFACE THINNING FLAKES (50 specimens)

These flakes exhibit characteristics indicating that they were taken off a bifacial lenticular object such as a biface. These characteristics include a curved longitudinal section, a platform which is often a segment of an edge showing bifacial work, a dorsal surface which often shows flake scars resulting from thinning flakes being removed from the same margin as well as from the opposite margin.

28. NONDIAGNOSTIC SHATTER/PROXIMAL END FLAKE FRAGMENTS/ DISTAL END FRAGMENTS (26,814 specimens)

This "type" includes:

(1) Nondiagnostic Shatter, which are unclassifiable debris resulting from the process of manufacture of stone tools. They have neither striking platform nor bulb of force and do not have attributes that indicate they can be classified as either flake or objective piece fragments.

(2) Proximal End Flake Fragments, which are fragments of flakes which retain both the striking platform and the bulb of force but are without a terminal end.

(3) Distal End Flake Fragments, which are terminal ends and mid-sections of flakes.

Additional data concerning numerical, metrical, material, and distributional characteristics at each of the above artifacts types is presented in the Appendix as well as in some of the tables and figures to follow.

4. DISCUSSION

4.1 Horizontal Distribution of Artifacts

One of the main purposes for excavating parts of the Beaver Creek Quarry was to determine the extent and composition of the site. To get an accurate picture of the spacial limits of the site an area consisting of about 50,400 square feet was randomly sampled. This is approximately one half of the total site area. Twenty randomly located, five-foot square quadrants were excavated to a depth of 6 to 12 inches in this area. These excavations amounted to approximately 1% of the sampling area. In addition, twenty nonrandom squares were excavated in the most promising localities in the study area. Thus, approximately 2% of the study area was sampled.

Although the number of artifacts recovered is very large, a 2% sample is quite small for statistical analysis. Therefore, the percentages of artifact types obtained from the random blocks were compared with the percentages of artifacts in the total sample. In this way it was hoped that it would be shown whether or not there were any inconsistencies introduced into the sample as a whole by the addition of the nonrandom excavations.

To show the significance of any observed differences the chi-square (X^2) statistical test was applied. Briefly the chi-square test shows whether an observed frequency differs significantly from the expected frequency (Moroney 1951:246-70). In this case the observed frequencies are the number of artifact types found in the random excavations and the expected frequencies are the number of artifact types in the artifact sample as a whole (i.e. both nonrandom and random samples combined).

The value obtained from the chi-square test can show that a distribution either could or could not have occurred by chance alone. Chi-square values at or greater than the .01 level of probability are here considered to represent a significant nonrandom distribution. That is, a chi-square value which could be expected by chance alone to occur only one chance in one hundred cases or less is thought to be high enough to permit its acceptance as a significant nonrandom distribution.

The expected and observed number of artifact types are given in Table IV. The chi-square test yielded a value which exceeded the .70 level of probability. In other words, it is likely that the observed frequencies in the random excavations is representative of the frequencies of the study area as a whole. Figure 7 illustrates the correspondence between the percentages of categories of artifact types in the random squares as compared to all squares excavated. This correspondence holds not only when nondiagnostic shatter is included in the graph but also when it is not, thus showing a close correspondence in frequencies of occurrence of all types of artifacts.

TABLE IV

RANDOM EXCAVATIONS COMPARED TO TOTAL EXCAVATIONS

Observed and Expected Frequencies of Artifacts Within the Random Excavations With the Chi-square Test of These Values

	ARTIFACT TYPE CATEGORY				
	Shatter	Flakes	Scraping Implements	Hammerstones Anvil	Bifaces/Cores Points/Uniface
Expected	9325.82	1040.56	33.47	16.00	44.14
Observed	9340	1023	32	12	53

Chi-square	$X^2 = 3.16$
degree of freedom	$df = 4$
probability	$p. > .70$

If the random sample obtained from the study area can be accepted as being representative then the density and composition of this sample can be used to predict the density and composition of the study area. It was noted that the mean average number of artifacts in the random excavations was 794 artifacts per square. Two standard errors of estimate from this mean totaled 400. Thus, *if this is a normal distribution*, we can be 95% sure that the average square we excavate in the study area will have between 129 to 929 artifacts in them. Pursuing this line of thinking to its conclusion, the random sample can be considered to represent 1% of the study area and thus we could be 95% sure that the mean of the total artifact inventory of the sample area is between 12,900 and 92,900 artifacts.

Unfortunately, the above estimate is highly suspect because the assumption on which it is based is incorrect. For the distribution of artifacts in the Beaver Creek Site to be considered "normal", they would have to form a symmetrical bell-shaped curve when plotted on a graph. That is, for every square with a certain number of artifacts less than the mean in the site there have to be an equal number above the mean. Such distributions would probably rarely occur in archaeological sites because of the biases of prehistoric peoples. It would be unrealistic to suppose that the site did not have areas which were the centers of activity while other areas were rarely used. Thus the artifacts will most likely be clustered around a number of activity areas within the site which, when plotted on a graph, produces a clearly *skewed curve*.

There are a number of statistical techniques which can be used to test a sample to see if it is representative of a normally distributed population. One such method is termed the *variance:mean ratio* (Greig-Smith 1964:61-4). This ratio produces an index of dispersion which is expressed as:

$$\text{Index of dispersion} = \frac{\text{Variance}}{\text{Mean}} \; x \; (\text{No. of observations} +1)$$

Using a chi-square table it is possible to show the probability that a sample is representative of a normal, Poisson or contagious distribution.

When this test was applied to the random sample from the Beaver Creek Site the resulting index far exceeded the .001 level of probability. Thus, the sample from the Beaver Creek Site is not representative of a normally distributed population of artifacts. Rather the distribution would more appropriately be termed a "contagious distribution".

It was therefore necessary to estimate the size of a population with an unknown non-normal distribution. Fortunately a whole range of statistical procedures have been developed to deal with this situation. These techniques, referred to as *nonparametric statistics*, free the investigator of any assumption about the kind of population distribution with which he is dealing.

For the present, attention will be confined to estimating the population size by using the median and standard confidence intervals for medians. This is a typical nonparametric method requiring no assumptions about the shape of the distribution curve of a population (Noether 1971:105-10). It was found that the sample median was 81. With the aid of a table of confidence intervals for medians (Dixon and Massey 1969:562) it was found that there is 95 percent confidence that the typical square in the sample area will contain between 3 and 608 artifacts.

On this basis it can be estimated that a population median of between 300 and 60,800 is in the sample area. A comparison of the estimates using the mean and the median show striking differences. This demonstrates the importance of recognizing contagious artifact distributions in archaeological sites.

The study area is an artificially delineated area within the Beaver Creek Site. Examination of the area adjacent to the sampling area revealed that the actual limits of the site are at least twice the extent of the study area. Therefore, the population median of the site could range from 2,600 to 121,600 artifacts. On the other hand, this estimation is based on only one half of one percent of the site and is probably too small to make adequate estimations.

One may wonder why such estimations are made at all if the range of confidence is large. The justification is that it is through comparison with other sites that one will find the significance of the relative density, frequency and associations of artifacts at the Beaver Creek Site. Meaningful comparisons can only be made when the samples are taken in such a way as to represent the total populations and when the proper descriptive statistics are applied to the samples. For populations which do not have normal distributions, comparisons could conceivably be made on the basis of the index of dispersion (or similar frequencies), median confidence intervals and with the aid of nonparametric techniques for sample comparisons.

In archaeological literature it is not uncommon for cultural inferences to be based on estimations of site size (e.g. MacNeish 1964:461). When such inferences are based on the assumption of normal artifact distribution (which is often the case) the investigator can be led to gross misinterpretation of his data. It is hoped that the above discussion will, in the words of Wonnacott and Wonnacott (1972:160), serve as a "warning that the assumption of population normality often may not hold -- and when it does not, an estimator from the large array of nonparametric statistics may be preferred."

4.2 Vertical Artifact Distribution

Each square was excavated in 6 inch levels from ground surface. The depth of the excavations varied between 6 inches and 36 inches, but the majority of the excavations were between 6 to 12 inches. The artifacts were concentrated in the upper 6 inches of each square. In some areas the vertical concentration extended to a depth of 8 to 12 inches. Below 10-12 inches the sterile sediments of Layer III appeared in most squares.

In order to determine if there were any significant differences in the exclusive vertical distribution of artifacts, the percentages of artifact types in two levels of five of the most productive squares were compared. These squares were numbered 23, 24, 25, 28 and 29 (see Table II and Fig. 2).

A high degree of correlation between levels in these squares is illustrated by the cumulative frequency graph in Figure 8. A chi-square test nevertheless failed to demonstrate the similarities between the levels. The test produced an inconclusive .05 level of probability (see Table V). Interestingly however, one broken artifact (a spall) was found in four pieces in square 23. One of the pieces was found in level I and three pieces in level II. Thus, it may be concluded that there is at present no identifiably distinct artifact populations deposited one on top of another (i.e. vertical stratification).

TABLE V

LEVELS COMPARED IN FIVE SQUARES

Observed and Expected Frequencies of Artifacts Within the Random Excavations With The Chi-square Test of These Values

	ARTIFACT TYPE CATEGORY				
	Shatter	*Flakes*	*Scraping Implements*	*Hammerstones Anvil*	*Biface/Core Point/Uniface*
Expected	1249.88	129.88	4.42	2.42	6.39
Observed	1235	148	8	1	1

$X^2 = 10.99$
$df = 4$
$p. > .05$

FIGURE 7

CUMULATIVE FREQUENCY GRAPH OF ARTIFACT TYPES

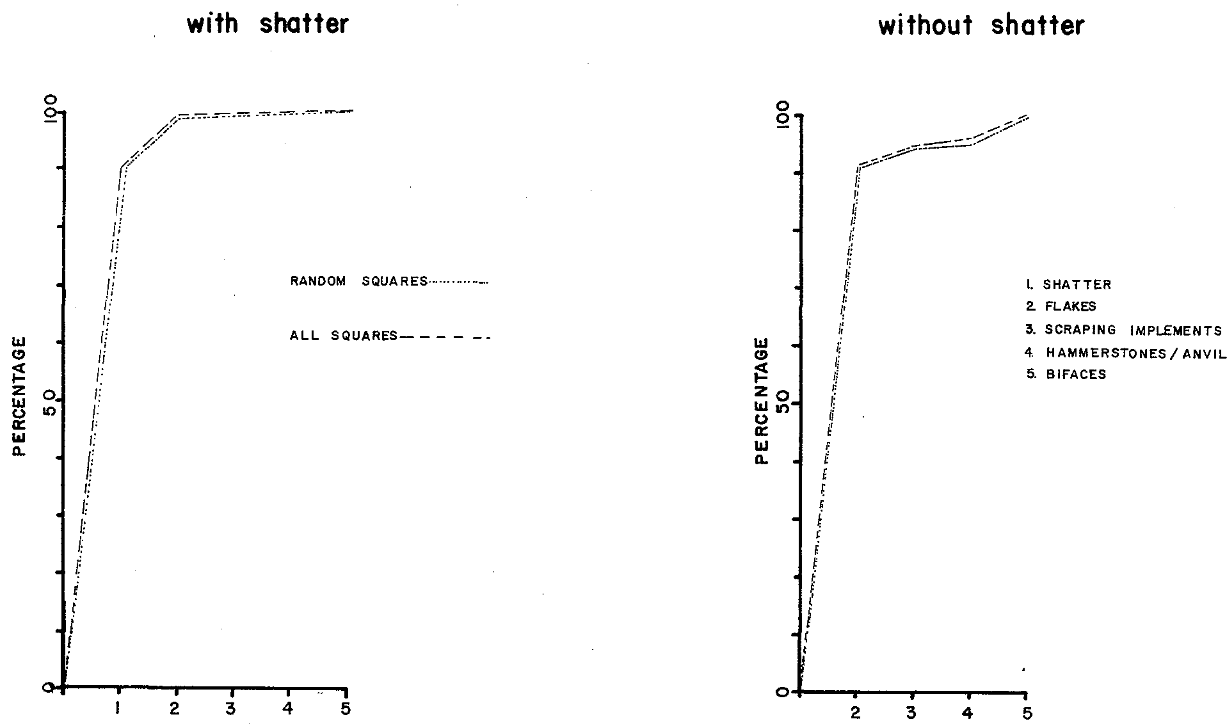
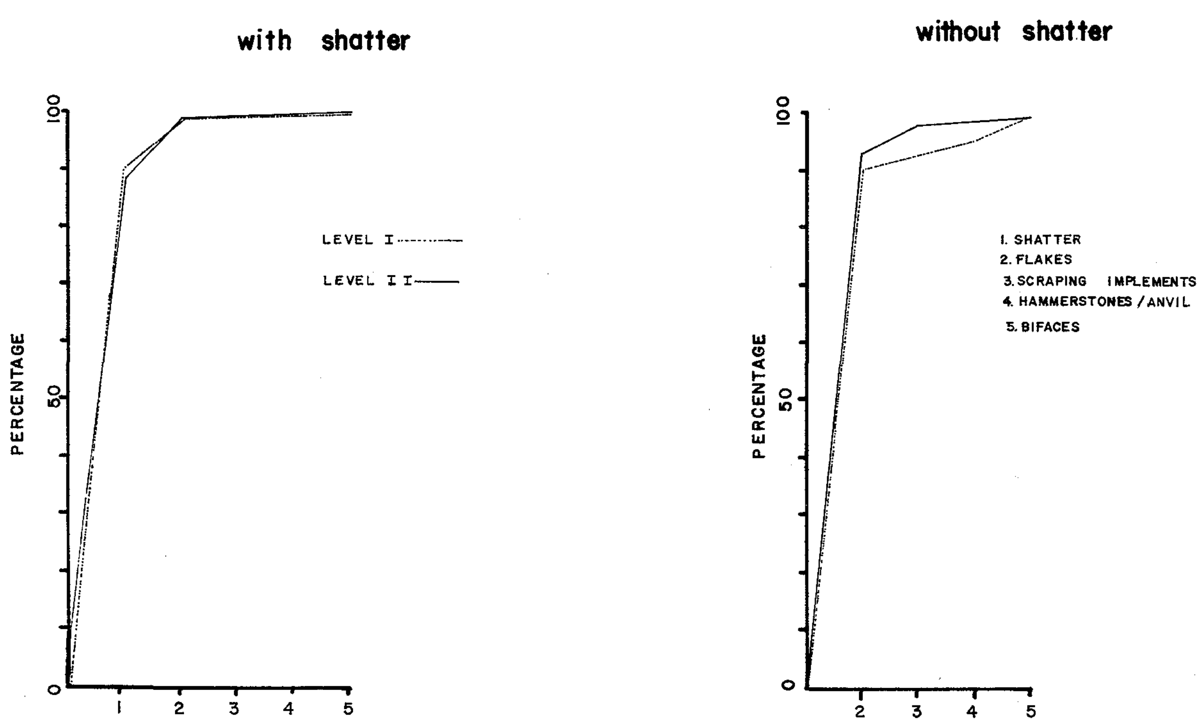


FIGURE 8

CUMULATIVE FREQUENCY GRAPH OF ARTIFACT TYPES



4.3 Compsosition of the Artifact Sample

It was stated in the introduction to this report that Kirk Bryan (1950) has outlined what a site should contain to justify its being called a quarry. A comparison of the artifact catagories expected by Bryan and those recovered by these excavations shows very close correspondence. Indeed, Bryan appears to have predicted all of the artifacts to be found in this site. The overwhelming majority of the artifacts consist of waste material, while scrapers, used flakes, retouched flakes, bifaces and hammerstones make up the major finished and unfinished tool categories.

It was noted in the introduction to this study Holmes' prediction (1919) that bifaces would be the major product of manufacture at quarry sites. This is precisely what was found in the collection of artifacts from the Beaver Creek Site. Considering these similarities between predicted and observed data, it is safe to conclude that the Beaver Creek Site conforms to all the definitions of an archaeological stone quarry. Thus, the initial impression that the Beaver Creek Site was a quarry is confirmed.

4.4 Processes of Manufacture Represented in the Artifact Collection

The artifacts from the Beaver Creek Quarry Site exhibit a number of characteristics which give clues as to how such stone artifacts came into being. These characteristics can be grouped and analysed as clues to how (1) material was procured, (2) fabricators were selected, (3) cortex was removed, and (4) tools were shaped and thinned.

1. Material Procurement. Five types of stone were distinguished in the collection of artifacts from the Beaver Creek Quarry. These materials included Beaver Creek Quartzite, quartzite, seam quartz, chert and various granitic rocks (schist, gneiss,

argillite, etc.).

