TECHNOLOGICAL TRAITS

Typology includes both form and surface techniques and there are four separate typological categories inherent in classifying artifacts into types. They are form, technological traits, function, and also the distribution in time and space. This paper will be concerned with the technological traits of the aboriginal peoples, and their relationship to typology. It would be difficult for any one person to conduct experiments on all core and flake types or to understand fully all the permutations of the features that go into the making of cores and their flakes and blades. But we can broaden our knowledge and resolve certain types by a careful study and analysis of flakes, blades and the debitage resulting from their manufacture. This analysis is basic to a concept of technological studies and is far too often overlooked as a factor of flake, blade and artifact analysis. It is a consideration of the debitage flakes found at the occupation site and the relating of this waste material to the stages of flaking techniques required to produce the desired size and type of flake, blade or artifact. Admittedly, debitage flakes are not as glamorous as the stone tools or cores, but they can be just as interesting and can furnish information not found on the core and the artifacts. The core or artifact usually shows only the last stage of its several steps of manufacture whereas the waste flakes can give clues to the primary, secondary

or intermediate steps of fabrication. The very presence of cores in tool typology is mute evidence of the importance of flake scar study. They are ~~certainly not a~~ not considered tool, (unless they show functional scars), but they are of prime importance in typology for the express purpose of studying the scars and technological features to resolve the tool types of their flakes and blades. Debitage flakes can be equally important.

In the Americas, where we have a great absence of cores, it is not only recommended but almost imperative that we resolve the core techniques by analyzing and mentally if not actually reconstructing the cores from the flakes and blades if we are to ultimately postulate the type of core with which they are compatible. Conceivably, a shortage of raw material forced the ancient stoneworker to reduce his core to a minute, unrecognizable or insignificant size and it is possible that this same lack of stone prompted the modification of these exhausted cores into tools such as wedges, scrapers, and other cutting implements. Pebble tool industries, ~~no doubt~~ undoubtedly, developed because materials larger than pebbles were not available. Even though we rightfully regard cores as basic in the study of the toolmaking industry, they represent only the residue of discard debitage to the prehistoric stoneworker. He was not concerned with their weight, beauty, or form, and he made no real attempt to keep them uniform

other than that required to successfully remove a flake or blade of the desired width, thickness and length. To the stoneworker, the core was the nuclei, the waste product, and he had no though for their regularity or uniformity. His efforts and aims were on the detaching of flakes and blades. But, since his needed blade type required certain consistency in flintknapping techniques, he ultimately produced a uniform core type. In other words, the design of the blade or the flake which was pertinent to different cultures, geographical areas, and economies determined the type and design of the core. This, of course, is what makes core study so important and contemporaneous with the movement and age of man. It also points out the need for careful study of the debitage flakes and for core reconstruction, when none of the cores are found at the site.

Because of the nature of the material being worked, and the human element of change and error involved, there are many variables and, therefore, stereotypes of flakes and artifacts cannot be expected but we can look for consistency. Consistent differences reflecting minor and major changes in techniques of flake and blade removal can be noted when the flakes are separated into the stages of their taxonomy. Each stage will readily demonstrate the rhythm attained by the worker and then there will be a greater consistency of flake

types. Categories, similarities, and like attributes will show the development of patterns which will denote the phases and stages of the part they played in the development of artifact types which will greatly assist in the interpretation of their cultural traits. Because of these slight variations and variables, the flakes should not be appraised individually but rather by the manifestations of their traits and techniques. Flake tool industries are represented by residue and debitage of the various stages of development of the artifact from the initial break of the raw material to the completed implement. The quantity and size of the flaking residue will normally be proportionate to the distance from the source of raw material. Should the archaeological site be of some distance from the source of raw material, then several stages of manufacturing are apt to be absent. This is due to roughing out, blanking and preforming of the artifact at the quarry. In this case, the flakes representing these phases of tool manufacture will occur in the proximity of the material source. These unifacially and bifacially worked preforms found at the quarry are generally made by direct percussion using the core technique. Cores may be derived from large tabular or primary flakes, sections or parts of nodular forms, or simply from parts of cobbles derived from alluvium. An occupation site located near a large quarry is more

