85. The flakes that show the rhythms and consistency of patterns & techniques.

1) Material Identification: The first step in the appraisal of flake assemblages is an evaluation of the material from which the flakes were made. Postulate the distance of the material from the source. What are its diagnostic qualities? How does it compare to materials from other well-known sources? How many varieties are represented in a site? The occurrence of material may be indicated by the altered outside surfaces found on the dorsal side of the primary flakes. The natural surface may denote bruising, abrading and cratering typical of alluvium. Natural surface can indicate that the material was quarried or natural breaks found in ledges, lodes, fault zones, bearing the mold markings of vesicular cavity. Organic replacements will indicate the material formed in sedimentary deposits. Concretions from flint will indicate the whereabouts of limestone and dolomite. These are but a few of the clues found on flakes that may indicate the occurrence and aid in locating the source. Detailed studies of material that were used in lithic industries hold much information regarding the movements of man through time and space, as each material bears impurities that are characteristic to that material alone. Such a study will ultimately aid in resolving the moving by man of these materials from their source to their final destination and their paths followed even though cultural tool forms are not in evidence. (See materials paper.)

2) Texture of Material: The texture of the material is a most important con-

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sideration when one is determining the quality of the material modes of manufacturing. The quality of the artifacts cannot exceed the quality of the material, regardless of the knappers' skill. The materials range from the glassy to the granulose, and the more granular varieties can result in inferior types of flakes and artifacts. The techniques must be adapted to the materials. Fine definition of flake attributes are usually erased in the coarse-grained rocks. The platforms crush more easily and the flakes or blades will collapse before they terminate at the distal end of the core. The flakes haven't the resistance to shock and a greater amount of applied force is necessary to remove them from the core. The use of direct percussion with a hard hammerstone to concentrate the kinetic energy to a confined area is usually necessary to fracture the coarse-grained materials. The more vitreous the material the greater the control, the sharper the cutting edge. A decreased amount of force is required to remove a flake of equal area compared to the granular material. Vitreous material has elastic qualities not found in the granulose rocks allowing the flakes to bend without breaking. I do not intend to imply that coarse-grained materials are not important to the economy of many ethnic groups, for they did play an important part. Sometimes they were even preferred to some of the more vitreous rocks because the flakes struck from the coarse textured rocks were most usable for certain functional needs. Such flakes serve admirably for sawing, and carving, forming materials of wood, bone, antler, shell and soft stone. These materials

may be severed and shaped with surprising and astonishing speed when using a tool made of the more vitreous coarse-grained materials which is not found with coarse-grained materials. A simple field test should be done by actually flaking questionable material before any final decisions are made regarding the workability of a particular mineral.

3) Material altered by thermal treatment: Certain siliceous materials will respond to an artificial vitrification by the application of heat. The change occurs upon the temperature being slowly raised to around four or five hundred degrees. The material will withstand considerably more heat than this but the change actually starts taking place above noted temperatures. Different materials require different temperatures to effect the alteration. All materials do not respond to the same heat. The alterations of these materials is an exacting practice requiring a thorough knowledge of the material being altered (Crabtree and Butler, Tebiwa, Vol. 7, 1964). In order to determine if the flake has been altered before a final judgement. After heating the surface of the material remains unchanged and one must remove a test flake from the mass to determine the alteration. To be positive thermal treatment was practiced, a flake of suspected material must be found which bears a flake scar on the exterior surface, the dorsal side

that still retains materials or original texture prior to heating. The ventral side of the flake or flakes removed from the piece of altered material will have a distinctive lusterous character pertinent to thermal treatment which is not present on the original surface. Should a flake be detached after all the surface of the treated core has been removed, then it will be lusterous on both dorsal and ventral surfaces. A flake such as this is not reliable but only suspect as there are few materials that have natural vitreous luster, however, they are limited, occasionally abandoned heat-treated flakes will be noted which will still retain their original luster, but occasionally close examination will reveal small flake scars on their margins which show the change of luster. These small flake scars may be the result of the aboriginal testing the material to see if the heat application was sufficient. A simple field test is accomplished by removing a small flake and then examining the scar to determine the difference in texture. If the material is heated over a long period of time, the trace minerals will be subject to oxidation causing yellows to become red and other color changes, depending on what mineral impurities were present in the material being heated. Flakes will be observed which have been overheated resulting in crazing, potlidding, and occasionally complete disintegration. These are relative infrequent considering the exacting control necessary to preform this alteration.