The Beaver Creek Quartzite was derived from a three to five foot bed of this material which occurs on top of Devonian Age deposits at the site. Presently this quartzite is of unknown age and origin. It is the opinion (based on discussions with a number of geologists) that it is probably a pre-McMurray formation, Cretaceous Age deposit.

This conclusion was arrived at (which should be viewed as tentative) by observing that it is clearly a non-marine formation and thus probably post-Devonian in age. Since it is situated above Devonian Age deposits it is clearly of pre-McMurray formation origin. The Beaver Creek Quartzite is considered an early Cretaceous deposit since other deposits of this age are found in a similar stratigraphic position (Carrigy 1966:6-9). Distribution of surface occurrences of this material would logically be confined to the Athabasca River Valley and the immediate vicinity. This distribution can be predicted because it is here that the McMurray deposits have been eroded away, exposing the lower strata.

Beaver Creek quartzite is sometimes very glassy, breaks with fairly sharp edges, and is easily flaked and shaped into stone tools. There are nonconformities in the stone, however, which complicate the process. Molds of fossil organisms are also common. Some of the quartzite is quite granular and is therefore difficult to control its fracture (although frost action has broken much of the residual material at the site).

This material was mistakenly identified as limestone and chert in the archaeological survey report of this area (Syncrude 1973d). The dull gray fossil bearing variety was thought to be limestone, while the highly siliceous variety of the stone was termed chert. Examination of thin sections and chemical tests of the material, however, showed that this material is clearly a quartzite. The term Beaver Creek Quartzite was used to distinguish this material from quartzites of glacial origin.

Other quartzites in the study sample were derived from waterworn cobbles from Pleistocene outwash deposits as were the pieces of seam quartz in the collection. These materials generally differ from Beaver Creek Quartzite because of their larger crystalline structure, color, water worn surfaces and lack of molds of fossil organisms. Quartzite and seam quartz are granular materials which are hard to work into chipped stone tools.

Chert collected from the Beaver Creek Quarry appears to have been derived from small pebbles with smooth waterworn surfaces. This chert is found in the Pleistocene outwash beds throughout the lower Athabasca River drainage. The texture varies from glassy to dull. This material is excellent for making stone tools because of its consistency homogeneity and brittleness. It is formed in beds of limestone and is chemically the same as flint (Ellis 1965).

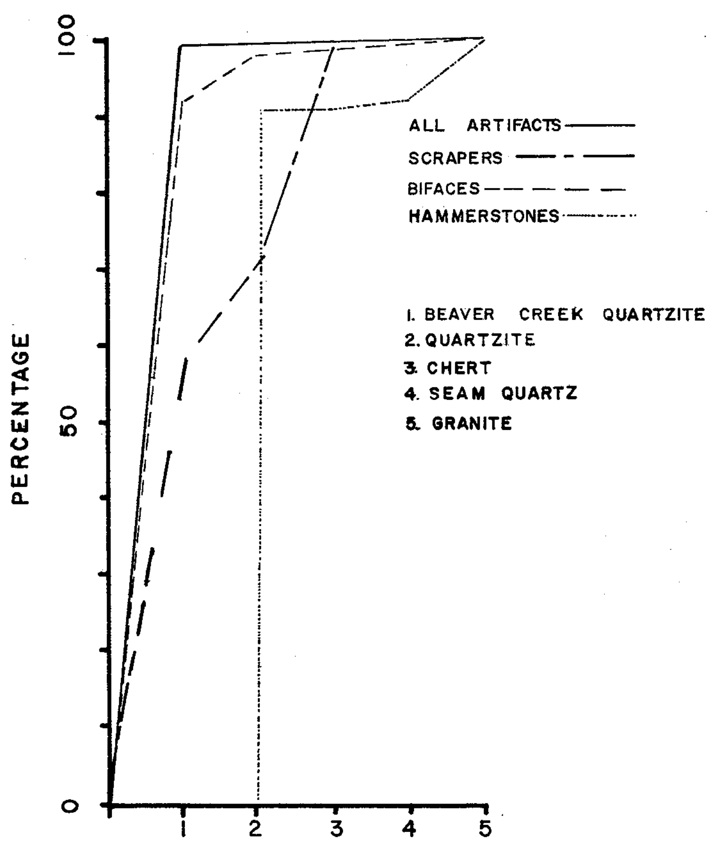
Small quantities of granitic materials were found in the collection. This material appears to have been of least interest to the prehistoric operators of the Beaver Creek Quarry. This is probably because these materials are the most difficult to shape into stone tools. These materials appear to have been derived in the form of cobbles from glacial deposits.

Beaver Creek Quartzite makes up 99.255% of the material in the artifact sample. The balance of the collection consists of quartzite 0.522%, chert 0.070%, seam quartz 0.013% and granitic rocks 0.140%.

Figure 9 presents a cumulative frequency graph for material percentages of all artifacts in the sample, for side and steep-end scrapers, for roughouts and bifaces, and for hammerstones alone. The graph clearly shows that the bifaces conform to the cumulative line of all the artifacts together, but the line for steep-end and side scrapers and the line for hammerstones do not. This suggests that the great amount of debris recovered from the site resulted from the manufacture of

FIGURE 9

CUMULATIVE FREQUENCY GRAPH OF MATERIAL TYPES



such bifaces and roughouts. Scrapers appear to have been brought to the area in finished form because there is almost no detritus in the sample recovered which would have resulted from their manufacture. Hammerstones are of a harder and larger crystalline quartzite which is less brittle than the Beaver Creek Quartzite. This allows the hammerstones to break the Beaver Creek Quartzite without being broken and is likely the reason materials other than quarry stone were sought for hammerstones. Table VI presents the distribution of materials within the artifact collection.

TABLE VI

MATERIALS OF ARTIFACTS

Observed Frequencies of Material Type in the Artifact Sample

ARTIFACT	BEAVER CREEK QUARTZITE	QUARTZITE	CHERT	SEAM QUARTZ	GRANITIC
Primary Biface	30	3	1	1	--
Secondary Biface	31	4	--	--	--
Roughout	10	1	--	--	--
Anvil	--	1	--	--	--
Hammerstone	--	41	--	--	4
Scrapers	14	3	7	--	--
Projectile Points	1	--	2	--	--
Cores	39	--	--	--	--
Spalls	--	22	--	--	4
Retouched Shatter	2	--	--	--	--
Uniface	3	1	--	--	--
Used Flake	35	1	1	--	--
Retouched Flake	27	1	--	--	--
Used Shatter	6	--	--	--	--
Shatter	26714	60	8	3	28
Flakes	2940	18	2	--	6
TOTALS	29852	156	21	4	42

No definite attributes of heat treatment were recognized on any of the artifacts from the Beaver Creek Quarry. This is somewhat surprising because a review of the 1973 survey material from sites upstream from the quarry (Syncrude 1973d) revealed a few specimens which were probably thermally altered. At least three explanations for this phenomenon can be proposed. The first is that the survey material was accidently burned and only appears to have been purposely heat treated. Second, heat treatment was conducted during the final stages of manufacture which were not carried out at the quarry. Third, the quarry and the upstream sites represent different periods of time, so that during the occupation of the quarry, heat treatment was either unknown or not practiced while during occupation of the upstream sites the reverse was true.

At present, all three explanations appear equally probable. It is only through continued work in the area that they can be properly evaluated. On sheer technological grounds, the second explanation seems nearest to reality. Crabtree (in Crabtree and Butler 1964:3) has noted that "spalls, or spall cores, and thinned down blanks are more efficiently heat treated than thick chunks or nodules ...". If this is so, signs of heat treatment should occur in the later phases of manufacture when the stone worker is dealing with smaller pieces of material. It is interesting that available ethnographic evidence provides independent support for Crabtree's observations (Hester 1972:63-4).

2. Fabricator Selection. The large number of hammerstones in association with large amounts of smashed and broken rock suggests that these "hammerstones" were in fact used to work the quarry stone. However, other fabricators made of wood, bone or antler, if present and used at the site, would probably have decomposed without a trace.

As noted in the introduction, soft hammers (such as those of antler, wood and bone) are thought to invariably leave a lip on the ventral (inside) edge of flake platforms. The tabulation of the number of flakes in the study sample which had such a lip on their platforms proved to be quite subjective in a large number of instances. This was the case since this characteristic is not as distinct in the Beaver Creek Quartzite as in many other materials.

There are, to be sure, distinct lipped and nonlipped platforms on a number of specimens although a large portion of the sample is ambiguous. Because of this it was decided that any numerical frequencies of lipped versus nonlipped flakes would be highly suspect. Still the fact that there were numbers of clearly lipped flakes should not be overlooked. This is a strong indication that antler, bone and even wood were used as hammers to work stone at the quarry.

There is some evidence that pressure flaking was used to produce some of the artifacts in the collection. The projectile points in particular could have been made only by the pressure flaking technique. This is deduced from the finely patterned flake scars on these points. It would seem then that hard hammers (hammerstones), soft hammers (antler, bone and wood billets) and pressure flaking instruments (probably of bone or antler) were used at the Beaver Creek Quarry.

3. Initial Manufacturing Processes. The making of a chipped stone implement begins with the reduction of a given block of material into a usable and manageable size and shape. The processes involved in the production of usable and manageable pieces of material are affected by the type of material, the type of fabricator, the cultural background of the stoneworker, the stoneworker's own individual motor skills, and the desired final product. Once a pattern of stone working is identified within a certain area, deviations from this pattern may mean that, (1) the deviant pattern represents a different time period

than the original pattern, (2) the deviant pattern represents a different cultural group than the original pattern, (3) the deviant pattern represents a different seasonal pattern of the same group than does the original pattern, (4) the deviant pattern is the result of different environmental restraints that did not limit the original pattern.

Thus, an identified stone working pattern can be a useful instrument in deriving cultural data. It is for this reason that it was attempted to first identify central tendencies and consistencies in the way stone was worked at the Beaver Creek Quarry and then to compare the identified pattern(s) with other findings. As so little work has been done in northern Alberta, the identification of the stone working patterns at the Beaver Creek Quarry should be viewed as the first step in a complex comparison of artifact collections which will hopefully be discovered in the lower Athabasca River Drainage.

One of the possible identifiable consistencies in chipped stone artifact collections is size. The size of flakes, for example, is mainly affected by the variety of raw material and fabricator type. Newcomer (1971:85-94) has experimentally demonstrated that the size of flakes produced during chipped stone tool manufacture *decreases* as work on an object progresses. This is due both to the decrease in the object's size and the need for the stone worker to execute finer and finer fractures in the later stages of manufacture.

In figure 10a and 10b cumulative frequency graphs for length and width of four flake types are given. It will be noted that primary, secondary and noncortex flakes tend to follow the same frequency curve whereas biface thinning flakes are quite distinct from other flakes in this tendency.

Significantly, the consistencies between the sizes of primary, secondary and noncortex flakes and the inconsistencies displayed between the sizes of these flakes and thinning flakes indicate that different techniques were used

FIGURE 10a

CUMULATIVE FREQUENCY GRAPH OF FLAKE WIDTH

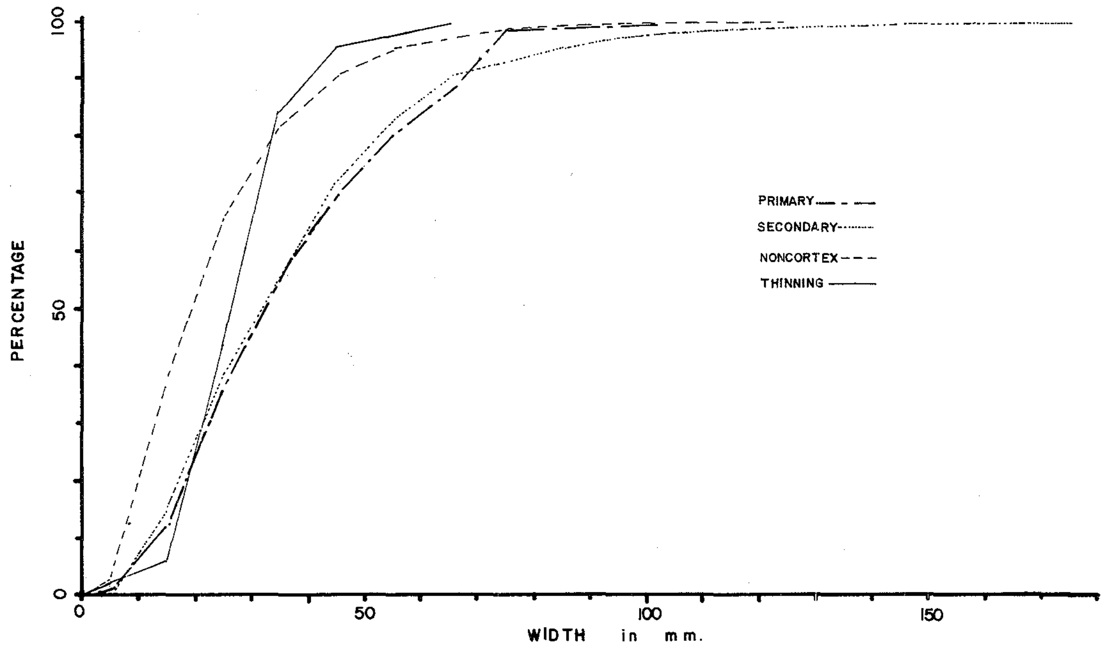
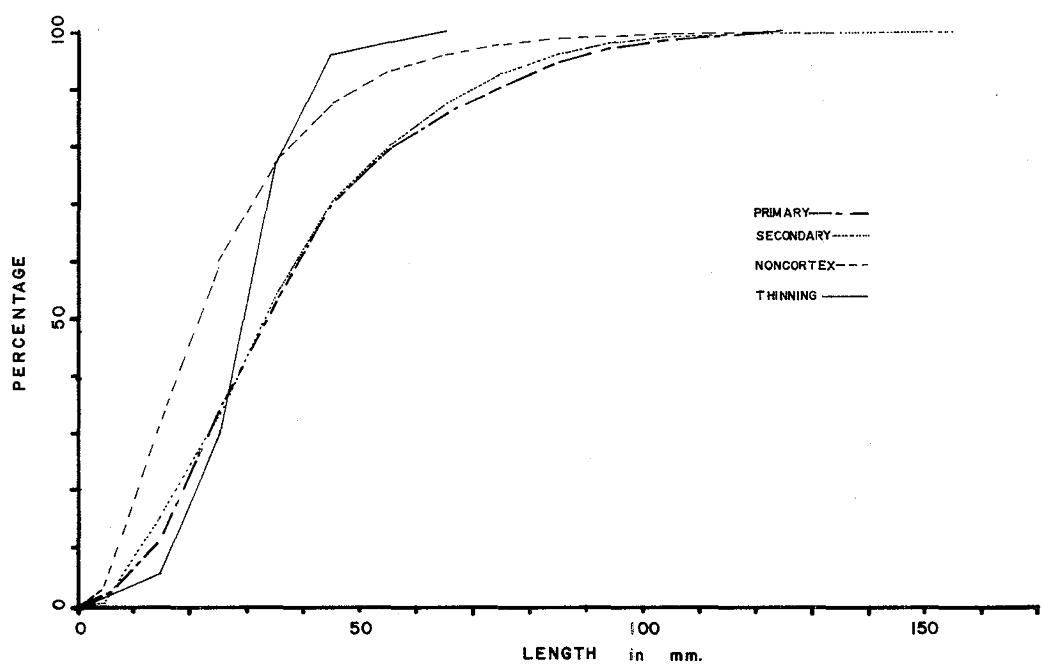


FIGURE 10b

CUMULATIVE FREQUENCY GRAPH OF FLAKE LENGTH



to produce these two groups of artifacts. That is, the thinning flakes represent a distinct technique in the manufacture of chipped stone tools. Primary flakes, as their name implies, are the first flakes to be struck from a piece of raw material. These flakes have dorsal (outer) surfaces which are completely covered with cortex (weathered surfaces). Secondary flakes have dorsal surfaces which are only partly covered by cortex. Noncortex flakes are obviously those with no cortex on their surfaces at all. Presumably as manufacture of an implement proceeds, first primary then secondary and then mostly noncortex flakes are produced as by-products. Thinning flakes are specialized flakes driven from bifaces during the later stages of manufacture. The differences which occur between the curves of primary and secondary flakes on the one hand and noncortex flakes on the other are easily explained. Noncortex flakes are generally taken off an objective piece after primary and secondary flakes. It can therefore be expected such flakes to be smaller if Newcomer's proposition is correct. The cumulative graph shows that noncortex flakes have higher percentages of smaller flakes than do primary and secondary flakes, thereby supporting the Newcomer proposition.

