Another use of the anvil stone is for turning the edges of bifacial flaked stone artifacts by direct percussion or pressure. The anvil also serves a dual purpose and after the edge of the artifact is turned I abraid the edges by rubbing them on the surface of the anvil to make them more resistant to crushing. This technique scars the anvil with incised parallell markings and differed from the bruising characteristic induced by its normal function of the anvil. The anvil is also often used as a rest for other stone working techniques,

10. HAMMERSTONE (free hand)

The hammerstone has no doubt endured the longest span of time in the history of mans developement. It persisted through time and space untill the advent of metal.
Its only modification is usually the result of use alone. But the hammerstone must be selected which will conform in size and weight and form to perform the immediate technique. Some techniques demand a hammerstone of hard tough material while others require that it be of a softer variety. The weights and forms of the hammerstone are varaible and must conform to the technique . The hammerstone is the implement used to cause the material being worked on to fracture in a predetermined manner. It is used to reduce large masses of lithic material into workable pieces. With the exception of pressure flaking, it is used for all phases of stone-implement making from the quarrying to the finished form, and that is Pressure flaking. Two types of hand motion are used to project the hammerstone to the object being worked on objective piece

Ce. 35.1% 71-29

One method is to propel the hammerstone in an arc and the second striking pattern is in a straight line and each method demands a different manner of holding with two types of hand motion. Its path of flight being in an arc and in the other method is a straight line. Each type of hand motion demands reflects on the manner in which the hammerstone is held. When the hammerstone is used in the straight line technique, it is held by the thumb and the first three fingers with its base resting under the first or second knuckle. The hand stone is then struck in much the same manner as a carpenter strikes a nail with a hammer. By using the forearm impetus of the stone, and keeping the wrist rigid, the impetus of the hammerstone is converted to propulsive force. The use of the forearm and keeping the wrist rigid. The motion is in a direct line with the follow through of the hammerstone. (put at end of ppr A) The hammerstone with a curved surface is used in a manner which will force the center of the curve to strike the material being worked on. The straight line motion is used when accuracy is not required only to reduce large masses of lithic material into workable pieces or when the worker desires generally and to make thick flakes and blades. The straight line motion is more suitable for the more massive types of work and that which accuracy is secondary. When the blow must be very accurate - then the arc motion is preferred. The straight line motion is not nearly as accurate as when the hammerstone is used as an arc. When they are used, the straight line method of using the hammers tone is struck back from the leading edge of the core, for if the the hammer contacts the edge of the core both platform + flake will crush. Flakes or blades that have been detached by the straight line percussion technique, have at the proximal end several marks of distinction, one being that the top of the flake or blade have distinctive marks at the proximal ends. One distinguishing mark is the

is thick with material flaring on either side of the truncated cone of percussion. The cone part is well defined and there is usualy a scar ~~remnant of the eraillure flake~~ present on the bulb ~~of~~ percussion. ~~Should this type of a blow be struck by the hammerstone near~~ the edge of a core ~~Both flake and platform will crush. These~~ flakes show little or no refined platform preparation. ~~Elongated hammerstones used for the straigh -t line technique will only show use marks on either ends if they were used alternately. While~~ if the hammerstone is ball shaped it may bear use scars over the entire surface.

~~The technique using the arc motion of the hammerstone~~ is much more accurate for removing flakes and blades from cores, but unsatisfactory for cleaving large masses of lithic materials. ~~The arc motion uses the hammerstone in a different manner than the straight line method. It hei -ng to hold the stone~~ between the thumb and the first and second fingers. The fore arm and the hand ~~holding the hammerstone is made travel~~ in an arc. ~~The~~ hammerstone contacts the ~~object being worked~~ on its prepared edge, ~~The hammerstone~~ because of its curved surface and the way it is projected will ~~only~~ strike a glancing blow. T his type of ~~a~~ blow ~~does not permit~~ the artifact or ~~the~~ core ~~to~~ recieve the full intensity and shock of the hammerstone. ~~Upon using the hammerstone in this fashion~~

greater
~~the~~ range of accuracy ~~is greater~~
~~one has a greater range of accuracy~~, and because of the curved surface

of the hammerstone and the curved path of flight, the intensity of the

force is incresed as the hammerstone, ~~travels~~ contacts & moves accross the striking surface ~~being~~

~~struck~~. ~~The~~ tolerance is ~~perportional~~ proportionate to the amount of curvature of the hammerston

-e and the ~~arc of the blow~~ magnetude of the arc propulsion. The arc technique permits the artifact to

be moved into the path of flight of the hammerstone and ~~the preselected~~ therefore accurate

~~area of impact~~ contact on the designated point of impact. ~~to be struck much more accurately than the straight line meth-~~

~~od. The~~ shock to the artifact may be incresed or lessened by the manner

o f holding both the artifact and the hammerstone, i.e. by relaxing the hands.

or by making them more ~~#####~~ rigid. Practice, intuition and "feel" permit

the knapper to literally thrust the hammerstone into the artifact at the exact

time of impact to ~~remove the desired~~ detach a flake. ~~Such~~ This "intuition and feel" are attained ~~is gained~~ only

after considerable practice. The accuracy of arc method ~~permits the knapper to iso-~~ can be controlled and, therefore, the spoker can

~~late platforms by prepreparing projections~~ prepare platforms by isolating projections of stone to ~~that will~~ recieve the percussion force

~~of percussion, also resulting in incresed accuracy~~. increasing the accuracy. The shape of the

flakes or blades will depend on ~~contours~~ the contours of the surface prior to striking.