4) Relation of material to flakes: The character of the flake has a direct relationship to the material being used for glassy rocks and well defined

attributes and characteristics that greatly assist in flake analysis. Each feature is quite obvious. These features are not readily found in the more granular materials. The knapper must make the techniques suit the material and the tools used to remove the flakes must also conform with the materials. Flakes made from tough, granular, [illegible] material naturally require a greater amount of applied force than the vitreous materials and, therefore, the impact area must be of sufficient size to withstand the additional force necessary to dislodge the flake. The platform on the proximal ends of the flakes will be larger when simple direct percussion is applied with a hard hammerstone. Normally, upon using the coarse textured materials there is not the careful platform preparation which is applied to the vitreous rocks. The freeing, or isolation of, the platform in the granular rocks reduces the amount of material that will receive the force and increases the chance of its collapse. No amount of skill can transform a granular textured material into the refined artifact which can be made from vitreous material. But, the lack of skill can reduce high quality material to an inferior artifact.

5) Amount of applied force: The amount of applied force may be related to the area measured on the ventral side of the flake, or on the flake scar itself. The amount of force is also contingent on the type of material, being fractured. The more granulose the material, the greater the amount of force required to dislodge the flake. The amount of force must be carefully controlled and the mind

must direct the muscles, to deliver the force to respond to predetermined intensities and velocities. Also, the eye must direct the muscular coordination to implant the force at a predetermined point on the material being worked. Because the variable amounts of force required to sever or detach portions of material of different dimensions, the ratio of force must be mentally calculated. The last series of numerous flakes of the same dimension removed from an artifact or a core will show that the intensity of the applied force was delivered in a uniform manner. Such a series of blades or flakes demonstrates the control and concentration of the mind directing the muscles to respond uniformly. Control of the applied force on ideal materials is one of the basic principles of flintknapping.

6) Kinds of applied force: The kinds of applied force are the key to the development of the independent techniques. The need and desire to make flakes of certain dimensions require the invention of different methods of applying force, whether by pressure or percussion to make a flake of a certain form. The force must be transmitted to the material by incorporating several techniques. These techniques are combinations of tool types, velocities of force, dampening of force, angles in which force is applied and the method in which the material is supported. All have a direct bearing on the detached flake. Certain combinations of methods will make similar flakes, however, variation in techniques will make minor but consistent differences in the resulting flakes. These differences will be useful

in separating pertinent cultural traits.

7) Methods of Applying Force: The methods of applying force usually fall into three major types, (1) percussion, (2) indirect percussion and (3) pressure. ~~Others are the use of~~ using the pressure implement ~~with the aid of~~ ~~a~~ by percussion. ~~In the~~ Egyptian ~~method of retouch accomplished by~~ technique of pressing the percussor on the edge of the artifact ~~to be retouched~~ and then striking both percussor and ~~the~~ artifact against a wooden anvil. This ~~drove~~ purportedly drove the retouch flake toward the anvil, thereby removing the retouch flake by ~~bi~~directional forces. This is a variation of the ~~bipolar~~ bipolar technique. Methods of applying force are ~~variable~~ numerous and ~~numerous~~ variable and the use of these methods results in a variety of flake forms and ~~their~~ scars. ~~These variations are the result of the methods of applying the force.~~ There may be ~~In some cases there will be~~ parallelisms of techniques which ~~will~~ appear to duplicate and converge, yet minor and major features will be represented on the flake ~~more~~ to a greater extent than on the flake scar. ~~These features are~~ This is due to ~~the~~ methods, materials, types of force, and the implements used to transmit the force. ~~The~~ Forces ~~will~~ range from a very sharp impact to gradually applied pressure. Pressure requires ~~much~~ greater ~~force~~ energy than percussion does ~~because~~ for a blow delivered by percussion is increased by the instantaneous conversion of potential energy to ~~dynamic~~ kinetic energy.