The implications of frequency differences in Figures 10a and 10b are that a different set of flaking techniques was used to work the piece into a bifacial tool than was used to initially shape the piece of raw material. This could, for example, mean a change from the use of a hard hammer in the initial stages of manufacture, to a soft hammer to shape and thin bifacial tools. As almost 100% of the thinning flakes have a distinct lip on the inner edge of their platforms, this could indeed mean that the final stages of manufacture were carried out with the use of an antler, wood or bone billet, while earlier stages were carried out with hammerstones.

This probably does not mean that the frequency differences in Figures 10a and 10b are due solely to changes in fabricators during manufacture. Other processes also take place as manufacture proceeds. Figure 11 presents the frequencies of various types of platform preparation among the four flake types. Primary flakes have unprepared platforms, while the majority of secondary flakes have either unprepared or single faceted platforms. The great majority of noncortex flakes are single faceted, while thinning flakes have, on the average, platforms with multiple facets and platform grinding.

It should be immediately apparent that the graph shows that as manufacture proceeds the intensity of platform preparation increases. This is undoubtedly linked to the need by stoneworkers to exercise ever increasing control over the size, shape and location of the flakes they removed as manufacture progressed.

From the simple percentages of material types in the artifact collection it is known that the Beaver Creek Quartzite was the basic raw material. It is also known from the same percentages that one of the chief objects in working this stone was the production of roughouts and bifaces. Whether these roughouts and bifaces are finished tools or simply objects abandoned before being finished into tools has been debated elsewhere (e.g. Bryan 1950, Holmes 1919). What is of interest here is any identifiable central tendencies in manufacturing techniques and resulting forms. Again size is a very instructive attribute in the search for trends.

Figures 12 and 13 present the width/thickness and width/length ratios of roughouts, primary bifaces and secondary bifaces. It will be recalled that it has been found that the reduction of the thickness in relation to length and width is a basic objective in chipped stone implement manufacture. With this in mind it seems useful to test the significance of the relationship of the changes in the three attributes (i.e. length, width and thickness) in roughouts and bifaces.

The analysis of the correlation between the length

FIGURE II

CUMULATIVE FREQUENCY GRAPH OF PLATFORM TYPE

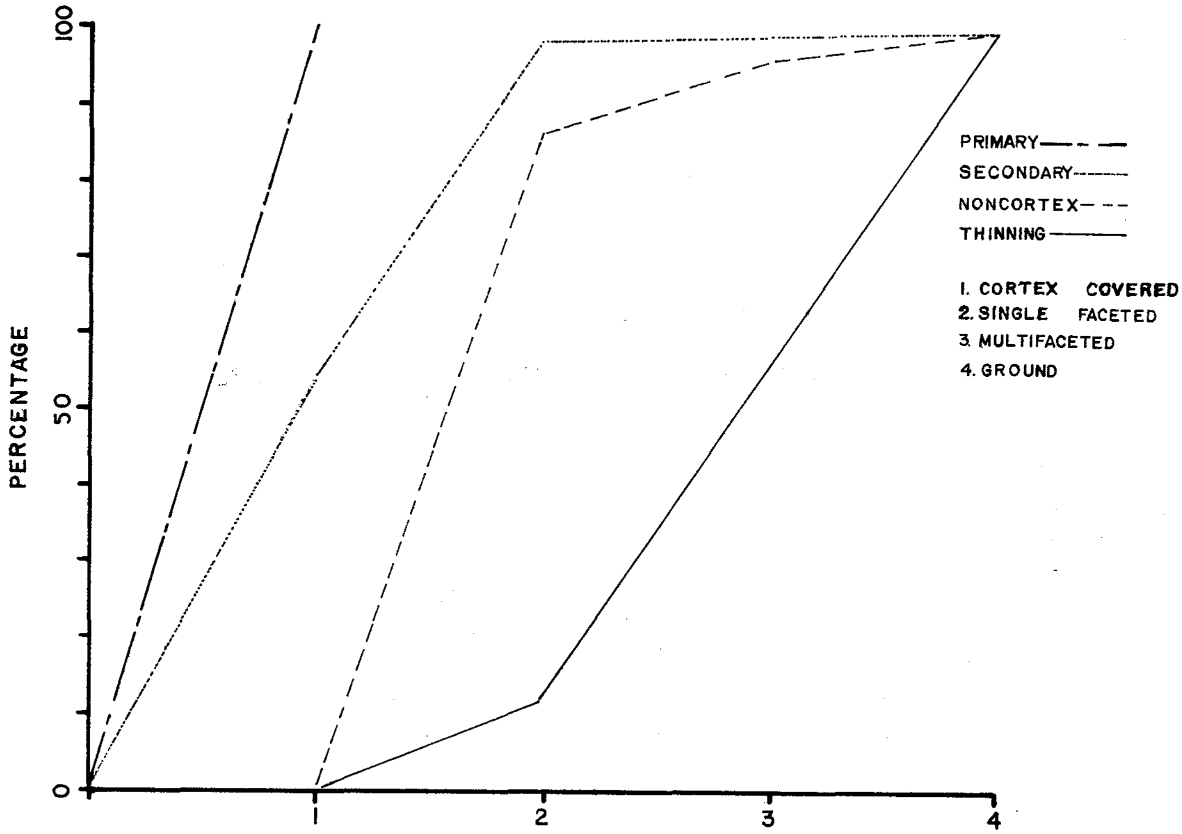


FIGURE 12

LINEAR CORRELATION OF LENGTH AND WIDTH

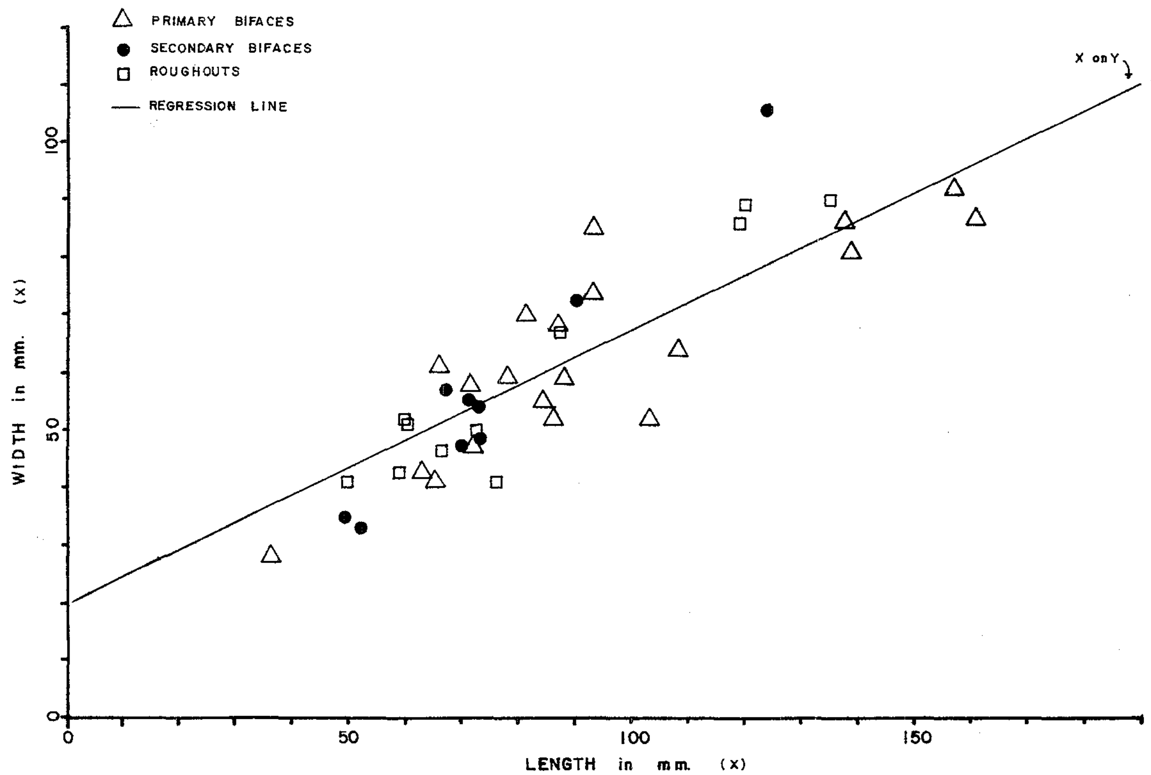
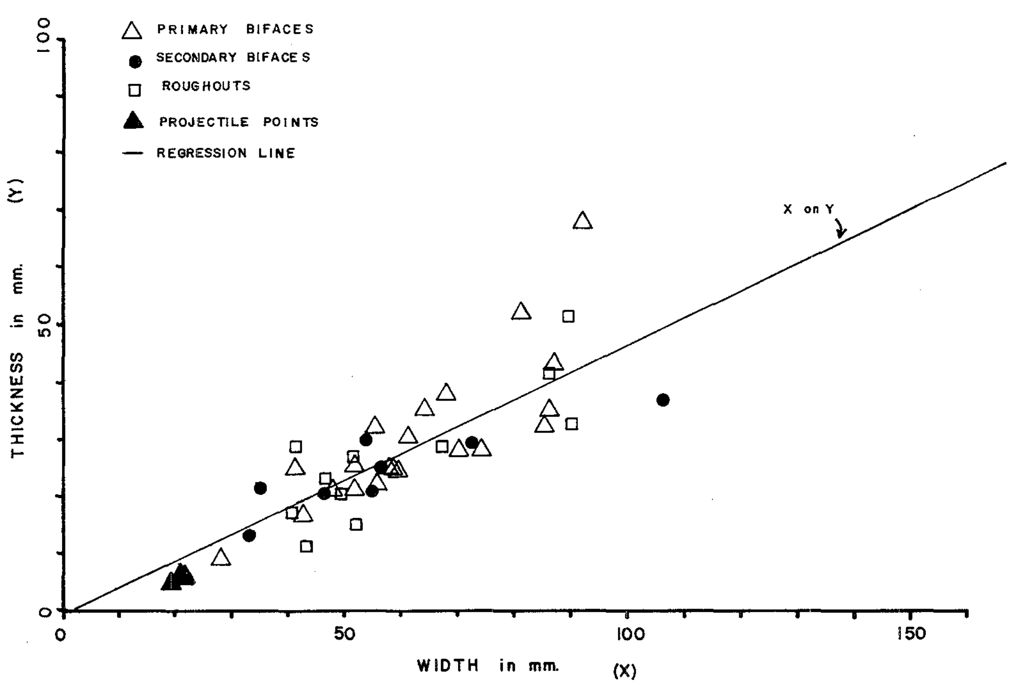


FIGURE 13

LINEAR CORRELATION OF WIDTH AND THICKNESS



and width and the width and thickness can be accomplished with "Pearson's product moment correlation coefficient" (Mueller and Schuessler 1961:270ff., Moroney 1952:271ff). On a scale from -1 to +1, this statistical procedure provides the mean of the variation of both variables. From this mean a regression line can be determined for the graphed objective pieces, illustrating the directions and rates of changes common to the variables.

The relationship between length and width was found to equal +.7385 and +.9071 for width and thickness. As zero is the point at which there is no relationship, the value obtained is a relatively high degree of positive correlation.

The coefficients obtained for the relationship between length and width and the relationship between width and thickness quantify a clear central tendency in the manner in which bifacial artifacts were produced at the Beaver Creek Quarry. Undoubtedly the material from which they are made imposed some restraints on prehistoric artisans. However the correlations illustrated in Figures 12 and 13 are due in large part to a common cultural heritage of the stone workers at the Beaver Creek Quarry. In a sense these workers inherited a similar "mental template" which gave them the picture of the "proper" bifacial artifact.

In future studies in the lower Athabasca River Drainage what should be looked for are significant (i.e. measured statistically) divergencies of mean length, width and thickness of bifacial artifacts from those found at the Beaver Creek Quarry. If such divergencies are found, insights into technological change, diffusion, migration, seasonality and specialization at particular sites or areas may be obtained from such data.

4. Final Manufacturing Processes and the Use of Finished Implements

The attributes which are considered in this study to be marks of finished artifacts are: wear, sharp edges, a generally regular outline, and in some cases a hafting mechanism. Artifacts classified as projectile points and scrapers generally exhibit one or all of the finishing attributes and are considered in this paper to be completed implements.

Some support can be given here to Holmes' previously mentioned contention that projectile points were made from bifaces. In Figure 12 the three projectile points in the sample are shown to conform to the same trends of thickness and width as do roughouts and bifaces. However this does not necessarily mean that this illustrates a manufacturing continuum. It may be that the similarities are due to the use of the same "mental template" to fashion the "proper projectile point" as prehistoric artisans used to fashion bifaces. What is needed is a large sample of projectile points from the lower Athabasca River drainage to demonstrate how they were manufactured. As such artifacts are very scarce in this region, it will be some time before one can come to an understanding of manufacturing relationships between bifaces and projectile points.

The finishing of unifacial implements made on flakes (side scrapers, end scrapers, etc.) involved retouch, by either direct percussion or pressure flaking, of the edge of the flake to sharpen, straighten, and strengthen it. In some cases it appears that these flakes were salvaged from the debris resulting from the manufacture of bifacial implements. The sharpening, straightening, and strengthening process is generally the only purposeful alterations of the flakes. However, the large number of multi-directional cores suggests that a good deal of the flake tools were derived purposely from these blocks of material.

Polishing, fracturing, and crushing along an edge of a chipped stone implement are considered in this analysis as prime indicators of wear. These attributes were noted on all of the artifacts classified as scrapers, used flakes and used shatter.

Wilmsen (1970:70-4) has noted that the angle of the worn edge of scrapers from early archaeological sites cluster in three groups: 26°-35°, 46°-55° and 66°-75°. He suspects that this distribution reflects different uses or functions of the implements (Wilmsen 1970:70). Edge angles are defined as "the angle between the ventral and dorsal surfaces of an artifact at those positions where either retouch or use scars are present" (Wilmsen 1968:38).

Table VII presents the distribution of edge angles among the scrapers, used flakes and used shatter in the study sample. The three largest clusters of edge angles in the sample do not correspond to the three observed by Wilmsen. There is a clear tendency towards angles greater than those found by Wilmsen. This may be due to differences in material type or differences in intended use. The distribution however, is significant in that it shows a possible nonrandom clustering of edge angles which probably reflects different uses of the scraping implements. The chi-square test was applied to the expected and observed frequencies of edge angles and is present in Table VII. The resulting chi-square value is over the .02 level of probability and is at least sufficiently high to suspect that there is a nonrandom distribution of edge angles among the scraping implements from the Beaver Creek Quarry.

TABLE VII

EDGE ANGLES OF SCRAPING IMPLEMENTS

Observed and Expected Edge Angle Frequencies With the Chi-square Test on These Values

	EDGE ANGLES						
	16^{0}-25^{0}	26^{0}-35^{0}	36^{0}-45^{0}	46^{0}-55^{0}	56^{0}-65^{0}	66^{0}-75^{0}	76^{0}-85^{0}
Observed	5	2	9	10	7	12	17
Expected	8.857	8.857	8.857	8.857	8.857	8.857	8.857

$X^2 = 16.14$
$df = 6$
$p. > .02$

Wilmsen (1970:70-1) has suggested that acute edge angles are associated with the preparation of hides, cutting meat, and whittling, while steeper angles are associated with wood working, bone working, and heavy shredding. Wilmsen found that the most frequent edge angles were those between the acute and steep angles at 46°-55°. This suggests to him that "this was a broadly useful attribute appropriate to a number of functional applications" (Wilmsen 1970:70). Some of the possible applications included hide scraping, skinning, shredding, wood cutting, and bone cutting.

The largest cluster of edge angles in the study sample is in the 76°-85° range, followed by the 66°-75° range and then the 46°-55° range. This may indicate that the optimum working angle was considered slightly steeper by stone workers who produced the artifacts under study.

The tendency toward the steeper angles indicates that chipped stone tool manufacture was not the only industry pursued at the Beaver Creek Quarry. Wood and bone working would appear to have been a common occurrence at this site. If this is correct then the initial assumption that only mining activities were conducted at this site should be altered. Raw material of various types (wood, bone, antler and hide) could have been brought to the quarry area for initial trimming, shaping or spliting. In other words the Beaver Creek Quarry may have been a rudimentary industrial center for small groups living in surrounding areas. If preservation was better, it could be expected to recover more evidence of such activities.