Both ~~The angle at which the blow is struck~~ The striking angle of the blow and the angle of the platform

will determine the termination ~~#####~~ of the flake or blade.

~~The~~ Rippling or shock waves will be governed, in part, by the material and the velocity

and thickness of the flake, ~~and the material being used~~. A hard hammer-

stone also magnifies 156 the shock waves to a greater degree than a soft one.

~~The~~ Flakes, artifacts and cores, made by percussion with the hammerstone ~~held~~ free hand, held ~~and the artifact or core also held free hand~~ are ~~apt~~ variable in form and size. ~~The many alterations are caused by a~~ These deviations are the result of constant changes of conditions. However, various stages of artifact making may be identified by separating flakes of similar character and stressing the character of the proximal ends. Certain ~~rythms~~ rhythms in the use of the hammerstone will disclose ~~traits heretofore undetected~~ definite traits, patterns & Techniques.

11

11, HAMMERSTONE WITH DIRECT REST

~~The hammerstone is used freehand, but instead of holding the implement or core in the left hand and striking with the right hand as~~ The hammerstone is propelled in the same manner as described under Hammerstones (freehand) No. 10, but the objective piece, artifact or core is artificially supported. ~~The supporting of the object being worked on~~ Support can be accomplished in several ways. The simplest is ~~to place~~ placing the core, or artifact, on the ground, ~~and in such a manner that~~ with the edge ~~to be worked on is~~ contact exposed ~~that~~ so the flakes may be ~~struck free~~ freely detached without being driven into the ground. In this case the ground ~~is made to suffice~~ serves as an anvil. ~~The~~ Rests or anvils may be of many substances, such as depending on how much resistance is required for a particular technique. ~~The anvil material may be of either~~ hard or soft stone, antler, bone Horn, or wood. ~~Such a~~ See page 45 This method creates by direction forces, for the anvil will prospect force simultaneously when contacted by the ~~The rest involves the use of force in a direction opposite that which the~~

hammerstone The anvil prevents any
~~which the hammerstone directs the blow. Any downward motion of the obje-~~
downward movement of the objective piece and
~~ct being worked on is prevented and~~ at the same time ~~force is exerted~~ transmits
force into the core or artifact.
from ~~the rest~~ or anvil into the artifact or core. ~~These~~ forces are ~~dire-~~ The striking pattern must be such
that these forces will not be opposing as this would
~~cted in such a manner that they will not~~ oppose each other ~~and~~ cause which would
Rapidly executed, this technique divert these forces
~~crushing to take place, but to bypass each other~~ and causes a shearing from their path of contact and

between the anvil and the hammerstone. Blades detached from cores by ~~the~~
the percussion + rest technique are flatter than the freehand tech
~~use of the rest are much flatter than~~ those ~~the hand held in the hand or aga-~~

~~inst the thigh~~, because they are allowed to roll with the blow and ~~are~~
as a result are projected. assuming the artifact is a biface
~~projected as a result of it.~~ The shock is ~~concentrated~~ between the ~~two~~
contained
the artifact is placed with one lateral margin with the
~~points~~ (the anvil and the hammerstone) which dampens the vibration to
ermine as he does the quick
the distal ends of the artifact, and flakes can be detached
~~assuming the artifact is a biface,~~ without removing the opposite edge

~~The~~ cores, because of their greater mass are resistant to
more
~~the~~ shock ~~because of their greater mass.~~ and The flakes and blades will

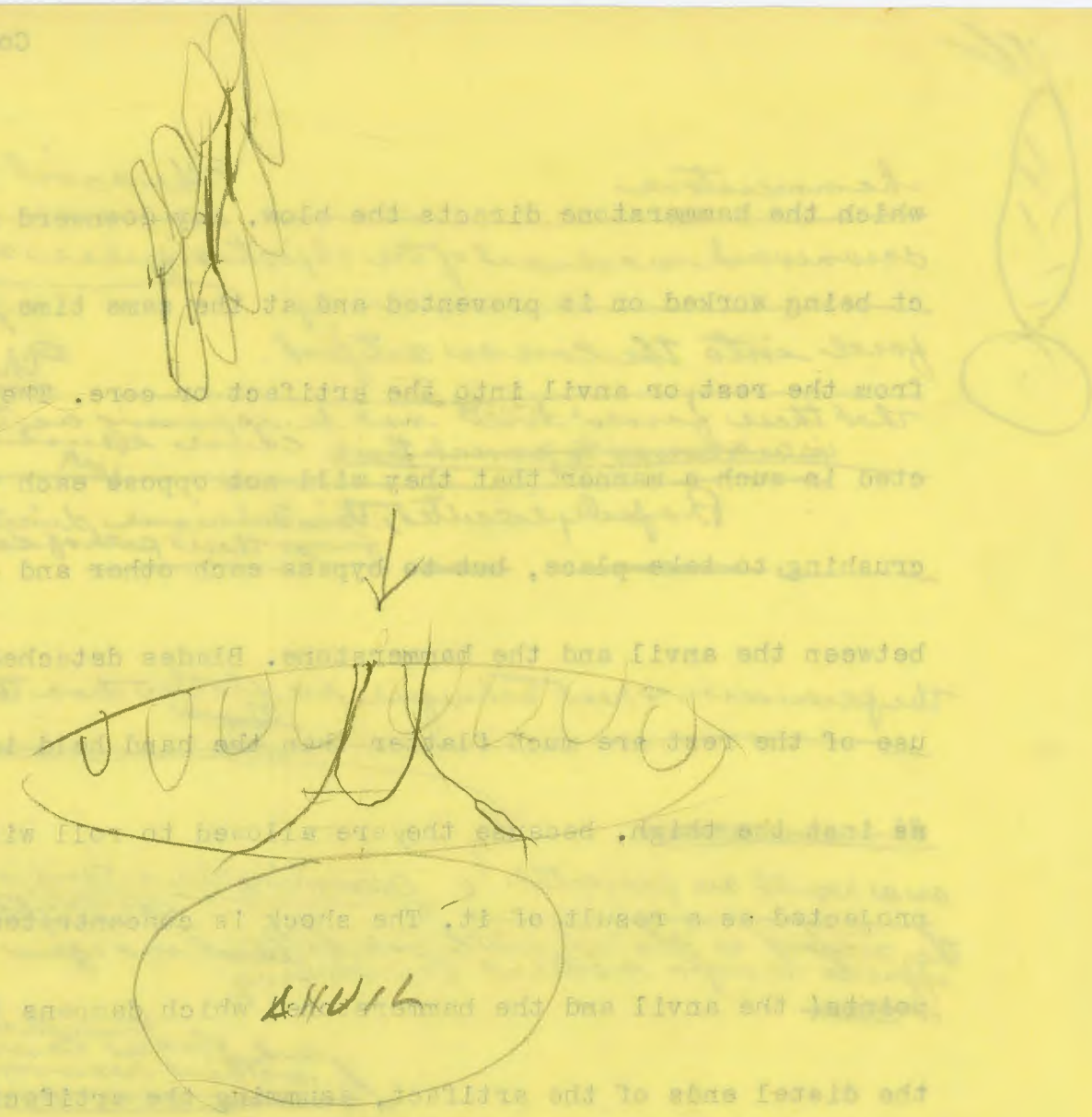
terminate to a feather edge without removing the opposite side of the