likely to have flakes representing all phases of their particular techniques of manufacture. Populations of cores are usually limited to areas abundant in lithic materials for ~~But~~ when materials for flake and blade removal had to be transported a great distance to the occupation zone, the core was normally consumed, until there ~~apparently~~ remained only a bare and unrecognizable remnant of the original piece of material. In this case we must attempt to resolve the core type by relating the flakes. Flakes and blades have certain identifying characteristics, which make it possible to reconstruct the core to which they are pertinent. ~~By the~~ study of aboriginal cores and ~~their~~ flakes, ~~one~~ will ~~be able to~~ resolve core types from the flakes alone. The study of cores and their stages of development is usually difficult, ~~for~~ the core was designed to produce flakes and blades ~~and, therefore~~, would be consumed in the process. Unless the aboriginal was interrupted and his unfinished work ~~was~~ abandoned ~~or broken~~, it is unlikely that the evolution of the core would remain. Therefore, at best, one must generally base his conclusions on the exhausted or malformed cores and flakes. It is rare indeed to find a great population of cores such as Francois Bordes found this year at Corbiac (about 1000) of the upper Perigordean (Personal communication November 6, 1966).

On the other hand, most literature shows great populations of flakes of

blades with small proportions of cores (J. Radley and P. Mellers, 1964 Proceedings of the Prehistoric Society. A Mesolithic Structure at Deepcar, Yorkshire, England. 23,000 flakes and 17 cores were found). By comparison of their diagnostic attributes, flakes are determined to be similar, or the same, and then one may select one or two as being representative of form and technique. Studying flakes and ultimately relating them to various tool types will indicate the cultural technological traits in modes of manufacture and will greatly assist in obtaining a sharper definition of a complex in a cultural area. The debitage flakes from the making of just a single artifact may number several hundred whereas the artifact is often considered individually without placing too much emphasis on the surface flake scars. But, even when these surface scars are evaluated, they usually cover only the last stage of fabrication whereas the debitage flakes which occur in conjunction with this would give us the true picture. The flake is far more useful in determining the technique than the flake scar, for the platform and part of the original lateral edge of the artifact was removed with the flake. Although the flakes removed from the artifact can be uniform, they may leave scars on the surface that are multi-directional. Uniformly flaked artifacts bear scars that appear to duplicate artifact types, but in reality there is no exact facsimile.

There are duplicates in technological traits but there is no exact duplicate artifact. Like fingerprints, each is distinct and a mould of one artifact, no matter how similar, would not fit the mould of another. The elements involved in manufacture are not that sterotyped and the human margin of variation is too great. Analysis of the flakes will show a greater consistency of form and attributes for it is only necessary to consider one unit rather than the composite units that compose an artifact. It will be much easier for a student to separate flakes into different technological categories than to type artifacts if he ~~is to~~ considers the surface character of the artifact together with the form. The projectile point forms are probably the most consistent of the flaked artifact types, but they too vary with the whim and needs of the maker. While their dimensions are variable their mode of manufacturing is generally constant. An outstanding and well-known example of the variation in form but consistency of technique are the points found at the Bison Kill site excavated by Dr. Joe Ben Wheat (Olson-Chubbuck). This site yielded a large population of unbroken and mint condition projectile points and was devoid of the discards and debitage usually found in zones of occupation. The flaking technique of these points was consistent and uniform with only slight variations, yet they vary in size and form. Unfortunately,

we do not have enough occurrences of these finds for they are a fine example of what actually went to the field and they furnish much knowledge regarding technology and typology. Because of their unique mode of manufacture and because they are in mint condition, a thorough analysis of this collection should resolve the consistency of flaking techniques and the variation of form and size.