It is significant that no attributes of wear (i.e. polishing, fracturing, and crushing of edges) were noted on roughouts, primary bifaces, secondary bifaces and projectile points. The absence of wear on roughouts and bifaces supports the contention that these are *not* finished tools but objects lost, discarded, or left before being completed. These unfinished artifacts may well have been intended for use in a form not unlike the form they now exhibit. Nevertheless, one cannot altogether discount the validity of Holmes' hypothesis that such bifacial artifacts were intended to be processed into projectile points. The fact that they were not used in their present form and that they conform in size trends to projectile points is exactly what would be expected if Holmes were correct. Further examination of this problem within larger artifact collections would help to clarify the usefulness of Holmes' propositions in obtaining cultural data.

4.5 Chronological and Spacial Relationships

Establishing the age of the artifacts from the Beaver Creek Quarry has been frustrated by the lack of preserved organic material in the site. Bone was completely absent in the site and while charcoal was plentiful, it was the result of frequent forest fires on the site. Thus good carbon samples suitable for carbon 14 dating could not be obtained.

The stylistic parameters of three projectile points found at the site provide the best clue to the antiquity of its occupation. The two corner-notched projectile points resemble what has been called "Besant" projectile points. These projectile points have been found in a number of archaeological sites in southern Alberta and Saskatchewan (Gruhn 1969; Wettlaufer 1955; Forbis 1962). Gruhn has stated that

> Available radiocarbon dates from ... sites with levels containing Besant points in Alberta and Saskatchewan consistently place this type between A.D. 300 and A.D. 400 (Gruhn 1969:144-3).

There is no reason to believe that the two corner-notched projectile points from the Beaver Creek Quarry are not of comparable age to those found in southern parts of Alberta and Saskatchewan.

The lanceolate projectile point, on the other hand, appears to be identical to a projectile point type which is called "Agate Basin". This type of projectile point ranges in age from 4000 B.C. to 8000 B.C. (Wormington and Forbis 1965:20-1) and has been found from the prairies of the United States to central Alaska. Although a single specimen could hardly be considered proof of an early occupation of the Beaver Creek Quarry, it does raise questions regarding the cultural homogeneity of the site.

It should be noted that the Besant-like projectile points were found in level I of square 23, about 4 and 6 inches below the surface. These points were in association with large quantities of detritus and stone tools. The Agate Basin-like projectile point was found about 10 inches below the surface in level II of square 33. The Agate Basin-like point was not associated with any detritus or other artifacts. It is possible that the lanceolate projectile point represents an early component at the Beaver Creek Quarry which is not very well represented in the sample of artifacts obtained from the site. As will be recalled, a comparison of level I with level II revealed no significant differences between percentages of artifact categories. This suggests that the artifact collection obtained is fairly homogenous and is therefore of similar antiquity.

More intensive excavations could possibly reveal additional evidence of earlier components at the Beaver Creek Quarry which are typified by lanceolate or other types of projectile points. However, for the present it can be concluded that the majority of the artifacts at the Beaver Creek Site are probably the result of a relatively late occupation at this site. This late occupation could date between A.D. 300 and A.D. 400. In any case, earlier component(s), if present at the site, obviously does not exhibit evidence of extensive quarrying activities.

The only other artifacts of stylistical importance are the blade-like flakes. These flakes are similar to specialized implements which require a specialized technology to produce them. In North America they are often considered to be diagnostic of Arctic and Early Man cultures. Micro-blades (blades less than one centimeter in width) have been reported from Calling Lake about 150 miles south of the Beaver Creek Quarry (Gruhn 1966, 1967). These micro-blades were associated with stemmed, leaf shaped, triangular, side-notched, lanceolate and corner-notched projectile points.

Apparently the micro-blades were in all levels of some of the Calling Lake sites and were thus probably produced over a long period of time. Two tabular micro-blade cores were also found at Calling Lake.

A relationship between the microblades at Calling Lake and the blade-like flakes at the Beaver Creek Site seems remote at the present time. The size range of the Calling Lake micro-blades was reported to be 0.8 x 0.3 x 0.1 cm to 1.7 x 0.9 x 0.2 cm. The blade-like flakes from the Beaver Creek Site have a mean length of 1.93 cm, a mean width of 0.70 cm and a mean thickness of 0.66 cm. Thus the blade-like flakes from the Beaver Creek Site are on the average longer and thicker than the micro-blades from Calling Lake. It also should be noted that this is a very small sample of blade-like flakes (4) from the study sample and that no blade cores were found associated with them. An examination of the mean and standard deviations of sizes of flakes from the Beaver Creek Quarry shows that the blade-like flakes fall well within the range of variation of flakes from the site. Thus, the blade-like flakes in the study sample may very well be simply flakes which by chance alone came to resemble micro-blades. Until more is known of the lower Athabasca River drainage prehistory it seems difficult to come to any other conclusion.

5. COMPARISONS

5.1 Local Comparisons

So far the Beaver Creek Quarry has been discussed largely in terms of itself. In order to obtain an understanding of its uniqueness and also its composition with other findings in North America it is necessary to compare and contrast this site and how it was analysed with other sites. The logical comparison would be between the quarry and other sites in the lower Athabasca River drainage. However, only a handful of sites are known from this region and none except the quarry have been excavated.

There are three comparable sites which are located on the Beaver Creek above the quarry. These sites are "comparable" in that the surface collections made at these sites are sufficiently large to justify numerical comparisons. All the other sites found in this area yielded too few artifacts to be of use in such a comparison. The comparable sites are numbered 8, 13 and 15 in Syncrude's 1973 archaeological survey report (Syncrude 1973d: 36, 42, 44). These sites appeared to the investigators to be small camping areas and workshops of short duration.

The size of the flakes found at sites 8, 13 and 15 are compared to those found at the Beaver Creek Quarry in Figure 14. It should be immediately apparent that while the cumulative curves of the two groups of artifact sizes are similar, in both cases greater percentages of small flakes were found in sites 8, 13 and 15. The reasons for this could include differences in raw material sizes and a concentration at the camp sites on finishing artifacts rather than simply roughing them out. Similar differences in flake size distribution between initial manufacturing areas and camps has been found elsewhere (Davis 1969:42). This evidence suggests that through the identification of a set of key attributes (e.g. flake size) one would be able to delineate to a certain degree the settlement patterns of prehistoric peoples in this area. This, of course, will have to wait until more archaeological sites can be located in the region.

Another way to illustrate that the Beaver Creek Quarry was the location of specialized activities (at least with reference to other sites in the area) is to compare scraping angles. In Table VIII the edge angles of the scraping implements from sites around the Beaver Creek Quarry (see Syncrude 1973d) are compared to those found in the quarry collection. The chi-square test was applied to these frequencies and the resulting figures far exceeded the .001 level of probability. Thus it is with some certainty that it can be said that there is significant differences between the distribution of edge angles of sites on the upper Beaver Creek drainage on the one hand and the quarry on the other.

TABLE VIII

COMPARISON OF EDGE ANGLES

Observed and Expected Edge Angle Frequencies With the Chi-square Test on These Values

	EDGE ANGLES						
	16^0-25^0	26^0-35^0	36^0-45^0	46^0-55^0	56^0-65^0	66^0-75^0	76^0-85^0
Expected	1.37	0.54	2.47	2.74	1.91	3.29	4.65
Observed	0	4	0	12	0	1	0

$X^2 = 65.45$
$df = 6$
$p. > .001$

FIGURE 14a

CUMULATIVE FREQUENCY GRAPH OF FLAKE WIDTH

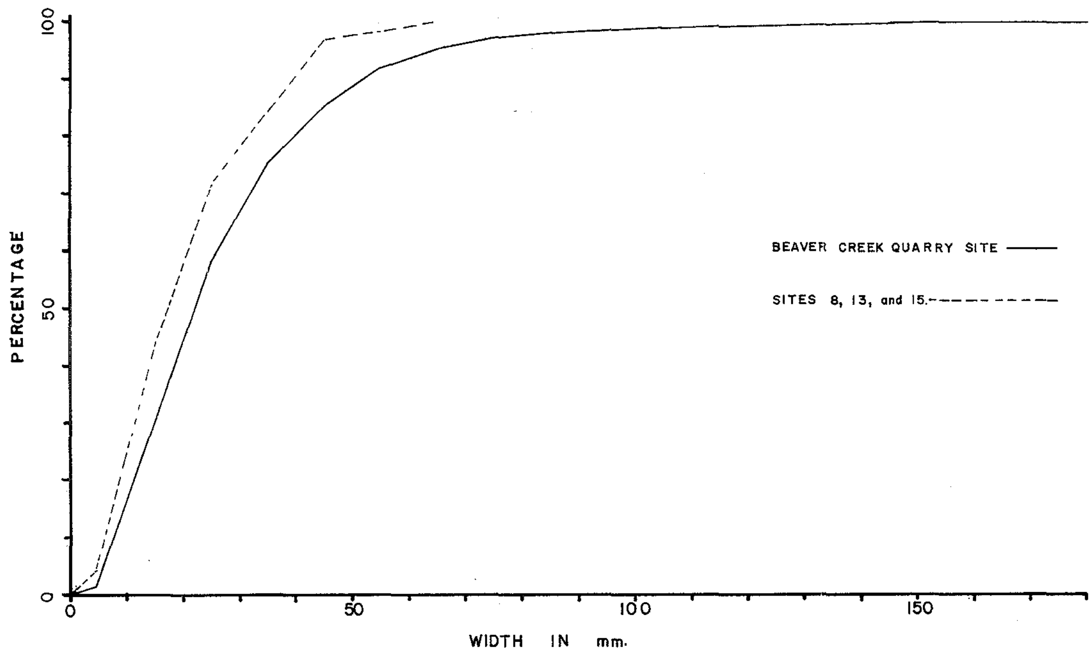
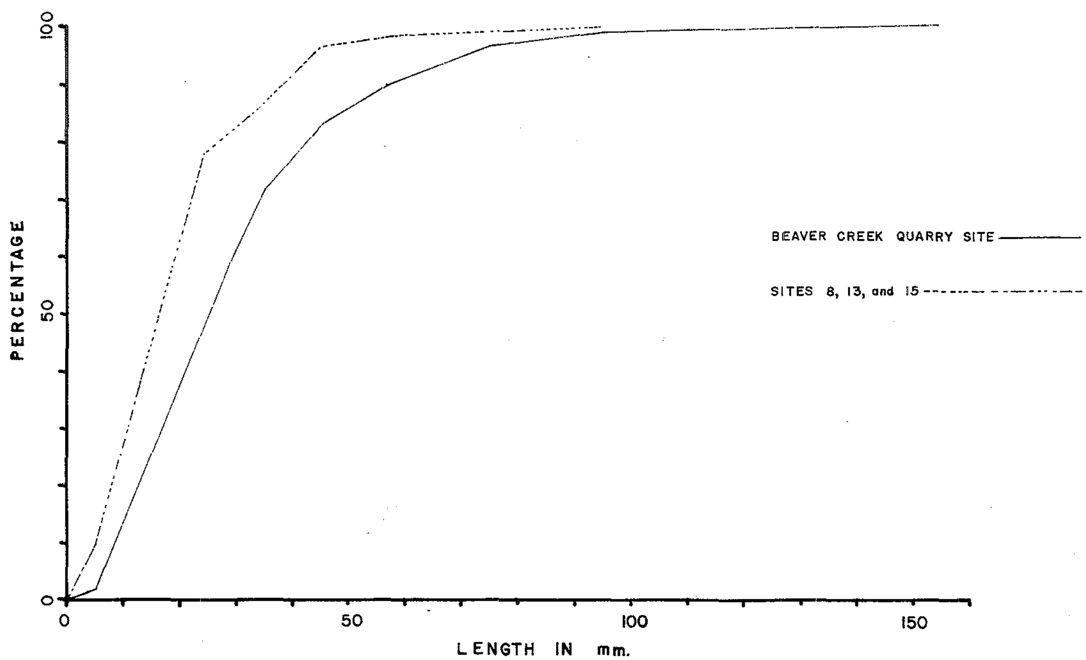


FIGURE 14b

CUMULATIVE FREQUENCY GRAPH OF FLAKE LENGTH



The reasons for these differences very likely lie in the different activities carried on at the quarry as opposed to the camp sites upstream from it. It will be recalled that the quarry collection exhibited steep edge angles suggesting that wood, bone and antler were being worked at the site. In the camp sites the majority of scraping angles were found to cluster in the 46°-55° range (Syncrude 1973d:82). This same clustering was noted at other sites in North America (Wilmsen 1970: 60-71). It is on this basis that it has been determined that this was the most useful edge angle to prehistoric man. In other words this edge angle would have been used for the widest variety of jobs. In terms of the sites under consideration, scraping implements at the camp sites exhibit general function angles while those from the quarry exhibit more specialized angles.

5.2 Quarry Sites

The Beaver Creek Quarry was excavated and the material analysed partly with the intention of comparing the data obtained with other quarry collections. The number of such collections in existence is very small considering the total number of known archaeological sites in North America. This reflects a general lack of interest among archaeologists in dealing with such sites. The reasons for this lack of interest are, (1) the great quantities of detritus in quarries which require a large investment in time to analyse, (2) the difficulty of deriving viable cultural insights from the analysis of such detritus and (3) the lack of understanding of stone tool manufacturing processes.

These three hindrances to knowledge of quarries and quarrying in North America can be traced to a number of practices which have typified quarry studies in the past.

These practices involve the manner in which the quarries are sampled, how the artifact types are defined, how artifact frequencies are described and how quarry collections are related to collections from other types of sites.

The general pattern usually followed in analysing quarry artifact collections was set between 50 to 80 years ago by the work of William H. Holmes (1891; 1894; 1897; 1900; 1919). His pioneering efforts stand unequaled by any work since in terms of numbers of sites analysed, types of stone material considered or the spacial limits of study. Homes analysed prehistoric stone quarries all across the United States and Mexico. These quarries ranged from quartzite cobble quarries in the vicinity of Washington, D.C., to turquoise mines in the southwest United States, to obsidian mines in Mexico. Holmes' theoretical orientation would not be out of place with popular trends in archaeology today. He states his view of the goals of archaeology as an attempt

> ...to spread before the world the story of the origin, the early struggles, the coming and goings, the ups and downs of the hordes, the tribes, and the nations, and *to interpret the laws responsible for the diversified results*, racially and culturally (Homes 1919:10 emphasis added).

To attain these goals Homes amassed a great body of data on prehistoric stone quarries and developed a number of useful procedures to interpret this data. These procedures included ethnographic analogy, direct historical records and oral traditions of native peoples, examination of environmental limitations and experimental replication of processes thought to have been used in the past (Holmes 1919: 9-10, 283ff.). These methods are the same ones applied in the present study.

While Holmes' theoretical orientation is perfectly acceptable today and his stated methods are still in general use, his techniques of site sampling, artifact classification, quantification and comparison are clearly dated. He used no systematic procedure to insure that his samples of artifacts were representative of the total artifact populations in his quarries. He made no attempt to classify the large amounts of flaking detritus from the sites or to present precise frequencies of the occurrence of any of the artifact types he found. Finally, he made no use of any type of statistical methods which could quantify the relationships between artifacts, between artifact types and between archaeological sites.

Holmes' failure to use such techniques caused a reaction against his work some 30 years after its publication. After years of inactivity on the part of the scientific community, Kirk Bryan (1950) once again took up the study of prehistoric stone quarries. The main object of Bryan's work was to demonstrate that prehistoric stone quarries were not only material sources "but also industrial sites or factories to which materials such as wood and bone were brought to be worked in the presence of abundant tools" (Bryan 1950:3). Bryan contended that Holmes was opposed to such an interpretation, but actually Holmes never denied this proposition. However, in his zeal to promote another hypothesis, Holmes tended not to give it much thought.

Holmes was principally interested in demonstrating that the major product of quarries were bifaces which were processed elsewhere into tools such as projectile points. Holmes' emphasis on supporting this proposition tends to obscure other activities which may have been carried on at quarry sites.

One can sympathize with Bryan's critique of Holmes' work, but the total rejection of Holmes' hypotheses cannot be accepted. Bryan unfortunately failed to grasp the sampling, typological, quantitative and comparative errors which Holmes had made and thus doomed himself to commit them again. Bryan's arguments are no more convincing than are those of Holmes' in the form in which they are presented. Bryan produces no representative samples, makes no quantitative comparisons and comes to no conclusion which is supported by statistical analysis.