artifact or the distal end of the core. Flakes detached by the
~~The use of the anvil or rest~~ anvil or rest method

will ~~not show~~ be devoid of compression rings ~~starting~~ radiating from ~~the~~ their distal end ~~of the~~
these rings will be present on which
~~flake~~ but ~~only at~~ the proximal end recieving the force from the hammer-
see page 44
stone. ~~The~~ Materials used for the rest are selected with regard to the

lithic material being worked. For ~~the~~ example, obsidian, because of its

brittle nature, will require ~~that~~ a wood anvil ~~be used~~ to prevent its fracture.



Quartzite or ~~the~~ granulose lithic materials ~~that~~ which require more force ~~to~~ ~~cause their~~ for fracture, ~~would require~~ demand an anvil of a dense, hard material. ~~The use of~~ Using the anvil, or ~~a~~ fixed rest, ~~adds one more complication to the simpler method of hand holding, and to use it~~ method the hand method effidiently requires considerably more skill and practice, ~~####~~ than the simple hand holding method because ~~you have another force to be directed~~ the two forces are created and, ~~the slightest~~ therefore any miscalculation of this additional force ~~will result in failure~~ will produce failure or neglect. When the artifact or core is hand-held, the use of the rest is an important aid to ~~##########~~ the knapper because it relieves the strain on the left hand, ~~when it is hand held. One is~~ assuming ~~that~~ the majority of ~~the~~ knappers were right handed and used the hammerstone in the right hand and held the artifact or core in the left hand. It is wielded with the right hand & held with the left. Conversely, the interesting to note that the left hand performs considerably more work than does the right ~~hand~~ arm and ~~arm~~ hand. The left ~~###~~ hand ~~is~~ must both supporting the core and manipulating properly ~~the core at~~ its angles ~~proper~~ to successfully remove ~~the~~ flakes. Also, the fingers of the left hand seek out the ridges and examine the underside of the object being worked ~~on by feel alone~~ and. ~~The underside~~ This must be by feel alone for the underside of the artifact is not visiable to the knapper, ~~So, ##~~ To retain this feel, the artifact ~~in order to retain a fixed position and retain the feel that would be~~ must be held in a fixed position and, therefore, keep ion and lost if the artifact was visually ~~examined after each blow~~, the fingers are in almost continual motion. The left hand receives further strain for it must counter the shock delivered by the hammerstone ~~which also creates undue strain on the left hand~~. Hand holding provides for

considerablely more ~~manuvicorabillity~~ maneuverability ##### and ease of manipulation than does the rest, but it is less accurate, ~~not found when using~~ the rest or anvil method. There are advantages and disadvantage to both methods and ~~there use~~ their application depends on the desires of ## the worker and ~~what~~ the tool form he ~~is going to make~~ desires. The size of the material being ~~worked~~ objective piece for on is sometimes a deciding factor in ~~which method~~ will be used. ~~A small object, upon being struck~~ When a small object is struck it will be projected with the force of the blow more redily than one of greater size. ~~An example~~ of the ground or body When a small agate pebble of approx two inches is cleaved ~~of the use of this technique~~ is the cleaving of small pebbles of agate devoid of a flat surface or projection (~~a varity of Chalcedony~~). These pebbles are from one ### to two inches ~~in diameter and have a semi polished surface. The pebbles,~~. They are ~~most~~ more intractable, and ### unyealding, ~~also without projections or flat surfaces, to impart the blow~~. Because ~~of this nature, it is impossible~~ of the lack of flat striking area, it is impossible to repetedly cleave these pebbles by the hand-held ~~repetedly cause the pebbles to be cleaved by the hand held percussion~~ technique and, the anvil or rest ~~must be resorted too~~ therefore the worker must resort to. Such an industry has been reported, by ~~Dris Tyed~~ Wendorf and ~~Joel~~ Shinner ~~as occuring in Wadi Halfa Sudan~~ in the Wadi Halfa Sudan area by, (Personal ~~correspondence~~ communication)[1].