(2) This paper is intended to assist in separating flakes and blades for the purpose of relating them to cores and techniques by interpreting their mode of manufacture. My experiments carried out over the past years have afforded a basis for some conclusive evidence regarding the mode of manufacture. Hopefully, these experiments will shed some light on the aboriginal lithic industries and will point out the magnitude of flake study due to the vast quantities of debitage. As more flake assemblages are analyzed in different geographical regions and related to different periods of time, the need for such a study will become apparent. My attempts at replicating flakes and cores have shown that materials, muscular motor habits of the worker, distinctive traits, human behavior patterns, evolution and phylogeny, conscious planning, traditional development, outright invention, pride of workmanship, and the need for superior tools provides an insight into the lives and economy of the

prehistoric people who skillfully fabricated stone tools necessary for their existence. My attempts to replicate the tools of this very complex industry has increased my respect for the earlier worker's achievements and for prehistoric mans' knowledge of materials and their sources. He had unbelievable control of muscular coordination; an ability to visualize the artifact within an irregular block of stone, understood how to overcome the mechanical and physical problems necessary to produce a useful end product, and he had a consistent and precise ability to calculate angles for projecting forces of variable intensities. These are just a few of the items to be considered when appraising the past stoneworkers unbelievable accomplishments. This text will attempt to portray the results of these experiments and to project the need for additional research on types not yet fully understood. Those not fully understood will be hypothecated on the basis of conclusions drawn from varied experiments and possible techniques will be postulated. These experiments have proven that before final judgement or analysis can be made one must replicate both core, flakes and blades in all aspects and characteristics, and unless a replica of the original can be duplicated many times by the same technique, one can go far afield with theory alone. There are definite laws of physical and mechanical properties of materials, and

applied force which remain constant and if aboriginal ~~results and those that result from experiments are the same~~ then we may conclude that the techniques used will be much the same.

The people who adopted the core and blade traditions most certainly recovered all flakes and blades which conform to their needs and, therefore, those found usually are aberrant, malformed or those which broke as they were removed from the core. Such populations of useable flakes, other than trimming, retouch and modification debitage, cannot be expected, other than an accidental occurrence, for the flakes were removed from the core for a functional purpose. It is from a reconstruction of these waste flakes and blade assemblages that the end product can be evaluated.

An infinite variety of core, flake and blade forms must be considered to separate the techniques used over a great span of both time and space. It is the writer's feeling that by flake study certain types of flakes will be pertinent to only certain groups of people in certain periods of time and certain geographical areas.

The first and basic step of working isotropic stone either by percussion, indirect percussion, or pressure is the ability to control the fracture of the material. THE PAST ARTISANS IN NO WAY STRUCK IMPLUSIVE BLOWS, AND ONLY AFTER

CAREFUL PREPARATION OF SURFACES AND ANGLES, WAS THE BLOW DELIVERED WITH CONTROLLED, CALCULATED, AND METICULOUS PRECISION. Before the experimenter starts to remove a flake from a core he must understand that detachment is not accomplished by indiscriminant random blows, but is the result of a preconceived design of the flakes. The worker must have control of muscular motor habits and must deliver the pressure or percussion force with extreme accuracy. Any carelessness or miscalculations in detachment will result in a hinge or step fracture causing the artifact to be malformed or useless. The superb examples of aboriginal work reveal not a bag of tricks but an intensive knowledge of materials that lend themselves to stone toolmaking and a splendid display of mental and muscular coordination. ~~Before an analysis of a flake is made I feel one should examine the chronology of the first experiments starting from my earliest attempts at stone flaking.~~

The analysis of flakes and cores in this text will hopefully outline the variables encountered in stoneworking and show how they are overcome and controlled by different techniques. Proper flake analysis should show the development of techniques traditional with each generation and any parallelisms in development as well as other techniques which are highly specialized for particular functions.

I recently had an opportunity to study collections at Idaho State University, Washington State University, University of Washington, University of British Columbia, University of New Mexico, Museum at Victoria, Field School at Vernon, Arizona, University of Arizona, at Grasshopper Site, the Denver Museum of Natural History, site at Kersey, Colorado, and the information that gleaned from these collections has been most rewarding and pointed out to me the great need for debitage analysis. Numerous technological traits and techniques were represented. My method of a rapid survey of flake assemblages was: (1) to separate the flake parts, for only the aberrant, ill-formed and broken material was normally abandoned and, subsequently, found by the archaeologist. (2) The proximal portions of the flakes were arranged in rows with the platforms facing the sorter, for these ends provided the bulk of the information pertaining to technology. (3) Then the mid-section and the distal ends of the flakes were also arranged in a like manner. (4) The proximal ends (those bearing the platform of applied force) were then regrouped by segregating those with like platform characteristics. This involves many features which will be further explained in this text.