In 1950 Alan L. Bryan and Donald R. Tuohy published a report on the Stockhoff Ranch Quarry Site in northeastern Oregon. In this report evidence was (not surprisingly) found which supported parts of both Bryan's and Holmes' arguments (Bryan and Tuohy 1960:506). Bryan and Tuohy were the first to give detailed descriptions of the artifacts from a quarry and the numerical frequencies at which they occurred. This allowed them to present a somewhat more acceptable statement on the function of quarries than had previous investigators. Unfortunately the work at the Stockhoff Ranch Quarry was carried out as part of a natural gas pipeline survey and the excavations were therefore largely confined to the pipeline right-of-way. For this reason one cannot be sure that the sample obtained by the two investigators is representative of the site as a whole.

One facet of the site which was not discussed was the flaking detritus. No attempt was made to either classify or quantify these artifacts. The major emphasis of these authors was on tools and unfinished tools. It is our opinion that such an emphasis cannot adequately describe a quarry site.

In the last few years there has been increasing interest in the analysis of quarry sites. Studies have been produced by Davis (1969), Tuohy (1970), Skinner (1971), Losey (1971), Bucy (1974), and Callahan (1974) among others. The primary concerns of these studies are not significantly different from those of Holmes' original works. However, these recent authors have introduced more detailed typologies of quarry artifacts (including detritus) (e.g. Bucy 1974: 18-20; Skinner 1971; Tuohy 1970; and Davis 1969), and have attempted to relate intensive experimental stone working data to quarry interpretation (e.g. Bucy 1974; Callahan 1974). Increasing concern has been shown for the identification of "diagnostic traits" which may have chronological, functional or cultural significance (e.g. Losey 1971; Davis 1969; Bucy 1974).

While the importance of the contributions of these recent works is recognized, it should be pointed out that the same sampling, typological, quantitative and comparative problems which flaw Holmes' works, persist in varying degrees in these recent studies. To understand this an examination of each of these problems in terms of the Beaver Creek Quarry is appropriate.

The sample of artifacts obtained from the Beaver Creek Quarry was taken in a random fashion. Twenty of the forty squares were located within the sampling area with the use of a table of random numbers. This random sample provides a way of determining if the total sample was biased. If it had been biased the sampling techniques would have provided a way of finding out why. Douglas Bucy (1974) on the other hand, has provided a description of a basalt quarry in western Idaho without such controls. While Bucy's description of his artifact sample is excellent, one wonders if this sample is really representative of the total artifact population at the site. No systematic randomizing procedures were followed by the excavators of the site (Bucy did not, it should be pointed out, excavate the site himself). Thus the importance of frequencies of artifact types which Bucy stresses in his concluding remarks are suspect. Sonia Ragir (1968:185) has remarked that

> A truly representative sample is a selection of individual elements from a population in the exact proportion that they exist in the original population. In order to obtain a representative sample the original population must be known. Simple random sampling is a method of selection in which every member of the population has exactly the same chance of being included in the sample as does every other member. A random sample is used to *estimate* a representative sample of a population of unknown constitution. The larger the random sample is, the greater is the probability that it resembles a truly representative sample.

In other words a random sample can be used by archaeologists to approximate a truly representative sample. The success of the archaeologist in accomplishing this task greatly affects the outcome of his research. Quarry sites are often very large and contain millions of artifacts. The likelihood of ever completely excavating and analysing such a site is very low. It is therefore imperative that those working with quarry sites choose their samples according to random principles.

The second problem which persists in quarry studies today is that of typology. No standards of classification have been accepted which allows any uniformity in the typology from site to site. This is especially disadvantageous to quarry studies because flaking detritus, which make up the large percentage of quarry collections, can and have been classified with the use of mutually noncomparable parameters. For example, David (1969:42) classifies flakes according to their length while Bucy (1974:18-20) classifies flakes according to the amount of cortex on their dorsal surfaces and Tuohy (1970:154) classifies flakes according to their shape. While each of the above authors make some effort to deal with other typologies, their work is not comparable with each other.

The flake typology used to classify the Beaver Creek Quarry collection constitutes an attempt to establish a generally acceptable, useful and comparable classificatory system. The basic types of flakes follow those defined by Bucy (1974) because they are based firmly on experimental stone working data. These flake types were defined according to the amount of cortex on their outer surfaces or according to special attribute clusters which are indicative of certain stone working processes (e.g. those defining thinning flakes and blade-like flakes). It is recognized that such a classification alone is not flexible enough to permit the comparison of our sample to other samples divided along different parameters. Therefore the length and width of the flakes was measured, and the ratios of these measurements recorded. These measurements are given in Figure 15. Thus it has been attempted in this study to present a typology based on attributes of cortex cover and attributes indicative of certain stone working processes. At the same time the variability within these types may be shown according to size and form (i.e. length/width ratio).

This typology was accomplished with a reasonable investment of time and labor. The length and width of the flakes were taken as the flakes were classified. The measurements were taken on a measuring board with a piece of graph paper taped to it. This allowed the length and the width to be recorded by one dot on the graph paper. The length/width ratio was determined by drawing ratio lines on the graph paper (see Hassan 1971 for a more detailed explanation of this technique).

It is felt that this classification system established here is superior to any one of the three used by the authors mentioned above, because of its flexibility. Figure 16, for example, compares the percentages of flake types in the Beaver Creek Quarry with those from the Midvale Quarry which Bucy analysed. It is immediately apparent that there is a wide difference on this triangular coordinate graph between the two sites. The Beaver Creek Quarry shows significantly smaller percentages of primary and secondary flakes than does the Midvale Quarry. This difference is related directly to the type of raw material used. The Midvale Quarry raw material consisted of irregular lumps of weathered basalt, while the Beaver Creek Quarry raw material consisted of bedrock. The chances of having a weathered surface on a piece of bedrock is much less because the total outer surface exposure is much less than a deposit of lumps of residuum or colluviuum. If one were to rely on this typology alone there is a chance that such divergent outcomes could be misinterpreted as indicating technological differences.

Figure 16 therefore illustrates the inadequacy of Bucy's flake typology. To truly detect technological differences exhibited by the debitage of the two quarries one must consider additional attributes. Hassan (1971) has shown that the form of a flake can be used to show differences in stone working technologies. The form of a flake can be recorded as the ratio of its length and width. If length/width ratios were available for the Midvale Quarry flake sample, it is possible that technological differences might be discernible between it and the Beaver Creek Quarry. Because they are not, one is left with the obvious, that different raw materials affect flake type frequencies.

It was pointed out in a preceding section of this chapter that flake size can be a useful indicator of site function, when the same type of raw material is involved in all the sites compared. With regard to future work in the lower Athabasca River drainage, the value of a flexible flake typology using size, form, cortex cover and special technological attributes needed to delineate the functional and temporal differences among sites cannot be over stated. It is to this end that the typology of flake classification was developed in this study.

FIGURE 15

FLAKE SIZE

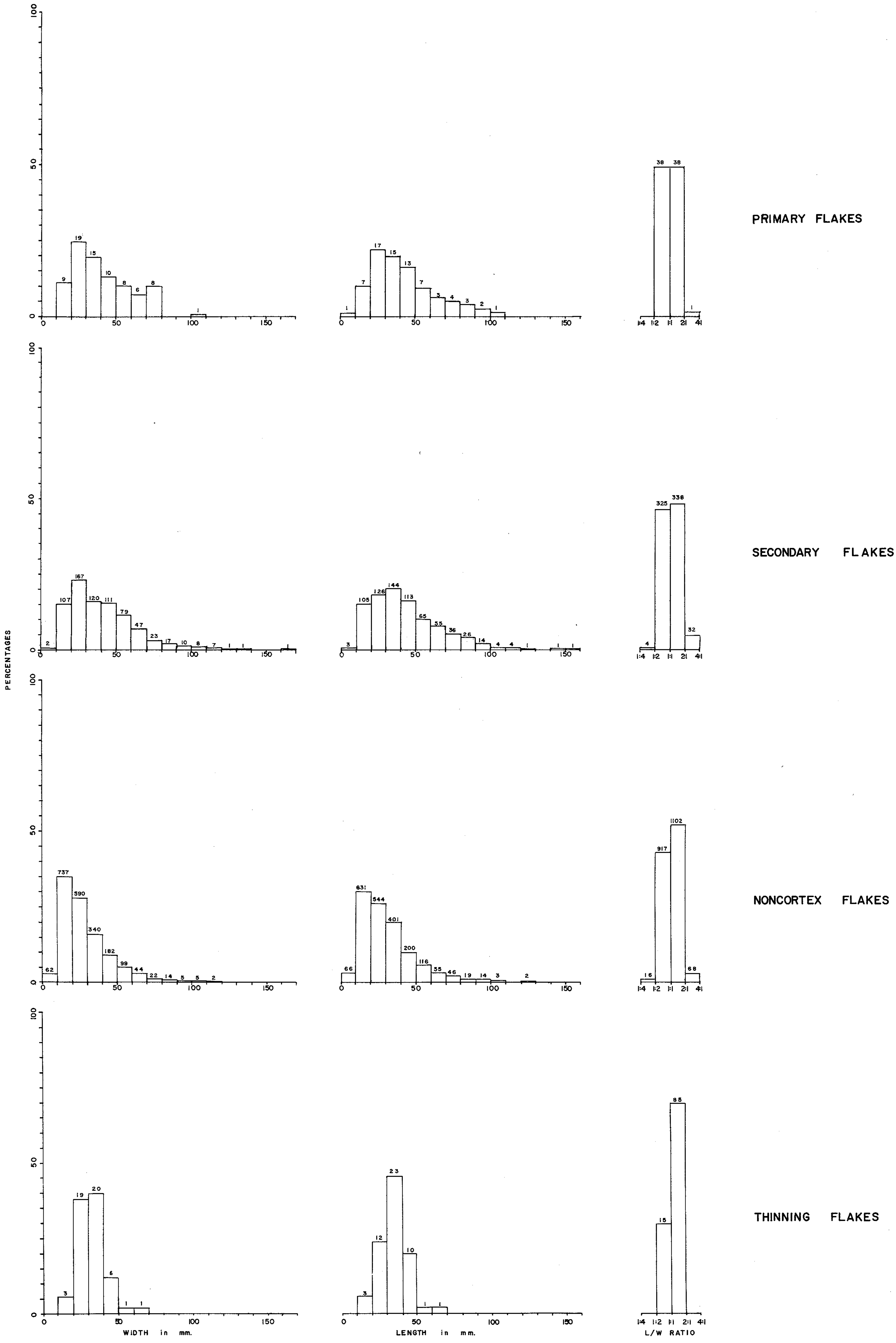
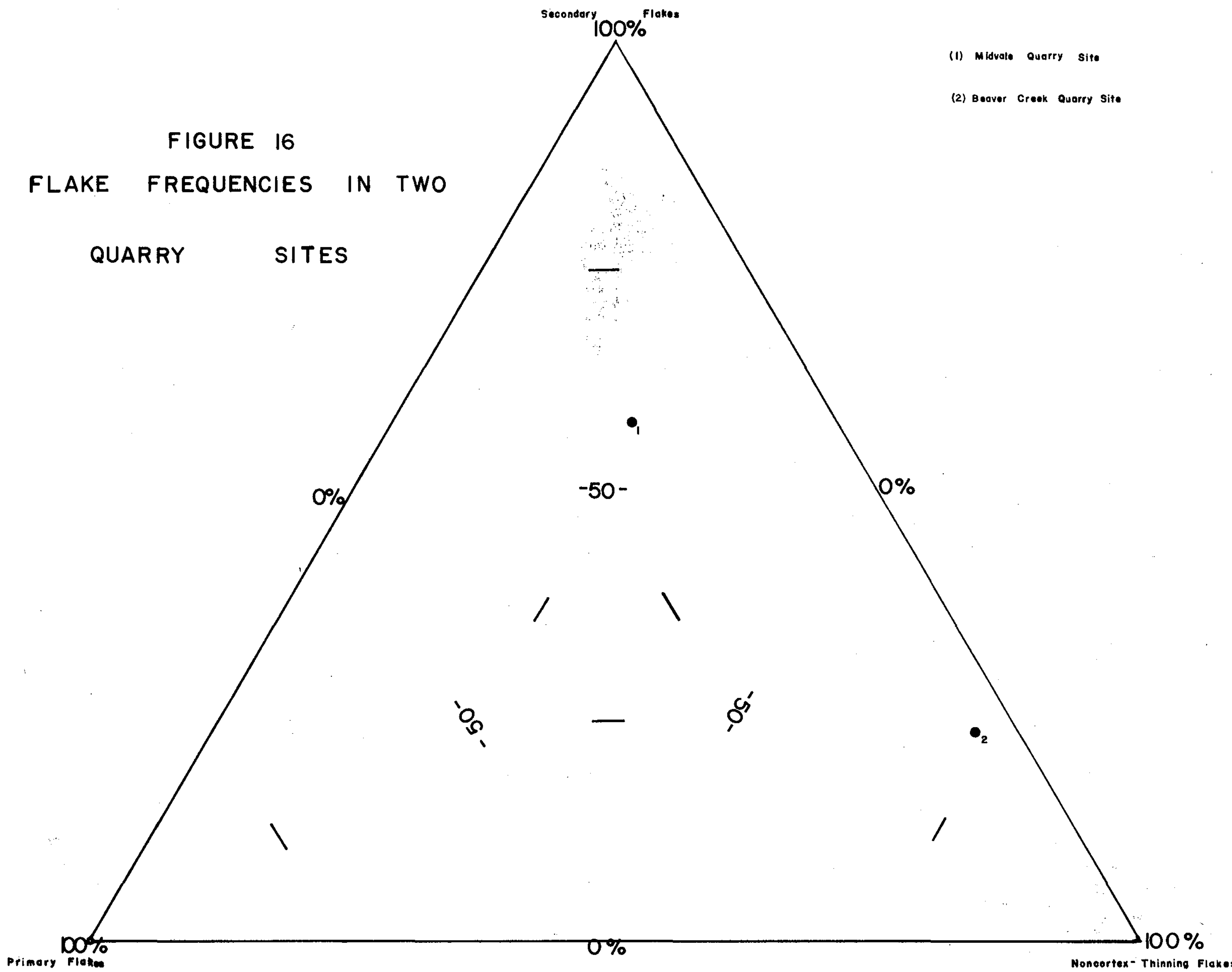


FIGURE 16

FLAKE FREQUENCIES IN TWO QUARRY SITES



The third and fourth problems often not recognized in the recent work on quarries are those of quantification and comparison. These problems are inseparably linked with the problems of sampling and classification already discussed. The assumption that populations of artifacts are normally distributed and the failure to use statistical methods to quantify samples is common. The comparisons of such samples is generally based on subjective observations of the particular investigator and usually can be neither supported nor refuted by the data presented.

In this report quantification of data was attempted by not only noting the range of variation but the seemingly significant central tendencies within the artifact sample. Few comparisons were possible owing to the small amount of known archaeological material from the lower Athabasca River drainage. Those comparisons which were attempted were made on the basis of statistical tests and explicit numerical frequencies which are presented for others to re-evaluate, criticize, test and compare. Through such work it is believed that definite cultural data of anthropological value can be obtained.

For example, the quantitative differences of scraping angles between the Beaver Creek Quarry and nearby camp sites is shown to be statistically significant. The cultural implications of these figures are interpreted here as evidence that prehistoric populations used the Beaver Creek Quarry for certain specialized purposes. This indicates movements of groups between temporary camp sites (in areas with a food resource) and a permanently located material source. In any attempt to define the seasonal movements of prehistoric peoples such nonseasonal changes in residence should not be overlooked.

In summary, the present study has made use of random sampling techniques and has devised a classification system which allows the artifact sample to be accurately quantified and to be compared to other artifact collections. This has been accomplished with an economy of time and effort, while still obtaining viable cultural insights into quarrying practices in the Boreal Forest.

6. SUMMARY AND IMPLICATIONS

6.1 Summary

This study was undertaken to examine the composition of the Beaver Creek site in northeastern Alberta. This study was entered into with a number of preconceived notions as to what would be found in the site. In the discussion of the site a number of conclusions about the artifact sample were able to be drawn and, through these, some conclusions about the original assumptions. In this section these assumptions and conclusions are summarized and their implications discussed.

Initially it was assumed that the Beaver Creek site was a quarry site which was repeatedly visited for short periods by small groups of prehistoric hunting and fishing peoples. These assumptions were based on the first observations of the site, knowledge of ethnographic accounts of aboriginal peoples in northern Alberta and a familiarity with other quarry sites in North America.