12. HAMMERSTONE (with rest and clamp)

The use of the hammerstone with ~~the aid of the~~ rest and ~~the~~ clamp is much the same as described in ~~section~~ No. 11, with the addition of

a holding aid. The holding devise, allows the worker considerably more freedom of movement than when the left hand has to be used to hold the material being worked on. The holding medium may be a second person or it may be held between the feet of the knapper. These two methods permit a certain amount of movement of the article being worked on and restrict the positions in which they may be struck. The aboriginal b ly numerous and varied devices used aboriginaly for holding, but because use of their perishiable nature, little or no evidence remains. There is, however, evidence of holding devices used for certain techniques that were made by the use of both downward and outward pressure and percussion Examples are the Artic Micro blade industries, the Mexican polyhedral cores, Hopwellian cores and many examples of percussion struck flat blade -s and flakes. Such holding techniques are by far more common in core and blade making than the making of bifacialy flaked artifacts.

The use of stops and pegs are usefull in preventing movement of the artifact in one direction only and do not fully imobilize the implement. The stops may be simply depressions made in a log , while the pegs may be driven into a log with a slight depression between them to provide clearance for the flakes being removed. This method is more usefull for indirect than direct percussion and may also be used for pressure.

When the feet are used as the holding medium, a certain amount of movement is still present and the striking area of the stone is restricted and limited because the worker must remain in a stationary seated position and he cannot manipulate the working piece to allow for selection of platform surface. When a second person is used, there is still a some movement of the abrasive piece but it does allow for greater platform selection and maneuverability of the knapper. However, further experiments with this method will be tried when I have a second person who is familiar with this technique, to assist.

These experiments have made use of all varieties of clamps vises and holding devices. They have proven means of holding. ~~I have found~~ that no ~~present day~~ mechanical vice is as satisfactory as the primitive method of loosely binding ~~one made from~~ two strips of wood, ~~loosely bound~~ inserting a mass of bark at the ends to provide leverage with ~~by~~ cordage at one end and sufficiently far back ~~as~~ to allow the insertion of a core, and the opposite ends of the wooden strips are then spread on the core to render it immobile. The binding must be sufficiently removed from the working end to allow the insertion of the core. forward until sufficient the ~~desired~~ pressure is attained. The strips of wood may be of any section or length ~~or section~~. This type of lever provides the maximum in clamping immobility. ~~Great amounts of clamping force may be gained by such levers.~~ Besides being portable ~~When such a holding method is dismantled it would be unrecognisable as a functional tool~~ a piece of this type would be quite unrecognizable as a functional tool when it was dismantled. However, Materials other than wood may be used to make a similar ~~similuar~~ devise. ~~If one is~~ When doing performing work ~~involving the use of~~ with massive material, I commonly ~~use~~ add a large flat stone ~~placed on~~ to the top of ~~the~~ This clamp to provide greater weight and further immobilize the object, ~~to further immobilize the object being worked on.~~

13. HAMMERSTONE (with rest , bipolar)

The bipolar technique is ~~a term~~ commonly referred to in ~~used in~~ Anthropological literature and ~~one that~~ deserves mention here ~~I have conducted numerous experiments~~ In my attempts to produce a flake or blade ~~that has~~ with a cone of force on both ends I have conducted numerous experiments. My present feeling is that it is impossible to make such a flake. If Peking man was able to produce such a flake, he took his secret with him. ~~, he still retains his secret.~~ To date I haven't been ~~so~~ fortunate

~~as~~ to see such flakes, ~~nor have I seen such flakes~~ in ~~numerous~~ collections ~~that~~ I have ~~examined~~. I fail to comprehend the laws of mechanics ~~that~~ could create such a flake. ~~Upon the application of force by placing~~ a nodule of flintlike material upon an anvil and then ~~striking~~ it in ~~such~~ a manner ~~that~~ a cone ~~will be formed~~ on both ends ~~will have~~ to be done by two ~~forces in~~ direct opposition ~~with each other, simultaneously~~. ~~Such a method~~ creates two opposing cones ~~that will shatter~~ the material ~~without removing a flake~~. The debitage ~~that results~~ from such an action is ~~commonly~~ a mess of splinters, roughly triangulate in section and having no definition of a bulbar scar. ~~The bipolar technique is not~~ to be confused with the anvil and rest technique, ~~because each embodies~~ a different set of mechanical ~~problems~~. A cobble-like core could, ~~however~~, bear scars on both ~~ends of the cobble~~ ~~meeting on the same plane~~ ~~but~~ the core would bear the negative bulbar impression and not ~~nessarily~~ indicate that ~~they~~ were removed ~~at the same time~~, ~~and this would be most unlikely~~. Such a core would ~~have the distinction and~~ possibly be a technological trait of ~~##~~changeing ends of the core as each flake was removed from the same face ~~of the core~~. Flakes removed from such a core would be truncated by either a hinge or a step fracture and expanding as they reached the distal end. The flakes would also be undualy

Two opposing forces would create normal opposing forces which would restrict the spreading beyond the elasticity of the material and, thereby restricting this elasticity these forces would compress, of the material and, therefore, shatter rather than detach a flake