Flake assemblages fall into two classes, those which result from flake artifact manufacture and those which result from making flakes and blades

~~which were~~ to be used freshly struck or to be modified into tool types characteristic to blades and flakes.

It is not the intention of the writer to ~~inject the meaning~~ infer that there ~~are two~~ is a major cultural differences ~~in separating the~~ between debitage flake assemblages derived from ~~making~~ made artifacts by ~~the use of~~ the core method or by the modification of those derived from flakes or blades, ~~as~~ both techniques can be used by a single group of people and It is only important to be able to recognize these techniques when they make their appearance. However, the core method is a successful technique and decides a greater amount of debitage than does the modification of a flake or blade

~~For the~~ purpose of analyzing ~~the~~ assemblages, all flakes and blades will be called flakes. although Existing literature does, ~~however~~, use the terms splinters, chips, spalls, blades, lamaller flakes, lamelles, bladelets, prismatic blades, flakes and blades, for etc. ~~There are numerous types of flake specializations. Many now existing in collections have no terminology yet they could have considerable diagnostic values in the interpretation of technological traits.~~ At present, the only separation of flakes seems to be blade-like forms yet there are numerous technological techniques + flake specializations used to remove blades from cores. The term "blades" encompasses a vast array of flakes with parallel sides with "their length being two times their width" (Francois Bordes, Les Eyzies Conference November 1964). Individual analysis of such assemblages will

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At present, The two technological patterns, of flakes & blades appear at the present to be their mode of manufacturing and the refinement in which they are made. One of their production. canot separate flakes and blades according to whether their mfg was by pressure or percussion was used to make them but must be careful to evaluate the techniques. and even then there will be a blanding of form when form alone is used. shape alone is used to separate flakes & blades Size is also a factor to be considered should also be as both percussion and pressure flakes may range from the most dimunitive to the more massive these from Meso-america which are #### as much as an inch wide and eight inches long may be and made by the use of pressure. ## Blades such as these have a consistancy yet are in form with two or more previously removed Blade scars, running in the same resulting from previous blade removal on the direction on the dorsal side and are complete tools within themselves, or longitudinal axes They they can be altered into geometrics, microburins and other forms characteristic of blades.
Their preparation and removal represent a varity of technological traits. pressure
(see Polyhedral core paper)
The old World blade forms are much the same in shape but forms of percussion as the prismatic blades

techniques , such as indirect percussion were propably predominant in their

making. Normaly blades are thought of as being the result of considerable considered to be the result of a refined
refinement and of a definite form while others consider ######long narrow techniques of but some classify

parallel and
flakes with sub parallel sides to be blades. There are specialized flakes

removed by simple direct percussion that would techn ologicaly be blades could

but without the refinement of form shown in the exaxting preparation and which is the result of they lack care

between the blade & indiscriminate blade making
and removal, so there can be no sharp lines of demarkation. Their main differences method of The

are technological ones.

readily demonstrate that they fall into two technological patterns which are distinctive to that group alone. Future study will no doubt indicate certain parallelisms and traditional traits in flake stone technology.

A flake and blade (specialized flake) industry represents specially formed flakes removed from cores - the flakes being used freshly struck or modified into artifacts. Blade making techniques are various and involve different types of core preparation from the simplest to the more refined. Blades can be used without modification or retouched by pressure flaking. Large flakes and blades are sometimes preformed by percussion into knives, projectile points, etc. When smaller flakes are to be modified into a projectile point, the flake is straightened by removing the bulb of applied force on the ventral side of the flake and by trimming the distal end of the flake ~~is also trimmed~~ on the ventral side until the longitudinal axis of the flake is straight. This is usually done by the pressure technique. Most pressure flakes are crushed during their removal and, therefore, will pass through the sifting screen at a dig. Cores which result from flake and blade making are sometimes utilized as core tools or can be reduced to useable flakes. Therefore, discarded well-defined cores cannot be expected unless there is an unabundance of raw materials near at hand. An exception to this is the microblade cores of the Artic. Some well-defined cores are found there for the worker removes

microblades until they were so small there were practically no room to seat his tool and, therefore, he discarded his core. So sometimes the very technique can determine whether or not cores were left at a site.