To help evaluate these assumptions a set of attributes were defined which were thought to be indicative of specific processes in the manufacture of chipped stone implements. These attributes included cortex cover, material variety, geographical and geological occurrence of raw material, presence of thermally altered specimens, lipped platforms, distinct bulbs of force, manner of flake termination, thickness in relation to length and width, outline, edge sharpness and the presence of a hafting mechanism.

The horizontal distribution of artifacts in the site was found to be of a "contagious" type rather than a normal distribution. This necessitated an introduction of some elementary nonparametric statistics to estimate the range of the number of artifacts in a typical square in the site. From this it was found that the possible median for the population of artifacts in the site could range from 2,600 to 121,600. It was also found that the horizontal distribution of artifacts was fairly homogeneous and therefore probably closely related. The great range between the confidence intervals of the median, the contagious distribution of the artifacts and the horizontal homogeneity of the sample gives a picture of how the site was used. The contagious distribution probably occurred because of the intermittence of site occupation and the tendency for prehistoric peoples to define activity areas within the site. Investigators not taking such data into account can be led to misinterpretations in site size and composition comparisons.

The vertical distributions of artifacts was examined in an extensively excavated area of the site. A high degree of correlation between levels in this area was illustrated by a cumulative frequency graph, but a chi-square test of the significance of this correlation proved to be inconclusive. However, a broken artifact was located in this area with one piece in level I and three pieces in level II. Thus we concluded that there was no identifiably distinct artifact populations deposited one on top of another represented in the study sample.

Through a comparison of artifact categories contained within the study sample with those predicted by Bryan (1950) and Holmes (1919) it was concluded that the Beaver Creek site conformed to the archaeological definition of a quarry. This confirmed the initial assumption that the area was a prehistoric stone quarry.

The examination of the artifact sample indicated how material was procured, fabricators selected, cortex removed, and tools thinned and shaped. The raw material at the site was dominated by the quantities of Beaver Creek Quartzite. This material was obtained from a bedrock formation which outcrops on the site. This bedrock formation is of unknown age but is probably a pre-McMurray formation, Cretaceous Age deposit. The distribution of the surface occurrences of this material is thought to be confined to the Athabasca River valley and the immediate vicinity. The other materials used at the site (chert, quartzite, seam quartz and granitic rocks) appear to have been derived from glacial outwash deposits.

The differences in the varieties of materials used to make different types of tools were found to be significant. Scrapers appear to have been brought into the area in finished form because there is almost no detritus in the sample recovered which would have resulted from their manufacture. Hammerstones were generally cobbles of a quartzite harder and less brittle than Beaver Creek Quartzite. This data indicates certain biases on the part of the prehistoric stone workers in choosing certain materials for certain purposes. It also is evidence of relatively brief visits to the quarry by groups living elsewhere.

No evidence was noted of heat treatment of stone at the Beaver Creek Quarry. The possibility that it occurs in nearby sites could be interpreted as another indication of site specialization. However this interpretation must await further data from sites in the area to be acceptable.

The large number of hammerstones in the sample from the Beaver Creek Quarry is good evidence that the direct percussion hard hammer was used to produce significant quantities of the detritus found in the site. An examination of flake morphology, however, has shown that probably soft hammers and pressure flaking instruments were also used.

An examination of flake sizes showed that average flake sizes decrease with the decrease in cortex cover. This was taken as evidence in support of Newcomer's (1971) hypothesis that flake size decreased during chipped stone tool manufacture. It was also found that as manufacture proceeds the intensity of platform preparation increases. This was linked to the need of stoneworkers to exercise ever increasing control over the size, shape and location of the flakes they removed as manufacture progressed.

The manner in which bifacial implements were made at the Beaver Creek Quarry showed clear central tendencies. It was suggested that these central tendencies were brought about by the restraints of the raw material and a common cultural heritage of the stoneworkers who produced the artifacts under study. It was therefore suggested that any future investigators of the lower Athabasca River drainage should look for significant divergencies from these discovered central tendencies. Such divergencies will provide insights into technological change, diffusion, migration, seasonality and specialization at particular sites or areas.

Little quantitative support could be found for Holmes' hypothesis that bifaces were intended to be processed into projectile points by prehistoric stoneworkers. The fact that none of the bifaces or rough-outs in the study sample exhibit signs of wear tends to support Holmes' proposition. Further investigations with larger samples than the one under study are recommended however before any definite conclusions are drawn in regard to this hypothesis.

A tendency was noted toward steep edge angles in the sample of scraping implements from the Beaver Creek Quarry. This was accepted as evidence that wood and bone working was a common occurrence at the quarry. Thus the site may have been more than a simple source of stone and

and primary workshop. Raw material of various types (wood, bone, antler and hide) could have been brought to the area for initial trimming, shaping or splitting. In other words the Beaver Creek Quarry is viewed as a rudimentary industrial center for small groups living in surrounding areas.

The only artifacts of chronological or spacial significance identified in the study sample were three projectile points and four blade-like flakes. Two of the projectile points resemble the "Besant" projectile point type which has been dated between A.D.300 and A.D.400. The other specimen resembles the Agate Basin projectile point type which has a time range of 4,000 B.C. to 8,000 B.C. The Besant-like points were found associated with the major portion of the study sample while the Agate Basin-like point was found stratigraphically lower and spacially separate from the rest of the study sample. It was therefore a preliminary conclusion of this paper that the majority of the artifacts at the Beaver Creek Site are probably the result of a relatively late occupation at this site. This late occupation could date between A.D.300 and A.D.400. An earlier occupation of the site is not ruled out, but it is felt that if an earlier occupation does exist it is not represented by extensive quarrying activities.

The blade-like flakes were found not to conform to size trends of micro-blades which have been found in sites to the south of the Beaver Creek Quarry. On the other hand, these blade-like flakes are well within the range of variation of other flakes in the study sample. On this basis it was concluded that these flakes came to resemble micro-blades by chance alone.

Comparisons of the sample of artifacts from the Beaver Creek Quarry were made with sites in the surrounding area. Differences in flake size and scraper edge angles were noted between these sites. The explanation for these differences probably lies in the different activities which were carried on at the quarry as opposed to the surrounding sites. As a whole this evidence supports the contention that through the identification of a set of key attributes (e.g. flake size and scraping edge angles) one would be able to delineate to a certain degree the settlement pattern of the prehistoric peoples of this area.

The work done at the Beaver Creek Quarry was also compared with that carried out at other quarries in North America. It was observed that most quarry studies were flawed by major problems with sampling, typology, quantification and comparison techniques. The present study has attempted to demonstrate the usefulness of random sampling techniques in obtaining a representative sample from a site. A classification system was also devised which allows the artifact sample to be accurately quantified and to be compared to other artifact collections. The adoption of this or a similar system would seem necessary if progress in interpreting quarry sites is to continue.

By making use of various statistical procedures it was sought to overcome the problems which have plagued previous investigators. The difficulties which were encountered in analysing the data from the Beaver Creek Quarry suggest that all of the methodological problems involved in quarry research has not yet been solved.

6.2 Implications

On the basis of the data presented in this report it is possible to roughly sketch the nature of the occupation of the Beaver Creek Site. The abundance of flaking detritus associated with numbers of rough-outs, bifaces, flake scrapers, used flakes and hammerstones is ample evidence that this is indeed a prehistoric quarry. The scarcity of finished implements, the fact that a large portion of the scrapers are made from materials uncommon at the site, the dichotomy between flake sizes and between scraper edge angles found in the quarry as compared to surrounding sites attest to a "special function" of the Beaver Creek Site. The generally steep scraping angles indicate that this special function is equated to use of the site as a rudimentary industrial center for groups living in surrounding areas.

The relative homogeneity of the artifact sample suggests that the major occupation of the site was during a single period. The Besant-like projectile points suggest a relatively recent age for this major occupation. The single Agate Basin-like projectile point, however, indicates that the site was probably occupied during other periods as well. The intermittent use of the quarry and the small camp sites upstream from the quarry reflect a "restricted wandering" pattern characteristic of small historic hunting, fishing and gathering groups of the Boreal Forest. The picture is of a people exploiting resources in the areas adjacent to the Beaver Creek Quarry and occasionally visiting the site to obtain raw material or to process some other materials. How seasonal variations affected this pattern, how long it persisted and what changes occurred in it over time only further work in this area will reveal.

BIBLIOGRAPHY

Binford, Lewis R. and Mark L. Papworth
1963 The Eastport Site, Antrim County, Michigan. In Miscellaneous Studies in Typology and Classification. *Anthropological Papers* 19. Museum of Anthropology, University of Michigan. Ann Arbor.

Birket-Smith, K.
1930 Contributions to Chipewyan Ethnology. *Report of the Fifth Thule Expedition.* 5:3.

Bonnichsen, Robson
1974 Models for Deriving Cultural Information from Stone Tools. Unpublished Ph.D. Thesis, Department of Anthropology, University of Alberta. Edmonton.

Bryan, Alan Lyle
1960 Pressure Flaking - The Problem of Identification. *Tebiwa* 3:1-2: 29-30. Pocatello.

Bryan, Alan Lyle, and Donald R. Tuohy
1960 A Basalt Quarry in Northeastern Oregon. *Proceedings, American Philosophical Society,* 104: 485-510

Bryan, Kirk
1950 Flint Quarries: The Sources of Tools, and at the same time, the factories of the American Indian. Papers, Peabody Museum of American Archaeology and Ethnology, 17(3).

Bucy, Douglas Reid
1974 A Technological Analysis of a Basalt Quarry in Western Idaho. *Tebiwa* 16:2: 1-45.

Callahan, Evvett
1974 The Wagner Basalt Quarries: A Preliminary Report. In *Experimental Archeology Papers* 3. Department of Sociology and Anthropology. Virginia Commonwealth University. Richmond.

Carrigy, M. A.
1966 Lithology of the Athabasca Oil Sands. Research Council of Alberta. *Bulletin* 18. Edmonton.

Clarke, David L.
1968 *Analytical Archaeology.* Methuen and Co. Ltd. London.

Crabtree, Don E.
1967a Notes on Experiments in Flintknapping: 3. A Flintknapper's Raw Materials. *Tebiwa* 10:1: 8-24. Pocatello.

1967b Notes on Experiments in Flintknapping: 4. Tools Used for Making Flaked Stone Artifacts. *Tebiwa* 10:1: 60-73. Pocatello.

1969 A Technological Description of Artifacts in Assemblage I. Wilson Butte Cave, Idaho. *Current Anthropology* 10:4: 366-367.

1972a An Introduction to Flintworking. *Occasional Papers of the Idaho State University Museum* 28. Pocatello.

1972b The Cone Fracture Principle and the Manufacture of Lithic Materials. *Tebiwa* 15:2: 29-42. Pocatello.

Crabtree, Don E., and B. Robert Butler
1964 Notes on Experiments in Flintknapping 1. Heat Treatment of Silica Minerals. *Tebiwa* 7:1: 1-6. Pocatello.

Davis, E. L.
1969 The Western Lithic Co-Tradition. *San Diego Museum Papers* 6. San Diego.

Davis, Wilbur A.
1972 The Concept of Technological Systems. *Northwest Anthropological Research Notes* 6:1: 1-64. Moscow.

Dixon, Wilfrid J., and Frank J. Massey, Jr.
1969 *Introduction to Statistical Analysis.* McGraw-Hill Book Company. New York.

Ellis, H. H.
1940 *Flint-Working Techniques of the American Indian: An Experimental Study.* Ohio State Museum Lithic Laboratory. Columbus.

Ells, S. C.
1926 Bituminous Sands of Northern Alberta, Occurrence and Economic Possibilities. Department of Mines, *Report* 632. King's Printer, Ottawa.

Forbis, Richard G.
1962 The Old Women's Buffalo Jump, Alberta. *National Museum of Canada Bulletin* 180. Contributions to Anthropology, 1960, Part I 56-123. Ottawa.

Greig-Smith, M. A.
1964 *Quantitative Plant Ecology*. Second Edition. Butterworths. London.

Gruhn, Ruth
1966 Summary of Field Work at Calling Lake, Northern Alberta. *Archaeological Society* of Alberta Newsletter 10: Fall: 2-4. Edmonton.

1967 Summary Report of 1967 Field Work at Calling Lake, Northern Alberta. Archaeological Society of Alberta Newsletter 15: Winter: 1-2. Edmonton.

1969 Preliminary Report on the Muhlbach Site: A Besant Bison Trap in Central Alberta. *National Museums of Canada Bulletin* 232. Contributions to Anthropology VII: Archaeology. Ottawa.

Hassan, Fekri
1971 Study of Debitage in Lithic Assemblages and its Uses. The Pan-African Congress on Prehistory and the Study of the Quaternary Commission on Nomenclature and Terminology, *Bulletin* 4: 20-29.

Helm, June
1968 The Nature of Dogrib Socioterritorial Groups. In Richard B. Lee and Irven DeVore (eds.) *Man the Hunter*. Aldine. Chicago.

Hester, Thomas Roy
1972 Ethnographic Evidence for the Thermal Alteration of Siliceous Stone. *Tebiwa* 15:2: 63-65. Pocatello.

Holmes, W. H.
1891 Aboriginal Novaculite Quarries in Garland County Arkansas. *American Anthropologist* 4:4: 313-15. Washington, D.C.

1894 Natural History of Flaked Stone Implements. *International Congress of Anthropology*. 130-9. Shulte Publishing Company. Chicago.

1897 Stone Implements of the Potomac-Chesapeake Tidewater Province. *Bureau of Ethnology. Fifteenth Annual Report*, 1893-94. Washington, D.C.

1900 The Obsidian Mines of Hildalgo, Mexico. *American Anthropologist* 2:3: 405-17. New York.

1919 Handbook of Aboriginal American Antiquities, Part 1. *Bureau of Ethnology, Bulletin* 60:1. Washington, D.C.

Hunt, Charles B.
1974 Natural Regions of the United States and Canada, W. H. Freeman and Company. San Francisco.

Jenness, Diamond
1967 The Indians of Canada. *National Museum of Canada. Bulletin* 15. Ottawa.

Knowles, H. S.
1953 Stone Worker's Progress: A Study of Stone Implements in the Pitt Rivers Museum, Pitt Rivers Museum, *Occasional Papers on Technology* 6. University Press, Oxford.

Leakey, L. S. B.
1960 *Adam's Ancestors, The Evolution of Man and His Culture*. Harper and Row, Publishers. New York.

Losey, Timothy C.,
1971 The Stony Plain Quarry Site. *Plains Anthropologist* 16:52: 138-154.

MacNeish, Richard S.
1964 Investigations in Southwest Yukon: Archaeological Excavations, Comparisons and Speculations. *Papers of the Robert S. Peabody Foundation for Archaeology* 6:2. Phillips Academy. Andover.

Moroney, M. J.
1952 *Facts from Figures*. Penguin Books. London.

Mueller, John H. and Karl F. Schuessler
1961 *Statistical Reasoning in Sociology*. Houghton Mifflin Co. Boston.

Muto, Guy Roger
1971 A Technological Analysis of the Early States in the Manufacture of Lithic Artifacts. Unpublished Master's thesis. Idaho State University. Pocatello.

Newcommer, M. H.
1971 Some Quantitative Experiments in Handaxe Manufacture. *World Archaeology* 3:1: 85-94. Routledge and Kegan Paul Ltd. London.

Noether, Gottfried E.
1971 *Introduction to Statistics: A Fresh Approach* Houghton Mifflin Company, Boston.

Osgood, Cornelius
1931 The Ethnography of the Great Bear Lake Indians. *National Museum of Canada, Annual Report.* 31-98. Kings Printer. Ottawa.

Pond, Alonzo W.
1930 Primitive Methods of Working Stone Based on Experiments of Halbor L. Skarlem. Logan Museum Bulletin II:1. Beloit College. Beloit.

Ragir, Sonia
1971 A Review of Techniques for Archaeological Sampling. In *A Guide to Field Methods in Archaeology* by Robert F. Heizer and John A. Graham. National Press. New York.

Rowe, J. S.
1972 Forest Regions of Canada. Department of the Environment. *Canadian Forestry Service Publication* 1300. Ottawa.

Sackett, James R.
1966 Quantitative Analysis of Upper Paleolithic Stone Tools. In J. D. Clark and F. C. Howell (eds.). Recent Studies in Paleoanthropology. *American Anthropologist* 68:2:2. Menasha.