The rest or anvil will aid in dampening the shock of the blow to the artifact, but because of the inaccuracy of this method it is will make it nessary to isolate the paltforms. ~~because of the inaccuracy of this method.~~ The accuracy may be # increased by constant practice which is true of most flint working techniques. ~~Brief experiments will resolve little.~~ Using the rest will relieve the fatigue of holding the left hand and the flakes will be flatter and have ~~will also result in flatter flakes with~~ feathered edges. ~~feathered edges.~~ This method is suitable for removing from tabular core pieces the distinctive side struck flakes. ~~from tabular corepieces.~~ Side Struck ~~They are the~~ flakes ~~that~~ expand rapidly as they near termination and bilaterally remove ~~reach the edge of the core, removing~~ the distal end of the core, ~~part bilaterally.~~ Therefore the ~~The~~ distal end of the flake ~~is then~~ is bipointed and somewhat triangulate in longitudinal ~~longetudnal~~ section. The hafted hammer and rest may also be used to remove blades. ~~Blades may also be removed by the use of the hafted hammer with a rest.~~ The cores are ~~designdd~~ designed with one or more ridges to limit the blades expansion for. The shape of the flake is largely controlled ~~for the largest part~~ by the core surface. The size and weight, as well as the length of the handle must ~~are to~~ be adapted to its functional performance. ~~the kind of function it is to perform.~~

16. BILLETS OR RODS (free hand)

Using ~~The use of~~ billets, ~~## or~~ rods of wood or antler either hafted or unhafted offer many advantages over the hammerstone percussor, ~~the use of the hammerstone, hafted or ##unhafted,~~ for removing flakes from bifacial tools. This baton-like percussor

is held in the right hand and ~~and the material being worked is held in the left hand. The billet~~ is normaly swung in ~~such a manner that it has an~~ arc like path of movement, ~~instead of~~ rather than a straight line. ~~Its~~ velocity can be increased ~~or decreased~~ by grasping the ~~the~~ baton ~~farther or nearer its working end. The billet has been a standby and favorite among many of those experimenting in flintworking techniques.~~ There are several reasons why this implement ~~has~~ can produced better results than ~~the use of~~ the hammerstone. It's use ~~does not require the accuracy that is nessary when using~~ permits a greater margin of ~~a~~ miscalculation than the hammerstone. The billet ~~does not~~ also imparts ~~the~~ less shbck to the artifact and it is eisier to direct the path of flight and, vary ~~the~~ velocity. ~~The wooden permits~~ a novice ~~to attain~~ can attain fair results, even ~~from~~ with the billet though the blows ~~of limited accuracy~~ are not disastrous because ~~the wood, even hard wood~~ even a hardwood billet is relitively softer than ~~the~~ hammerstone and ~~permits~~ will the flint ~~to~~ slightly penetrate the billet and ~~without~~ dampen the shock ~~out creating the shock of the hammerstone~~. Because of the dampening effect, poorly directed blows will not shatter the artifact and The novice can ~~repetedly~~ repeatedly strike the edge of the artifact ~~to be~~ without removing the desired flake. And even tho the striker may be unaware of it ~~but unbeknowest to the striker~~ small bits of flint are being removed ~~removed~~ from ~~ridge or the underside~~ the underside of the artifact on either side of a ridge or ~~at least a~~ the high part ~~on the underside of the artifact. The ridge or high part~~ This ridge or high part has more resistance because of its greater thickness, the ridge or high part has more resistance

~~in that part~~. ~~The~~ Repeted blows of the billet will eventualy free the part of the edge ~~that~~ which bears the ridge, scar left from a previously ~~made~~ removed flake ~~scar~~, thereby making a platform and centering the ridge ~~without being concioudly designed by the weilder of the baton~~. Flakes removed by ~~the use of~~ the wooden billet will ~~be by nature~~ naturally be thin, ~~####~~ have a diffused bulb of percussion and will lack the and without ~~a~~ sharp definition of the cone, or ~~in otherwords with a diffused bulb of percussion~~. ~~The area~~ and will have a slight lip on the ventral side contacted by the billet ~~will be~~ will be the width of the proximal ~~end~~ of the flake. ~~The~~ Bulbar surface flakes ~~are~~ usualy characterized by the presence of ~~a~~ slight ~~lip on the ventral~~ side. The lip is caused by the ~~#~~ slight penetration of the edge of the flint into the billet and is more pronounced ~~in~~ when using a wood billet than one made from antler. The hardness of the wood will accentuate this diognostic feature, ~~when the billet technique is used.~~

The wooden billet is of little use for striking blades from a core. The worker must be much more accurate in striking when using The antler billet ~~must be used with greater accuracy~~ because of its due to its incresed hardness, And thicker flakes may be removed with a single blow. In order to use the antler billet effeciently one must have some knowelege of the fracture of flintlike materials, because one must pre establish surfaces prior to getting to remove a flake ~~#~~ the desired dimentions. Special attention must be given to the selection or preparation of the platform areas. The end of the billet ~~#####~~ which ~~that~~ strikes the artifact must be