Experiments in replicating the aboriginal flake stone artifacts has indicated that they fall into two basic classifications. Artifacts which are themselves cores, and artifacts made from flakes and blades removed from cores. Making artifacts from flakes is a more economical industry than the core type tool for it leaves very little waste. Flakes and blades are removed from a mass of material (core) by applying force on a predetermined definite surface area which is to receive the applied force will be known as a platform and its design has a direct bearing on the type of flake or blade removed from the core. The raw material sometimes determines which technique will be used to remove flakes or blades. Materials must respond under the application of force in such a manner that portions of the material may be detached in any direction. This quality in material is known as isotropism. Removal of raw material must include control of the width, length and thickness of the flake, and the applied force must follow the desired direction of the worker.

The simplest core form is a piece of material bearing a flake scar. This embryonic stage of core development could go unrecognized but, nevertheless it was able to provide substance for usable flakes. Most cores have more than one flake scar which are usually characterized by a negative bulb of force at the apex. The removed flake retains the platform and the bulb of force but the scar left on the core indicates the order of flake removal. When a cobble is severed by force delivered by a hammerstone, the portion bearing the bulb of force will be the flake part and the half bearing the negative bulbar scar will be the core. There is one exception to this rule and this is the absence of a bulb on either part of a severed cobble. This is accomplished by a special technique which results in the splitting of the cone of force. When the cone is split, both halves will have duplicate features. This special technique occurs rarely and is usually associated with pebble and cobble industries and core rejuvenation. Normally, the flake will be smaller than the core for the core must be heavier and more massive in order to provide sufficient inertia to remove the smaller flake.

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The use of the core as a source of blades, or flakes, is an indication of man's first economy for it provides quantities of usuable flakes either modified

or unmodified, whereas the artifact made by the core method provides only a single tool and much waste material. Since both artifacts and cores bear flake scars it is sometimes difficult for the analyst to determine whether it is a core or a tool. For example, a chopping tool is the core remnant and under certain conditions could be mistaken for a core or vice versa. A case in point is the so called cores from the Shoop Site. These were identified by John Whitoff as exhausted cores and, in fact, could be confused as such. But at the Lez Eyzes conference November 1964 it was termed by both Europeon and American archaeologists that they were "Piece Esquilles". They are, in fact, a core tool but not an exhausted core. The normal conception of the core is a mass of material used for making blades and flakes and the residue or remnant of this mass is the core. A notched projectile point couldn't look less like a core, yet a core it is. Exhausted cores, or cores which had the flake removal operation either suspended or discontinued were sometimes used as functional tools such as pulping planes, or they were sometimes converted into hammerstones. Cores defined as having been used as a tool should be appraised very carefully before they are typed. The leading edges should be examined for wear patterns and functional scars, for there are instances of a similar surface which is produced when preparing platforms for

subsequent ~~series of~~ flake removal. Grinding and removing the overhang left by the last series of flakes ~~and grinding~~ are technological traits used in certain techniques and ~~can~~ could be mistaken for functional scars or abrasions.

Core forms are endless, yet they play an important part as a diagnostic trait and they demonstrate many technological differences. Many are difficult to recognize ~~as cores~~ as cores when they were worked down to a small unfamiliar form. Some sites are distinctive because ~~of the~~ there is a complete absence of cores, yet ~~from~~ the flake discards ~~we know that cores were present at the time of occupation.~~ indicate detachment from cores. Generally this denotes a shortage of material and the worker ~~reducing~~ is need to reduce the core to the last usable piece of material. In this case, flakes and blades will have to be evaluated and the core reconstructed from the diagnostic features which the flakes and blades reveal.