Aboriginal man instinctively took advantage of this feature and ~~over extended~~ concentrated stress & strain on the raw material by over-extending the elastic limits of the stone to the point of fracture.

the elastic limits and concentrated stress and strains on his [redacted]g raw materials.

Experiments have shown that each technique varies the amount of required [redacted] force.

A large hammer moving at a decreased velocity can deliver the same amount of energy as a small hammerstone moving at a high velocity. The decreased velocity of a large hammerstone decreases the shock and will prevent the shattering of the lithic material. This technique uses [redacted] potential energy as a means of rapidly applying pressure. However, it has the [redacted] disadvantage of overcoming the enertia of the object being struck and propelling it with the blow. The use of a large [redacted] hammerstone at slow velocities is therefore only suitable for the more massive types of flake and blade removal. Potential energy can be used instead of [redacted]ic energy by changing the percussor from stone to materials which [redacted] such as antler, bone, wood and soft stone. The softer the material of the percussor or the percussion tool, the greater must be the velocity of the blow. Flakes and flake scars made by the use of [redacted]ic and potential energy bear diagnostic features which will be described under individual techniques.

8) <u>Throwing on an Anvil</u>: The earlier toolmakers derived their flakes by the use of percussion. There are many percussion methods and techniques to produce flakes. The simplest and probably the [redacted] initial method was by throwing a piece flint-like material against another large piece of rock until pieces were dislodged or the rock [redacted] shattered, then [redacted] recovering the pieces that retained a sharp cutting edge

But Flakes produced in this manner will be irregular in form and will show evidence of ~~much~~ shattering, and it is ~~It is~~ inconceivable that any degree of control could be gained ~~by use of this~~ with this method. ~~This method~~ It does not allow selection of ~~the~~ an impact surface and The angles on the surface of the core cannot be predetermined. neither could The amount of force necessary to ~~propel~~ propel the core ~~cannot~~ be ~~regulated~~ related to the size of the detached flake, ~~and~~ nor could contact ~~cannot~~ be made with the anvil with ~~the~~ any duplication ~~and~~ or regularity. ~~When~~ When this technique ~~is not~~ is used, both cores and flakes will contain strains and weaknesses which would render the largest ~~proportion~~ portion of the material useless. However, this method has recently been ~~recently~~ observed among the Australian aborigines by Tindale (Norman ~~Kindale~~) (South Australian Museum, Vol. 15, No. 1, Oct. 1965). This cultural trait may be ~~only~~ characteristic to the Nakako and the Ngadadjara as well as the ~~Pitjandjara~~ Pitjandjara of the great western desert. (G?, W?, D.

Donald F. ~~A.~~ Thompson writes of his experience among the Bindibu ~~Pidibu~~ and of their skillfully removing flakes from large ~~blocks~~ of material, which obviously came from ~~xxx~~ long experience and/knowledge of the stone's behavior. He stated, "we watched men carefully examine and balance each block and with a few dexterous blows convert them into what was obvious ~~the~~ sharp effective cutting tools." (Proceedings of the Prehistoric Society, 1964)

These are examples of ~~the~~ embryotic and refined techniques being used at ~~in~~ the same period of time and not separated by a great deal of geography ~~as~~ according to Tindale. ~~The~~ cores resulting ~~resulted~~ from casting ~~the~~ material, lack regular form and have a battered and a bruised surface and do

not bear the flake scars ~~which indicate~~ detachment ~~by~~ a preconceived and a ~~preplanned~~ point of impact. ~~The core residue is distinctive because of a lack of regular form.~~ On the other hand Thompson's Bidibu people have cores and flakes ~~that~~ show the selection of platforms and flakes removed in ~~the~~ regular manner plus the evidence of percussion tools.