13. Hammerston (with rest Bi-polar) vacant on page 49

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~~The use of~~ Using the hammerstone with ~~a~~ rest or anvil ~~supporting the~~ to support the objective piece is a technique involving the principals ~~of~~ of force, ~~and~~ motion and the elasticity of solids. Absolute bi polarity of forces applied to material ~~with the properties of isotrophisim and homogeneity are in no way usefull~~ is not useful for making flaked stone artifacts with any degree of control. ~~A simple experiment~~ To observe ~~in understanding~~ the behavior of forces that are in direct opposition ~~with~~ ~~each other~~ a simple experiment can be conducted. ~~is to~~ place a pebble of flint-like material in a machineist's vise and then subject the pebble to the forces ~~made by the~~ of the tightened jaws of the vise untill rupture occures. The force exerted from each jaw of the vise will cause a cone of force to be formed at both ~~the~~ poles of the pebble(for the lab. a glass marble can be substituted) and as the pressure is incresed ~~a shattering~~ will be exceeded the pied will shatter ~~will occure when~~ the elastic limmits of the material ~~has been reached~~. Because ~~of~~ the cones of force are ~~being~~ in direct opposition ~~with each other~~ the material will crush ~~be crushed~~ and the resultant fragments would be of little use for tool makeing. When this experiment is altered to include percussion instead of pressure and an anvil ~~is duplicated but direct percussion is used~~ instead of pressure and the anvil is used instead of the jaw of the vise a rock. The results will be duplicated ~~the results are the same~~. The bi polar technique ~~of using bipolar force~~ must, therefore, be changed ~~so that the forces do not oppose each other but permit each force to~~ to prohibit an opposition of forces and provide for the by pass of the two movements. This causes a shearing and then by pass ~~each other and~~ cause a shear to take place and cause the objective the objective piece and ~~piece and~~ the cones of force will be ~~to be~~ severed. The fractures that occur from and cause severing which

the by-pass of force
~~the use of this technique of severing the cone~~ do not produce a bulb of force because the ~~the~~ plane of fracture does not involve ~~the use of the cone angle.~~ using the angle of cone for detachment. ~~The ### F~~orce is directed slightly less than vertical to prevent their opposition ~~the forces from ppposing each other, while if~~ the angle of the cone is used, When the force must be directed at an angle ~~that~~ which coresponds with that of the cone. When cleaving ~~the objective piece~~ the mass by the bi-polar technique it is ~~hard~~ difficult to distinguish between the core and the flake as there is no bulb of percussion. The fracture surface is quite flat and the concentric rings of force ~~are hardly apparent and when they do occur they are very closely spaced.~~ are diminished and very closely spaced. When ~~the~~ shearing ~~of the objective piece~~ occures, the compression rings ~~start to radiate from~~ is from one pole ~~only and~~ and the apex of the ~~flake~~ pole will be determined by and can ~~start from~~ either pole ~~depending on~~ the contact points of the anvil or the percussor. Because of differences in the distribution of the mas of the material ~~being cleaved~~ and it's irregularity, the end or pole with the greater mass will have greater resistance to the force and permit the fracture to start at the end with the least resistance. If the vertical axis between the anvil and the point of impact by the hammerstone is tilted more than a few degrees then ~~the promenence of the bulb of force will~~ the bulb of force will be more conspicuous and will ~~grow and~~ increse in prominence as the deviation from vertical is incresed.

Numerous experiments in the use of bipolar flakeing ~~has~~ have shown that this technique is unsatisfactory for ~~making~~ detaching blades or flakes the entire

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length of the core. ~~The~~ attempts have been made to ~~make~~ fabricate a flake or blade with a bulb of force on the ventral side at both the proximal and distal ends ~~on the ventral side of the flake.~~ Flakes can however be made with the bulb of force on opposite inds of a flake or blade but, ~~the~~ the positive bulb of force will be on only on the ventral side ~~and at the proximal end~~ and at the distal end the negative bulb will be ~~one can have the negative bulb of force~~ on the dorsal side. ~~I fail to comprehend~~ I do not understand + cannot resolve the laws of mechanics and elasticity which would ~~and~~ force, ~~that could create a flake that exhibits the double bulbs~~ detach a flake with bulbs of force on the ventral side at both ends of a flake. ~~on the ventral side of the flake.~~

These experiments have made use of all varieties of clamps, vises and holding devices. They have proven that no mechanical vice is as satisfactory as the primitive method of loosely binding two strips of wood with cordage at one end and inserting a mass of rock at the other end to provide leverage. The binding must be far enough back from the working end to allow for insertion of the core. The opposite ends of the wooden strips are then spread by moving the lever rock forward until sufficient pressure is attained on the core to render it immobile. The strips of wood may be of an section or length. This type of lever provides the maximum in clamping immobility. Besides being perishable, a vise of this type would be quite unrecognizable as a functional tool when it was dismantled. However, materials other than wood may be used to make a similar devise. When doing preforming work with massive material, I commonly add a large flat stone to the top of the clamp to provide greater weight and further immobilize the object.

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13. HAMMERSTONE (with rest bi-polar)

The bi-polar technique is useful for certain phases of stoneworking, but it will not produce a flake or blade with - a bulb of force at back end on the ventral side.

_____. I have examined many collections, but I have never seen a flake or blade with this technological trait and I fail to comprehend the laws of mechanics or force which could produce such an implement. If a nodule of flintlike material is placed on an anvil and then struck in a manner to detach a flake bearing a cone on both ends, the two simultaneous forces, from the percussor and the anvil, would be in direct opposition. Two opposing forces would created two opposing cones and their attempt to expand ~~which would spread and over-~~

~~crush~~

would exceed the elastic limits of the material and, therefore, the mass would shatter without detaching a flake or blade. The opposing forces and the opposing cones would restrict the normal expansion of the cone; the two forces would compress and, therefore, the mass would be shattered. The resulting debitage would be a mass of splinters roughly triangulate in section and having no definition of a bulbar scar. However, a cobble-like core could bear bulbar scars on both ends with the distal end of the flake scars having a common termination point on the same plane but this does not necessarily indicate that the flakes were removed simultaneously, but rather that they were detached by rotating the striking ends of the core. A core with this distinctive technological trait would show that the flakes were truncated by either a hinge or step fracture and expanded as they reached the point of termination. Also, the flakes from such a core would be unduly thick and the core face would be concave rather than convex.