Since all man's acts are by nature inquisitive with ~~the~~ a natural and inboard urge or motivation, a relationship between ~~that~~ the lithic technique of early man and my experiments will have certain parallelisms. ~~In order to replicate early man's stone implements must conceive his methods without regressing into time to ask themselves what did he do and how did he do it.~~ The methods that I have used and the methods he would, or ~~die~~ did use, may not be concurrent, but their counterparts may have a certain amount of similarity. Before I made my first

I tried to remove usable flakes from a core eolith. ~~I began~~ by striking a piece of flint-like material with a small cobble ~~rock in order to remove usable flakes.~~ I used ~~The first results using~~ direct free-hand percussion which resulted in battering and bruising and ultimate shattering my piece of flint. ~~The~~ My core, ~~as such~~ was not even recognizable and The flakes lacked style and uniformity ~~or style.~~ However, several ~~pieces~~ flakes in this shattered mass ~~did have~~ had sharp cutting edges ~~that could have been used for~~ and could have served as tools but they would not be recognized as such by an archaeologist. When ~~this repeated striking with a~~ I continued using the hammerstone ~~was continued~~ in direct freehand percussion over a considerable period of time I ~~would~~ accidentally removed a few good flakes. Then, by studying the conditions ~~that brought about~~ which accomplish ~~its~~ this removal, such as the correct amount of force, the vector of striking angle, the character of the ~~point of~~ impact and the surface of the stone on the dorsal side of the flake, ~~one~~ I could ~~then look for~~ determine the ~~same~~ conditions ~~to make a~~ which produced a replica flake. But These conditions must be firmly resolved in the mind of the stoneworker before he ~~can graduate into a class of~~ became a good eolith maker. These first futile attempts in stoneworking stoneworking did, however, produce flakes and cores even though any refinement was sorely lacking. Since these first ~~embryonic~~ efforts some 40 years ago to remove a flake from a core ~~some forty years ago~~, certain ~~inferences~~ conclusions have been reached regarding the mechanical laws pertinent to ~~may be drawn regarding core types relative to mechanical laws relating to~~ isotropic materials and relating them to core types. ~~isotropic materials.~~ The ~~inherent nature of these~~ isotropic materials causes ~~definite~~ When working isotropic material, their inherent nature causes definite patterns in flakes and cores. Upon appraisal, these characteristics may be

related to various techniques and these techniques corresponded to certain people in time and space.

Before one can explain cores and flakes, one must understand what is happening when force is directed against a mass of flint-like material. Making of cores, blades or tools, may be compared to a game of chess, or checkers, for one must keep at least one move (and sometimes several) ahead of the proposed flake removal. Allowing a flake to step or hinge fracture will ruin the core or artifact. In spite of the best of coordination, a failure can result from a slight miscalculations, undetected flaws in the material, a crushed platform, the slightest angle change of either the artifact or the flaking implement, and the improper dampening of force. It is doubtful if there are any perfect examples of the more complex artifacts, Even the classic examples of the Danish and the Egyptians, show slight miscalculations of the workers. The human margin of error makes it almost impossible to fabricate a perfect stone artifact. This statement will probably raise a few eyebrows but minute examination of specimens will reveal minor flake scar distortions, or insignificant step-fractures. The making of flint tools is not the manifestations of a long line of ancestors, but the result of each new generation trying to improve the product. With an experienced teacher and an apt and

the ~~foregoing~~ following text will attempt to enlighten the interested student in the cause & effects of force & Materials

When force is properly applied against a flint like mass - the objective piece will fracture but the worker must control the ~~force~~ direction & amount of force in order to ~~produce~~ remove ~~the~~ surplus material from the artifact or flake at the point end of the thickness & shape he has predetermined. This is the basis for the many & diverse ~~stoneworking~~ techniques.

When force is properly applied against a flint-like mass, the objective piece will fracture. However, the worker must control the direction and amount of force to successfully remove surplus material from an artifact or detach a flake or blade from a core

When force is properly applied against a flint-like mass, the objective piece will fracture. However, to successfully remove surplus material from an artifact or to detach a flake or blade from a core, the worker must control the direction and amount of force. He must be able to terminate the force at a predetermined point and remove flakes of the desired thickness and ~~shape he desires~~. This is the basis for the many and diverse stoneworking techniques.