9) Striking on an Anvil: Using the anvil as a percussor is just the reverse procedure of using a stone to strike the material to be worked. This technique involves the material to be worked ~~is held~~ in both hands and then ~~struck~~ on a large stone which is partially immobilized by ~~bearing~~ or at least secured in some manner to prevent its movement when struck by the core. This technique uses the utmost concentration of ~~cinetic~~ energy. The energy and force is condensed into the material being worked due to the stability and ~~the mass~~ of the anvil and the velocity of the object ~~is~~ propelled ~~against the anvil~~. There is a greater concentration of forces because the core is not projected ~~from~~ the application of ~~the~~ force as is ~~done~~ when the core is struck ~~off~~ by another object. ~~The~~ force applied in this ~~manner causes a distinctive break in the isotrophic material. The fracture made by the use of this technique produces no bulb of force~~, and the bulb of force is part of a cone, usually ~~the cone part being~~ well defined by the radiation of the force. ~~The use of this~~ technique causes the cone to be ~~sheared~~ and ~~is~~ bi-sected, ~~A break such as this~~ is distinctive because at the point of impact the ~~cone~~

~~widening~~ expanding circles of force make~~s~~ waves which are [redacted] accentuated and [redacted] much closer together than when the flake is removed with a hand-held hammerstone. ~~One of the experiments~~ I experimented with this technique ~~was~~ by immobilizing a large cobble which had a natural ridge on the exposed surface. This ridge was used as the contact area ~~to contact another~~ for the isotrophic cobble to be cleaved. The cobble ~~of material~~ to be bisected was held in both hands and struck vertically on the ~~end on the~~ anvil, which was a partly buried ~~waterworn tuff~~ tough granulose, waterworn cobble. The flint-like material was cleaved in two equal pieces ~~with~~ each part having a flat surface at the point ~~where the break occurred~~ of fracture; and each ~~The~~ piece ~~are~~ is well suited for cores. This technique was ~~probably~~ well understood in Mexico and probably used to make the thin flat, regular, uniform ~~in~~ thickness, flakes which were used ~~to~~ make graduated radii of obsidian for ~~their~~ neck ornaments. The surfaces of these ornaments bear the same type of rippling or ~~of~~ force circles ~~or rippling~~. ~~The use of~~ But this technique requires considerable skill to deliver ~~a~~ an accurate blow of the correct intensity and ~~at the same time mentally~~ to simultaneously calculate the ~~proper~~ correct striking angle. ~~The~~ Angles may vary ~~according to both~~ depending on the desire of the ~~manipulator~~ worker and the proposed implement. Because ~~of~~ the ~~concentration of~~ force is concentrated in such a restricted area, this technique is unsatisfactory for removing blades. There are indications that a similar striking method was used ~~in~~ to making ~~the~~ a Levallois flakes. for the Core is held in both hands and struck against an anvil stone ~~but~~ ~~But However~~ a ~~platform is~~ prepared by preparing a ridge to receive the impact on the Levallois core ~~for striking at a different angle~~, an angle ~~when one is preparing platforms on cores or cleaving materials to be used as cores~~ and it is struck at a different angle than when cleaving a cobble. This ridge provides for greater accuracy. Removing one or two flakes

from a Levallois core involves another set of principles. The platform is specially prepared to provide a ridge directly above the flake to be removed. This is established by removing two or more flakes which will produce a ridge from the dorsal side of the core to the ventral side. The ridge is isolated to increase the accuracy of the blow, so it will contact the anvil when the core is struck. In order to remove a flake from a Levallois core, the cone of force must be bisected, but the angle of the cone itself is calculated and the core is struck against the anvil in such a manner that the cone will make the negative scar on the core. This technique concentrates the force to such a degree that the Levallois flake will not flex and will be flat if the core is struck against the anvil in the proper manner. This experiment requires practice to properly prepare the core and the platform and to regulate the intensity and velocity of the force. This type of toolmaking requires an abundance of material and it is wasteful when making only one or two useable flakes. The use of a small anvil is useful when making certain types of burin-like implements from flakes and blades.