Using the hammerstone with rest or anvil to support the objective piece is a technique involving the principals of force, motion and the elasticity of solids. Absolute bi-polarity of forces applied to isotropic and homogeneous material is not useful for making flaked stone artifacts with any degree of control. To observe the behavior of forces that are in direct opposition, a simple experiment can be conducted. Place a pebble of flint-like material in a machinest's vise and then subject the pebble to the forces of the tightened jaws of the vise until rupture occurs. The force exerted from each jaw of the vise will cause a cone of force to form at both poles of the pebble and as the pressure is increased, the elastic limits of the materiall will be exceeded and the piece will shatter. (for the lab. a glass marble can be substituted)

Because the cones of force are in direct opposition, the material will compress and crush and the debitage would be of little use for tools or toolmaking. When this experiment is altered to include percussion instead of pressure and an anvil is used instead of a vise, the results will be duplicated. The bi-polar technique must, therefore, be changed to prohibit the opposition of forces and provide for the by-pass of the two movements. This causes a shearing and then the objective piece and the cones of force will be severed. The fractures and cone severing which occur from the by-pass of forces do not produce a bulb of force because the plane of fracture does not involve using the angle of cone for detachment. Force is directed slightly less than vertical to prevent their opposition. When the angle of the cone is used, the force must be directed at an angle which corresponds with that of the cone. When cleaving the mass by the bi-polar technique, it is difficult to distinguish between the core and the flake as there is no bulb of percussion on either. The fracture surface is quite flat and the concentric rings of force are diminished and very closely spaced. When shearing occurs, the apex of the compression rings is from only one pole and ~~the~~ which pole will be determined by the contact points of the anvil or the irregularity and percussor. Because of the differences in the distribution of the mass, the end or pole with the greater mass will have greater resistance to the force and permit the fracture to start at the end with the least resistance. If the vertical axis between the anvil and the point of impact are titled more than a few degrees, the bulb of force will be more conspicuous and will increase in prominence as the deviation from vertical is increased.

Numerous experiments in the use of bi-polar flaking have shown that this technique is unsatisfactory for detaching blades or flakes the entire vertical length of the core. Attempts have been made to fabricate flakes and blades with a bulb of force on the ventral side at both

the proximal and distal ends but have resulted in failure when using the bi-polar technique. Flakes and blades can, however, be produced with bulbs of force on opposite ends but the positive bulb of force will be on only the proximal end on the ventral side and the negstive bulb of force will be at the distal end on the dorsal side.

What is the variation?

thick. The core face would be concave rather than convex.

Both the aborigenials + the writer have used

A slight variation of the bipolar technique was used both aboriginaly and in the experiments to make right angle edges on blades and flakes, Such a method is used to prepare a burin core prior to removing burin blades for and notching the edges of blades, edges and for making + for both severing and the making of microburins. Several styles of both flake and blade knives are backed by an abrupt arupt retouch which is accomplished done by placeing the flake or blade on an anvil and then carefully striking the supported edge with a small pebble (small Hammerstone), However the blow is struck slightly less than vertical, which is not truly bipolar for and the forces are not directly in opposition, with each other. Edges made by the use of this technique have certain distinctive charistics which that will be described in more detail under flake and blade knives.

14

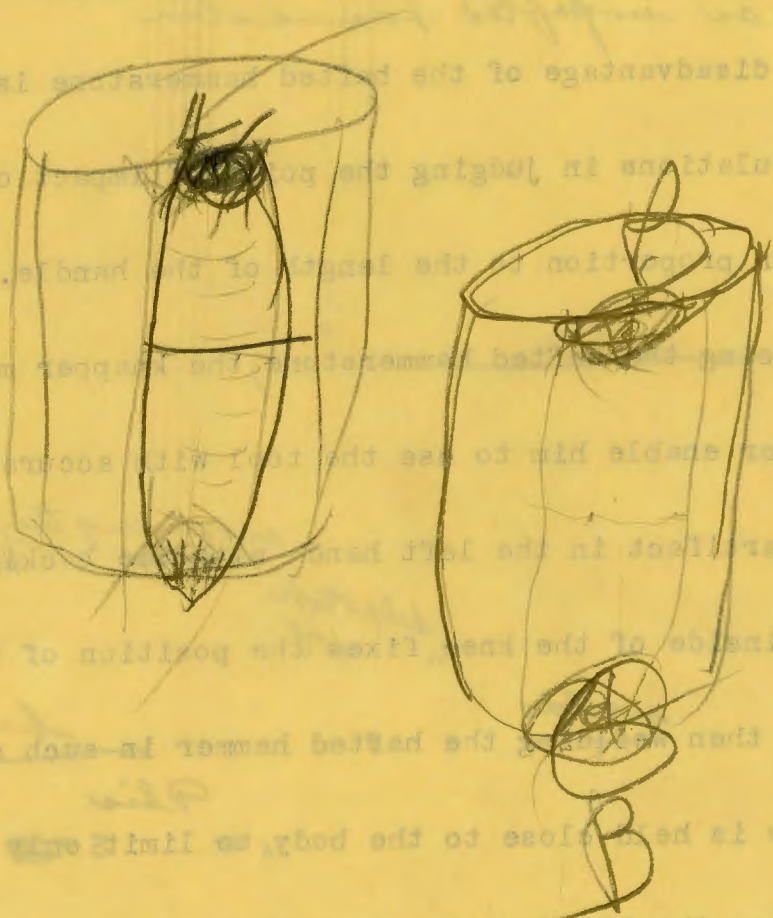
14. HAFTED HAMMERS (= freehand)