Sharrock, Floyd W.
1966 Prehistoric Occupation Patterns in S. W. Wyoming and Cultural Relationships with the Great Basin and Plains Culture Areas. *University of Utah Anthropological Papers* 77. Salt Lake City.

Skinner, S. Alan
1971 Prehistoric Settlement of the De Cordova Bend Reservoir, Central Texas. *Bulletin of the Texas Archeological Society* 42: 51-148. Dallas.

Steward, J. H.
1955 *Theory of Culture Change*. University of Illinois Press. 244 pp. Urbana.

Syncrude Canada Limited
1973a The Habitat of Syncrude Tar Sands Lease 17: An Initial Evaluation. *Environmental Research Monograph 1973-1.* Syncrude Canada Limited. Edmonton.

1973b Beaver Creek: An Ecological Baseline Survey. *Environmental Research Monograph 1973-2.* Syncrude Canada Limited. Edmonton.

1973c Migratory Waterfowl and the Syncrude Tar Sands Lease: A Report. *Environmental Research Monograph 1973-3.* Syncrude Canada Limited. Edmonton.

1973d Syncrude Lease No. 17: An Archaeological Survey. *Environmental Research Monograph 1973-4.* Syncrude Canada Limited. Edmonton.

Tuohy, D.R.
1970 The Coleman Locality: a Basalt Quarry and Workshop near Falcon Hill, Nevada. *Nevada State Museum, Anthropological Papers,* 15:4: 143-205. Carson City.

Wettlaufer, Boyd N.
1955 The Mortlach Site in the Besant Valley of Central Saskatchewan. *Saskatchewan Department of Natural Resources, Anthropological Series* no. 1. Regina.

Willey, G. R. and P. Phillips
1958 *Method and Theory in American Archaeology.* The University of Chicago Press. Chicago. 270 pp.

Wilmsen, Edwin N.
1968 Paleo-Indian Site Utilization. *Anthropological Archeology in the Americas.* Anthropological Society of Washington. Washington D.C.

1970 Lithic Analysis and Cultural Inference: A Paleo-Indian Case. *Anthropological Papers of the University of Arizona,* No. 16. Tucson.

Wormington, H.M., and Richard G. Forbis
1965 An Introduction to the Archaeology of Alberta, Canada. *Denver Museum of Natural History Proceedings* no. 11. Denver.

Wonnacott, Thomas H., and Ronald J. Wonnacott
1972 *Introductory Statistics.* Second Edition. John Wiley and Sons; Inc. New York.

APPENDIX

The Artifacts

The artifact sample from the Beaver Creek Quarry Site includes 30,075 artifacts. Of this sample 26813 (89.16%) are of broken flakes (proximal ends, distal ends, midsections and logitudinal sections) and non-diagnostic shatter. The other 3262 artifacts (10.94%) consists of unbroken flakes, unfinished tools and finished tools.

These artifacts were classified into 28 artifact types, which may be described as follows.

The Artifact Type Descriptions

TYPE: ROUGHOUT

NO. OF SPECIMENTS:	*11*
SIZE RANGE:	*Length* *Mean 8.22 cm* *Standard Deviation 2.78 cm* *Width* *Mean 5.96 cm* *Standard Deviation 1.88 cm* *Thickness* *Mean 2.70 cm* *Standard Deviation 1.13 cm*
DESCRIPTION:	*Irregular pieces of stone which have been worked in an irregular fashion. All of the specimens have been worked bifacially to some degree. The flaking is multidirectional and was very likely produced by the percussion technique.*
MATERIAL:	*Quartzite 1, Beaver Creek, Quartzite 10.*
DISTRIBUTION:	*2 in Sq. 11-I 1 in Sq.25-I 1 in Sq.28-I* *2 in Sq. 19-I 1 in Sq.26-1 1 in Sq.33-I* *2 in Sq. 20-I 1 in Sq.27-I*

TYPE: PRIMARY BIFACE

NO. OF SPECIMENS:	21 complete, 14 fragmentary
SIZE OF RANGE:	Length Mean 9.22 cm Standard Deviation 3.23 cm Width Mean 6.39 cm Standard Deviation 1.64 cm Thickness Mean 3.42 cm Standard Deviation 1.73 cm
DESCRIPTION:	These bifaces are irregular in outline and in transverse section. They appear to have been manufactured mostly from natural blocks of stone or large pieces of shatter and large irregular flakes. On a number of speciments the original platform and bulb of percussion scar is still visible. They are thick in relation to width and seven speciments retain a small remnant of the stones original outer surface (cortex). The flaking is irregularly patterned and was probably executed by the percussion flaking technique.
MATERIAL:	Quartzite 3, Chert 1, Beaver Creek Quartzite 30, Seam Quartz 1.

DISTRIBUTION:

5 on Surface	1 in Sq. 17-I	1 in Sq. 30-I
1 in Sq. 1-II	1 in Sq. 19-I	1 in Sq. 31-I
2 in Sq. 2-I	1 in Sq. 21-I	2 in Sq. 32-I
2 in Sq. 10-I	4 in Sq. 24-I	1 in Sq. 34-I
1 in Sq. 11-I	1 in Sq. 25-I	2 in Sq. 36-I
1 in Sq. 12-I	1 in Sq. 27-I	2 in Sq. 37-I
1 in Sq. 14-I	1 in Sq. 28-I	
1 in Sq. 15-I	2 in Sq. 29-I	

TYPE: SECONDARY BIFACES

NO. OF SPECIMENS: 8 complete, 27 fragmentary

SIZE RANGE:

Length
Mean 6.91 cm
Standard Deviation 2.66 cm

Width
Mean 5.75 cm
Standard Deviation 2.18 cm

Thickness
Mean 2.46 cm
Standard Deviation 0.68 cm

DESCRIPTION: These bifaces tend to be ovate in outline and generally lenticular in transverse section. These bifaces are relatively thin in relation to width in comparison to primary bifaces. No identifiable cortex remnants remain on these artifacts. The flaking is moderately well patterned and was probably executed by the percussion flaking technique.

MATERIAL: Quartzite 4, Beaver Creek, Quartzite 31

DISTRIBUTION:

1 on surface	1 in Sq. 12-I	1 in Sq. 29-I
1 in Sq. 7-I	2 in Sq. 18-I	1 in Sq. 31-I
7 in Sq. 10-I	4 in Sq. 21-I	1 in Sq. 35-I
1 in Sq. 10-II	1 in Sq. 24-II	1 in Sq. 36-I
2 in Sq. 11-I	6 in Sq. 25-I	5 in Sq. 37-I

TYPE: UNIFACE

NO. OF SPECIMENS: 3 complete, 1 fragmentary

SIZE RANGE:

Length
Mean 5.20 cm
Standard Deviation 1.35 cm

Width
Mean 3.63 cm
Standard Deviation 0.46 cm

Thickness
Mean 1.90 cm
Standard Deviation 0.48 cm

DESCRIPTION: These specimens have been steeply flaked on one surface. They appear to be flakes which have had their dorsal or outer surfaces completely reworked. The specimens are triangular to subtriangular in outline and plano convex in transverse section. The flaking is moderately well patterned and was probably executed by the percussion flaking technique.

MATERIAL: Quartzite 1, Beaver Creek Quartzite 3

DISTRIBUTION: 1 in Sq. 11-I 1 in Sq. 28-I
1 in Sq. 21-I 1 in Sq. 37-I

TYPE: LANCEOLATE PROJECTILE POINT

NO. OF SPECIMENS: 1

SIZE RANGE: Length 4.8 cm, Width 2.1 cm, Thickness 0.8 cm

DESCRIPTION: This projectile point has a lanceolate outline which tappers to a point at the tip and to a straight base at the opposite end. The projectile point is lenticular in transverse and longitudinal sections. The edges of the blade are convex. The edges of the base are ground as well as of the blade from the base to 1/4 of the distance to the tip. The projectile point has well patterned diagonal flake scars running across both of its sides. The edges of the blade and the base have been finely retouched. The tip of this projectile point has been broken off. The flaking is most likely the result of the pressure flaking technique.

MATERIAL: Beaver Creek Quartzite 1

DISTRIBUTION: 1 in Sq. 33-II

TYPE: CORNER-NOTCHED PROJECTILE POINT

NO. OF SPECIMENS:	2
SIZE RANGES:	Length 3.0-2.1 cm, Width 2.1-1.85 cm, Thickness 0.7-0.55 cm
DESCRIPTION:	These projectile points are triangular in outline and lenticular in transverse section. They have rounded shoulders and a slightly concave to slightly convex base. The edges of the blade are straight. The notches are of moderate depth. The edges of the notches and the base of the smaller specimen have been ground. Both specimens have broken tips. The flaking is moderately well patterned and could have been produced either by the pressure or percussion flaking techniques.
MATERIAL:	Chert 2
DISTRIBUTION:	2 in Sq. 23-I

TYPE: USED SHATTER

NO. OF SPECIMENS:	6
SIZE RANGE:	Length Mean 8.38 cm Standard Deviation 3.35 cm Width Mean 5.65 cm Standard Deviation 2.83 cm Thickness Mean 3.33 cm Standard Deviation 1.70 cm
DESCRIPTION:	These artifacts are irregular pieces of shatter which exhibit signs of wear (fracturing, crushing and polishing). This wear is generally confined to a small area along the margin of the artifact.
MATERIAL:	Beaver Creek Quartzite 6
DISTRIBUTION:	1 in Sq. 20-I 1 in Sq. 32-I 1 in Sq. 35-I 1 in Sq. 27-I 2 in Sq. 34-I

TYPE: HAMMERSTONE

NO. OF SPECIMENS: 18 complete, 27 fragmentary

SIZE RANGE:

Length
Mean 7.48 cm
Standard Deviation 2.33 cm

Width
Mean 6.15 cm
Standard Deviation 1.50 cm

Thickness
Mean 4.37 cm
Standard Deviation 0.84 cm

DESCRIPTION: This artifact type includes small to medium sized water worn cobbles which have been battered on one or more ends.

MATERIAL: Granitic 4, Quartzite 41

DISTRIBUTION:

2 on surface	3 in Sq. 20-I	1 in Sq. 28-II
7 in Sq. 1-I	1 in Sq. 22-I	2 in Sq. 29-I
2 in Sq. 1-II	1 in Sq. 23-I	3 in Sq. 30-I
1 in Sq. 3-II	3 in Sq. 24-I	2 in Sq. 31-I
1 in Sq. 5-II	3 in Sq. 25-I	1 in Sq. 33-I
1 in Sq. 11-I	2 in Sq. 26-I	2 in Sq. 37-I
1 in Sq. 15-I	1 in Sq. 27-I	1 in Sq. 38-I
2 in Sq. 18-I	2 in Sq. 28-I	

TYPE: ANVIL

NO. OF SPECIMENS: 1

SIZE RANGE: Length 9.7 cm, Width 8.0 cm, Thickness 5.9 cm

DESCRIPTION: This artifact is a water worn cobble which has been battered on one surface. It is assumed that this battering resulted from something being set on it and subsequently being struck. Thus the term anvil is used to distinguish it.

MATERIAL: Quartzite 1

DISTRIBUTION: 1 in Sq. 20-I

TYPE: IRREGULAR MULTI-DIRECTIONAL CORE

NO. OF SPECIMENS: 32 complete, 7 fragmentary

SIZE RANGE:

Length
Mean 11.13 cm
Standard Deviation 5.01 cm

Width
Mean 8.98 cm
Standard Deviation 3.80 cm

Thickness
Mean 5.98 cm
Standard Deviation 2.49 cm

DESCRIPTION: These artifacts are small to large irregular blocks of stone which have had large flakes driven from them. The flake scars run in many directions. The platforms are unprepared surfaces. Flaking was executed by the percussion technique.

MATERIAL: Beaver Creek Quartzite 39

DISTRIBUTION:

3 on surface	3 in Sq. 19-I	3 in Sq. 29-I
1 in Sq. 1-I	1 in Sq. 20-I	3 in Sq. 30-I
1 in Sq. 2-I	5 in Sq. 21-I	1 in Sq. 31-I
1 in Sq. 11-I	1 in Sq. 22-I	2 in Sq. 32-II
1 in Sq. 11-II	2 in Sq. 23-I	1 in Sq. 36-I
1 in Sq. 12-I	1 in Sq. 24-I	2 in Sq. 37-I
1 in Sq. 15-I	1 in Sq. 25-I	1 in Sq. 38-I
1 in Sq. 17-I	2 in Sq. 28-I	

TYPE: STEEP-END SCRAPERS

NO. OF SPECIMENS: 8

SIZE RANGE:

Length
Mean 3.18 cm
Standard Deviation 0.52 cm

Width
Mean 2.61 cm
Standard Deviation 0.46 cm

Thickness
Mean 0.78 cm
Standard Deviation 0.20 cm

DESCRIPTION: These scrapers are made on flakes which have been altered on one end to form a working edge. On seven of the specimens this working edge is on the distal end of the flake. On one specimen the working edge is on one of the longitudinal margins of the flake. One specimen has been retouched on three sides. All but two of the specimens exhibit polishing and fracturing along their working edges which probably resulted from use. The working edges are generally slightly convex but on one specimen it is nearly straight. The flaking is moderately well patterned and was probably executed by the percussion technique.

MATERIAL: Chert 6, Beaver Creek Quartzite 2

DISTRIBUTION:

1 in Sq. 2-I	1 in Sq. 23-II	1 in Sq. 28-I
2 in Sq. 11-I	2 in Sq. 24-I	1 in Sq. 37-I

TYPE: SIDE SCRAPERS

NO. OF SPECIMENS: 4

SIZE RANGE:

Length
Mean 4.07 cm
Standard Deviation 1.29 cm

Width
Mean 3.00 cm
Standard Deviation 1.16 cm

Thickness
Mean 0.42 cm
Standard Deviation 0.10 cm

DESCRIPTION: These scrapers are irregularly shaped flakes with at least one longitudinal edge having been retouched. This retouch is steep, well patterned and consists of a series of relatively small flake scars.

All four specimens appear to have some form of wear (crushing fracturing or polishing) on their working edges. The retouch was probably produced by the percussion flaking technique.

MATERIAL: Quartzite 2, Beaver Creek Quartzite 1, Chalcedony 1.

DISTRIBUTION: 1 in Sq. 10-I 1 in Sq. 22-I
1 in Sq. 16-I 1 in Sq. 24-I

TYPE: FLAKE SCRAPERS

NO. OF SPECIMENS: 6

SIZE RANGE: Length
Mean 7.68 cm
Standard Deviation 1.60 cm

Width
Mean 4.45 cm
Standard Deviation 0.61 cm

Thickness
Mean 1.93 cm
Standard Deviation 0.32 cm

DESCRIPTION: These scrapers are made on irregular flakes. They usually have one edge which has been retouched to strengthen and sharpen it. The retouch is poor to moderately well patterned and was probably produced by the percussion flaking technique. All the working edges show signs of wear (i.e. fracturing, crushing, and polishing). One specimen has been slightly trimmed around its entire margin.

MATERIAL: Beaver Creek Quartzite 6

DISTRIBUTION: 1 in Sq. 1-I 1 in Sq. 19-I 1 in Sq. 27-I
1 in Sq. 10-I 1 in Sq. 25-I 1 in Sq. 29-I

TYPE: TABULAR SCRAPERS

NO. OF SPECIMENS: 5

SIZE RANGE:

Length
Mean 7.66 cm
Standard Deviation 3.51 cm

Width
Mean 4.88 cm
Standard Deviation 3.73 cm

Thickness
Mean 2.28 cm
Standard Deviation 1.25 cm

DESCRIPTION: Natural tabular pieces of stone or pieces of shatter which exhibit steep marginal retouch. This retouch is usually confined to a single side. All of the specimens exhibit signs of wear along the retouched margins. The retouch is irregularly patterned and was probably produced by the percussion technique.

MATERIAL: Beaver Creek Quartzite 5

DISTRIBUTION: 1 in Sq. 19-I 1 in Sq. 25-I 1 in Sq. 32-I
1 in Sq. 20-I 1 in Sq. 29-I

TYPEL COBBLE SPALL SCRAPER

NO. OF SPECIMENS: 1

SIZE RANGE: Length 8.8 cm, Width 7.5 cm, Thickness 1.7 cm

DESCRIPTION: This artifact is a large flake taken from the surface of a large water worn cobble. It is plano-convex in transverse section and ovate in outline. It has been lightly trimmed around two thirds of its margin on the ventral surface. The dorsal surface is completely covered with cortex. The working edge exhibits signs of wear (polishing).