Two experiments in replicating this burin type form are as follows: the first is to select the proper blade or flake with existing flat on the lateral margin or to make one by marginal retouch. The flattened edge will be the platform to be impacted on the edge of the anvil. The angle at which the edge of the flake is struck will determine the angle of the edge to be used. The flake can then be

struck against the anvil a second time, but changing the position of the flake in using the flat surface or the scar surface made by the previously struck flake. The removal of the second flake should leave a chisel edge. The angle of the chisel edge depends on the angle in which the flake was struck. This type of burin may be made by placing the flat edge of the flake on the anvil and striking the flake with a small hammerstone to remove the second flake. However, this method usually dulls the tip. This burin technique is fast but lacks control.

The second method is to remove the burin spalls by the use of a pressure tool which will be described in detail under pressure techniques. The use of the anvil to remove flakes and make artifacts is an important method, making both flakes and simple chopper forms. No one can appreciate the difficulty encountered in removing a flake from material such as a waterworn cobble which is rounded and devoid of flat surfaces. It is difficult to remove flakes or cleave a spheroid cobble with a hammerstone. The anvil stone allows the worker to concentrate the force in a predetermined area and produce a fracture that will either cleave or remove a flake. Once a flake has been removed or an angle created, then a hammerstone can be used efficiently. Evidence of the use of this anvil technique was noted on material collected by Dr. George Charles Borden, University of British Columbia. This material was collected on the high terraces above the Fraser River and exhibited both flakes and cores made with great skill with the aid of the anvil. Some of the large

primary flakes show superb control of this technique. It is unfortunate that the very useful anvil is difficult to recognize as a tool, perhaps this is because it may be of any hard durable stone of assorted shapes and sizes. Only close examination of its surface would distinguish it from another similar stone.

Experimenting while replicating knives with the distinctive cortex backing I made use of the anvil to remove flakes from one end of a quartzite cobble rock. The original aboriginal back knife had a back surface which indicated that its origin was a waterworn quartzite cobble. My first attempts to remove flakes that resembled the aboriginal tool was by using a hand-held hammerstone. I shattered three hammerstones without breaking or removing a flake from the quartzite cobble. I then resorted to striking the cobble on an anvil. By using the anvil, a series of flakes were removed from the cobble which bore a strong resemblance to the back knife. Upon examining the core it replicated the common chopper, made on a cobble. It might be interesting to note that unless there is a sign of use on the chopper, it could very well be the core. Back knives made of coarse granular material should possibly be called saws because they are excellent for shaping and forming objects of antler, bone, wood and soft stone, yet they are almost worthless for skinning or dressing game. By using the same technique on vitreous material, the same style of flakes are suitable for a different function such as skinning and other cutting purposes.

Another use [redacted] for the anvil stone is for turning the edges of a bifacial flake stone artifact prior to thinning either by direct percussion or pressure. The anvil also serves a dual purpose for my experiments. After [redacted] the edge of the artifact is turned I abrade the edges by rubbing them on the surface of the anvil, in order to make them more resistant to crushing. This technique marks the anvil within incised parallel markings rather than bruising characteristic of the normal anvil function. The anvil is also often used as a rest for other stone working techniques.

10) Hammerstone, free-hand: A hand-held hammerstone has no doubt endured for the longest span of time in history of man's development. [redacted] It was a tool that persisted through time and space until the advent of metal. Its only modification is usually the result of use alone. A stone is selected to suit the technique for which it will be used. Some techniques demand a hard, tough material while others [redacted] require a soft material. The weight and forms are variable and must conform to the technique. The hammerstone is an implement used to cause the fracture of a pre-determined manner of material being worked [redacted] on. The hammerstone is used for all phases of stone implement-making from the quarrying to the finished form, with only one exception and that is pressure flaking.

The [redacted] hammerstone is projected to the object being worked on with two types of hand motions. One method propelling the tool in an arc and the other method in a