MATERIAL: Quartzite 1

DISTRIBUTION: 1 in Sq. 19-I

TYPE: USED FLAKE

NO. OF SPECIMENS: 37

SIZE RANGE:

Length
Mean 4.89 cm
Standard Deviation 1.97 cm

Width
Mean 3.38 cm
Standard Deviation 1.30 cm

Thickness
Mean 1.23 cm
Standard Deviation 0.66 cm

DESCRIPTION: These artifacts are irregular flakes which exhibit signs of wear (fracturing, crushing and polishing). This wear is generally confined to a small area along the margin of the artifacts.

MATERIAL: Chert 1, Quartzite 1, Beaver Creek Quartzite 35.

DISTRIBUTION:

1 in Sq. 1-I	3 in Sq. 21-I	2 in Sq. 30-I
2 in Sq. 3-I	1 in Sq. 23-I	1 in Sq. 32-I
1 in Sq. 3-II	1 in Sq. 24-I	1 in Sq. 32-II
1 in Sq. 10-I	1 in Sq. 24-II	1 in Sq. 34-I
2 in Sq. 11-I	4 in Sq. 25-I	1 in Sq. 36-I
2 in Sq. 12-I	1 in Sq. 25-II	1 in Sq. 37-I
1 in Sq. 16-I	1 in Sq. 26-I	1 in Sq. 38-I
2 in Sq. 18-I	3 in Sq. 29-I	
1 in Sq. 19-I	1 in Sq. 29-II	

TYPE: RETOUCHED FLAKE

NO. OF SPECIMENS: 28

SIZE RANGE:

Length
Mean 6.22 cm
Standard Deviation 1.95 cm

Width
Mean 4.45 cm
Standard Deviation 1.30 cm

Thickness
Mean 1.68 cm
Standard Deviation 0.67 cm

DESCRIPTION: These artifacts consist of flakes which have been retouched along one or more edges. This retouch usually consists of a number of small irregularly patterned flake scars. None of these specimens exhibit any signs of wear.

MATERIAL: Quartzite 1, Beaver Creek Quartzite 27.

DISTRIBUTION:

2 in Sq. 1-I	1 in Sq. 20-I	1 in Sq. 28-II
1 in Sq. 8-I	3 in Sq. 21-I	1 in Sq. 29-I
4 in Sq. 10-I	1 in Sq. 22-I	1 in Sq. 29-II
1 in Sq. 11-I	2 in Sq. 23-I	1 in Sq. 30-I
1 in Sq. 12-I	1 in Sq. 23-II	1 in Sq. 35-I
1 in Sq. 18-I	1 in Sq. 25-I	1 in Sq. 37-I
1 in Sq. 19-I	1 in Sq. 26-I	1 in Sq. 38-I

TYPE: RETOUCHED SHATTER

NO. OF SPECIMENS: 2

SIZE RANGE: Length 6.6-9.5 cm, Width 6.2-5.1 cm., Thickness 3.6-3.1 cm.

DESCRIPTION: These two artifacts are irregular pieces of shatter with one area on their margin having been retouched. This retouch consists of irregularly patterned flake scars which was very likely produced by the percussion flaking technique. These specimens exhibit no identifiable signs of wear.

MATERIAL: Beaver Creek Quartzite 2.

DISTRIBUTION: 2 in Sq. 32-II

TYPE: BLADE-LIKE FLAKE

NO. OF SPECIMENS: 4

SIZE RANGE:

Length
Mean 1.93 cm
Standard Deviation 0.35 cm

Width
Mean 0.70 cm
Standard Deviation 0.17 cm

Thickness
Mean 0.66 cm
Standard Deviation 0.77 cm

DESCRIPTION: These flakes are small, with parallel to sub-parallel lateral edges and very small platforms. The platforms are lipped on the ventral edge. They are trangular in transverse section. One longitudinal ridge runs the length of each flake resulting from the previous removal of similar flakes.

MATERIAL: Beaver Creek Quartzite 4.

DISTRIBUTION: 3 in Sq. 25-I 1 in Sq. 28-I

TYPE: COBBLE SPALL

NO. OF SPECIMENS: 26

SIZE RANGE:

Length
Mean 5.97 cm
Standard Deviation 2.05 cm

Width
Mean 4.55 cm
Standard Deviation 1.57 cm

Thickness
Mean 1.51 cm
Standard Deviation 0.74 cm

DESCRIPTION: These are flakes driven from water worn cobbles. As such they have a dorsal surface completely covered with cortex.

MATERIAL: Granitic 4, Quartzite 22.

DISTRIBUTION:

1 in Sq. 1-I	2 in Sq. 20-I	1 in Sq. 28-II
1 in Sq. 1-II	1/2 in Sq. 23-I	1 in Sq. 29-I
1 in Sq. 3-I	1/2 in Sq. 23-II	1 in Sq. 29-II
1 in Sq. 15-I	1 in Sq. 24-I	1 in Sq. 30-I
2 in Sq. 16-I	4 in Sq. 25-I	1 in Sq. 32-II
1 in Sq. 18-I	1 in Sq. 26-I	1 in Sq. 36-I
1 in Sq. 19-I	1 in Sq. 27-I	2 in Sq. 37-I

TYPE: OUTREPASSE' BIFACE THINNING FLAKES

NO. OF SPECIMENS: 2

SIZE RANGE: Length 7.6-6.4 cm., Width 4.6-33 cm., Thickness 2.5-1.4 cm.

DESCRIPTION: Outrepasse' is said to mean, "over and beyond the opposite margin" (Crabtree 1972:80). As applied to thinning flakes, it refers to flakes that terminated by taking off the opposite margin of the bifacial object being worked. Such flakes exhibit the usual characteristics of thinning flakes including a curved longitudinal section, a platform which shows flake scars resulting from thinning flakes being removed from the opposite margin as well as these from the same margin. The platforms of these flakes are often prepared by a series of beveling flakes. These beveling flakes are removed from the surface of the biface opposite the side on which the flake is to be removed.

MATERIAL: Beaver Creek Quartzite 2.

DISTRIBUTION: 1 in Sq. 14-I 1 in Sq. 18-I

TYPE: POSSIBLE BI-POLAR FLAKE

NO. OF SPECIMENS: 2

SIZE RANGE: Length 3.4-5.4 cm., Width 1.7-3.3 cm., Thickness 1.0-1.9 cm.

DESCRIPTION: These flakes have attributes which suggest they were produced by the bi-polar flaking technique. These attributes include crushing and pitting on their distal ends.

MATERIAL: Beaver Creek Quartzite 2.

DISTRIBUTION: 1 in Sq. 21-I 1 in Sq. 24-I

TYPE: CORE REJUVINATION FLAKE

NO. OF SPECIMENS: 4

SIZE RANGE:

Length
Mean 4.43 cm
Standard Deviation 1.22 cm

Width
Mean 3.38 cm
Standard Deviation 0.90 cm

Thickness
Mean 1.33 cm
Standard Deviation 0.76 cm

DESCRIPTION: These flakes have attributes which suggest that they were taken from a core to either straighten the flaking surface or to remove some obstruction (e.g. step fractures). The flakes generally have a large platform and have flake scars on their dorsal surfaces which indicate a number of flakes having been taken off from the same platform.

MATERIAL: Beaver Creek Quartzite 4.

DISTRIBUTION:

1 in Sq. 23-II	1 in Sq. 30-I
1 in Sq. 29-I	1 in Sq. 32-I

TYPE: PRIMARY FLAKES

NO. OF SPECIMENS: 79

SIZE RANGE:

Length
Mean 4.34
Standard Deviation 5.72

Width
Mean 2.79
Standard Deviation 3.78

Thickness not taken

DESCRIPTION: These flakes have their dorsal surfaces completely covered with cortex.

MATERIAL: 1 Quartzite, 1 Granitic, 77 Beaver Creek Quartzite.

DISTRIBUTION:

1 in Sq. 1-I	5 in Sq. 19-I	3 in Sq. 26-I
2 in Sq. 2-I	4 in Sq. 20-I	4 in Sq. 27-I
2 in Sq. 3-I	1 in Sq. 21-I	4 in Sq. 28-I
1 in Sq. 10-I	4 in Sq. 22-I	2 in Sq. 29-I
4 in Sq. 11-I	3 in Sq. 23-I	4 in Sq. 30-I
6 in Sq. 12-I	3 in Sq. 23-II	1 in Sq. 35-I
2 in Sq. 15-I	1 in Sq. 24-I	2 in Sq. 36-I
2 in Sq. 16-I	2 in Sq. 24-II	5 in Sq. 37-I
3 in Sq. 17-I	6 in Sq. 25-I	2 in Sq. 38-I

TYPE: SECONDARY FLAKES

NO. OF SPECIMENS: 708

SIZE RANGE: *Length*
Mean 4.25 cm
Standard Deviation 5.29 cm

Width
Mean 4.25 cm
Standard Deviation 4.79 cm

Thickness not taken.

DESCRIPTION: *These flakes have their dorsal surfaces covered with more than 0%, but less than 100%, cortex.*

MATERIAL: *3 Granitic, 4 Quartzite, 1 Chert, 700 Beaver Creek Quartzite.*

DISTRIBUTION:

6 in Sq. 1-I	6 in Sq. 17-I	36 in Sq. 28-II
12 in Sq. 2-I	18 in Sq. 18-I	6 in Sq. 29-II
2 in Sq. 2-II	9 in Sq. 19-I	35 in Sq. 30-I
8 in Sq. 3-I	27 in Sq. 20-I	12 in Sq. 31-I
4 in Sq. 3-II	15 in Sq. 21-I	8 in Sq. 32-I
2 in Sq. 5-II	33 in Sq. 22-I	9 in Sq. 32-II
1 in Sq. 8-I	22 in Sq. 23-I	5 in Sq. 34-I
25 in Sq. 10-I	11 in Sq. 23-II	4 in Sq. 35-I
3 in Sq. 10-II	23 in Sq. 24-I	23 in Sq. 36-I
44 in Sq. 11-I	11 in Sq. 24-II	45 in Sq. 37-I
1 in Sq. 11-II	42 in Sq. 25-I	6 in Sq. 37-II
48 in Sq. 12-I	3 in Sq. 25-II	12 in Sq. 38-I
15 in Sq. 12-II	22 in Sq. 26-I	2 in Sq. 38-II
1 in Sq. 14-IV	28 in Sq. 27-I	1 in Sq. 39-I
4 in Sq. 15-I	35 in Sq. 28-I	
11 in Sq. 16-I	12 in Sq. 28-II	

TYPE: NONCORTEX FLAKES

NO. OF SPECIMENS: 2117

SIZE RANGE: *Length*
Mean 2.46 cm
Standard Deviation 3.33 cm

Width
Mean 2.79 cm
Standard Deviation 6.98 cm

Thickness not taken.

DESCRIPTION: These flakes have no cortex remaining on their dorsal surfaces.

MATERIAL: 2 Granitic, 12 Quartzite, 2103 Beaver Creek Quartzite.

DISTRIBUTION:

15 in Sq. 1-I	4 in Sq. 15-II	12 in Sq. 28-II
114 in Sq. 2-I	42 in Sq. 16-I	56 in Sq. 29-I
4 in Sq. 2-II	14 in Sq. 17-I	13 in Sq. 29-II
51 in Sq. 3-I	33 in Sq. 18-I	149 in Sq. 30-I
2 in Sq. 5-I	80 in Sq. 20-I	43 in Sq. 32-I
1 in Sq. 7-II	54 in Sq. 21-I	51 in Sq. 32-II
1 in Sq. 8-II	93 in Sq. 22-I	1 in Sq. 33-I
81 in Sq. 10-I	94 in Sq. 23-I	10 in Sq. 34-I
25 in Sq. 10-II	38 in Sq. 23-II	6 in Sq. 35-I
139 in Sq. 11-I	71 in Sq. 24-I	58 in Sq. 36-I
2 in Sq. 11-II	20 in Sq. 24-II	96 in Sq. 37-I
156 in Sq. 12-I	108 in Sq. 25-I	18 in Sq. 37-II
28 in Sq. 12-II	7 in Sq. 25-II	42 in Sq. 38-I
3 in Sq. 14-III	45 in Sq. 26-I	5 in Sq. 38-II
1 in Sq. 14-IV	69 in Sq. 27-I	1 in Sq. 39-I
4 in Sq. 15-I	74 in Sq. 28-I	
14 in Sq. 3-II	39 in Sq. 19-I	30 in Sq. 31-I

TYPE: BIFACE THINNING FLAKES

NO. OF SPECIMENS: 50

SIZE RANGE:

Length
Mean 3.53 cm
Standard Deviation 9.44 cm

Width
Mean 4.17 cm
Standard Deviation 3.35 cm

Thickness not taken.

DESCRIPTION: These flakes exhibit characteristics indicating that they were taken off a bifacial lenticular object such as a biface. These characteristics include a curved longitudinal section, a platform which is often a segment of an edge showing bifacial work, a dorsal surface which often shows flake scars resulting from thinning flakes being removed from the same margin as well as from the opposite margin.

MATERIAL: Beaver Creek Quartzite 50.

DISTRIBUTION:

9 in Sq. 2-I	3 in Sq. 22-I	2 in Sq. 31-I
1 in Sq. 2-II	2 in Sq. 23-I	1 in Sq. 32-I
3 in Sq. 3-I	1 in Sq. 23-II	2 in Sq. 32-II
2 in Sq. 3-II	1 in Sq. 24-II	1 in Sq. 34-I
1 in Sq. 7-II	1 in Sq. 25-I	2 in Sq. 35-I
5 in Sq. 10-I	1 in Sq. 25-II	3 in Sq. 37-I
3 in Sq. 11-I	2 in Sq. 27-I	1 in Sq. 38-I
2 in Sq. 17-I	1 in Sq. 30-I	

TYPE: NONDIAGNOSTIC SHATTER/PROXIMAL END FLAKE FRAGMENTS/ DISTAL END FRAGMENTS

NO. OF SPECIMENS: 26,814

SIZE RANGE: No measurements taken.

DISCRIPTION: This "type" includes:

(1) NONDIAGNOSTIC SHATTER, which are unclassifiable debris resulting from the process of manufacture of stone tools. They have neither striking platform nor bulb of force and do not have attributes that indicate they can be classified as either flake or objective piece fragments.

(2) PROXIMAL END FLAKE FRAGMENTS, which are fragments of flakes which retain both the striking platform and the bulb of force but are without a terminal end.

(3) DISTAL END FLAKE FRAGMENTS, which are terminal ends and mid-sections of flakes.

MATERIAL: Quartzite 60, Chert 8, Seam Quartz 3, Granitic 28, Beaver Creek Quartzite 26,714.

DISTRIBUTION:

183 in Sq. 1-I	1123 in Sq. 21-I
3 in Sq. 1-II	1221 in Sq. 22-I
1604 in Sq. 2-I	1324 in Sq. 23-I
20 in Sq. 2-II	482 in Sq. 23-II
529 in Sq. 3-I	1014 in Sq. 24-I
161 in Sq. 3-II	166 in Sq. 24-II
2 in Sq. 5-I	1116 in Sq. 25-I

1 in Sq. 5-II
9 in Sq. 8-I
2 in Sq. 8-II
1 in Sq. 9-I
701 in Sq. 10-I
210 in Sq. 10-II
2138 in Sq. 11-I
23 in Sq. 11-II
1749 in Sq. 12-I
171 in Sq. 12-II
3 in Sq. 13-I
4 in Sq. 14-I
18 in Sq. 14-II
7 in Sq. 14-III
8 in Sq. 14-IV
1 in Sq. 14-V
50 in Sq. 15-I
26 in Sq. 15-II
249 in Sq. 16-I
161 in Sq. 17-I
515 in Sq. 18-I
282 in Sq. 19-I
1063 in Sq. 20-I

95 in Sq. 25-II
777 in Sq. 26-I
876 in Sq. 27-I
1349 in Sq. 28-I
261 in Sq. 28-II
867 in Sq. 29-I
231 in Sq. 29-II
2244 in Sq. 30-I
328 in Sq. 31-I
251 in Sq. 32-I
231 in Sq. 32-II
6 in Sq. 33-I
213 in Sq. 34-I
52 in Sq. 35-I
1013 in Sq. 36-I
1171 in Sq. 37-I
41 in Sq. 37-II
400 in Sq. 38-I
12 in Sq. 38-II
3 in Sq. 39-I
20 in Sq. 39-II
27 in Sq. 39-III
6 in Sq. 40-I