Using The The use of hafted hammer, freehand held in one hand and the lithic material held in the other hand has advantages and disadvantages over the unhafted hammerstone. The affixed handle afixed to the hammerstone has the advantage of increasing the velocity increases of the blow of the blow which will be and the velocity is incresed in proportion to the length of the handle. The increased higher velocities

gained by ~~the use of~~ the handle ~~serve an important step~~ are very important in freehand flaking of small artifacts ~~that~~ which have insuficient weight or inertia. ~~If~~ The artifact will be projected with the blow ~~from~~ of the hammerstone. ~~If the blow is~~ ~~## ##~~ slow moving. High velocity blows from the hafted hammer will permit the knapper to remove thin, wide ~~and feathering~~ falkes from the artifact. The ~~h~~afted hammer doesn't bruise the hand ~~holding the hammer~~ striking as readily as an unhafted hammerstone. The disadvantage of the hafted hammerstone is that the slightest miscalculations in judging the point of impact on the artifact are magnified in proportion to the length of the handle. Because of ~~the error~~ this factor ~~in using the hafted hammerstone~~, the knapper must seek handle holding positions ~~that~~ which will better enable him to use the tool with accuracy. I find that by holding the artifact in the left hand ~~with the~~ and placing the back## of the ~~left~~ hand against the inside of the knee, helps to fix the position of the artifact. The right hand then ~~weilding~~ weilds the hafted hammer ~~in such a fashion that~~ but the right elbow is held close to the body. This limits ~~only~~ the movement nessary to deliver the blow# of the hammer. This method is done in a sitting position on a low seat, or on the ground.

15. HAFTED HAMMER (with rest)

The hafted hammer is used in much the same way as in No. 14 with the exception that the object being worked on is pladed on a rest.



The rest or anvil will aid in dampening the shock of the blow to the artifact but, because of the inaccuracy of this method, it is necessary to isolate the platforms. Striking accuracy may be increased by constant practice which is true of most flint working techniques. Using the rest will relieve the fatigue of the left hand and the flakes will be flatter and have feathered edges. This method is suitable for removing the distinctive side-struck flakes from tabular core pieces. Side=struck flakes expand rapidly as they near termination and bilaterally remove the distal end of the core. Therefore, the distal end of the flake is bi-pointed and somewhat triangulate in longitudinal section.

The hafted hammer and rest may also be used to remove blades. The cores are designed with one or more ridges to limit the blades expansion, for the shape of the flake or blade is largely controlled by the core surface. The size and weight, as well as the length of the handle must be adapted to its functional performance.

16

16. BILLETS OR RODS (free hand)

Using billets, rods of wood or antler - either hafted or unhafted - for removing flakes from bifacial tools offers many advantages over the hammerstone percussor. This baton-like percussor,

is held in the right hand and is normally swung in an arc-like path of movement rather than a straight line to contact the objective piece in the left hand. Velocity can be increased by grasping the baton at the far end and decreased by holding near the striking end. For several reasons this implement can produce better results than the hammerstone. It permits a greater margin of error and miscalculation than the hammerstone tolerates. Also, the billet imparts less shock to the artifact and it is easier to direct the path of flight and to vary the velocity of the blow. A novice can attain fair results with the billet even though the blows are not exact because the flint will slightly penetrate the wood billet and dampen the shock. Because of this dampening effect, poorly directed blows will not shatter the artifact and the novice can repeatedly strike the edge of the artifact without removing the desired flake. However, even though he is unaware of it, small bits of flint are being removed from the underside of the artifact on either side of the ridge(the high part) This ridge - or high part - has more resistance because of its greater thickness.

Repeated blows of the billet will eventually free the part of the edge which bears the ridge left from a previous removed flake - thereby making a platform and centering the ridge. Flakes removed by the wooden billet will naturally be thin, have a diffused bulb of percussion, a slight lip on the ventral side, and will lack the sharp definition of the cone. The slight lip on the ventral side of the flake is due to the slight penetration of the edge of the flint into the billet and is more pronounced when using a wood billet than one made from antler. When the billet technique is used, the hardness of the wood will accentuate this diagnostic feature.

The wooden billet is of little use for striking blades from a core. An antler billet is used. The antler billet requires that the worker be much more accurate in striking because of its increased hardness. And thicker flakes may be removed with a single blow. In order to use the ~~fracture of flintlike materials~~ antler billet efficiently, one must ~~have some knowledge of~~ understand the fracture of flintlike materials, because one must preestablish surfaces prior to removing a flake to get the desired dimensions. He Special attention must be given to the selection or preparation of the platform areas. The end of the billet which strikes the artifact must be

diagnostic feature.

The wooden billet is of little use for striking blades from a core and the antler billet is preferred. But, because of its increased hardness, the antler billet requires that the worker be much more accurate in striking. With the harder billet, thicker flakes may be removed with a single blow.

In order to use the antler billet efficiently, one must understand the fracture of flint-like material, for, to get the desired dimensions, he must preestablish surfaces prior to removing a flake, and special attention must be given to the selection or preparation of the platform area. The end of the billet ~~which strikes the artifact~~ must be slightly rounded and the curved part ~~must~~ contact the edge of the stone. As the billet becomes worn from use it may be rotated to prevent its becoming flat and developing large facets.

There seems to be a scarcity of aboriginal billets. Wood could not be expected to endure the ravages of time but there should be evidence of the antler billet unless it was consumed through use. There is an illustration of four typical antler billets ~~pictured~~ on page 193 B.A.E. Bulletin # 60, W.H. Homes ~~(below)~~

Many flakes found in aboriginal sites indicate that they were removed by the billet technique.

below: The wear pattern indicate that both ends of the billet were used for thinning and forming the ~~preform~~ which was originally ~~made by a~~ hammerstone. In my experiments, I have used both ends of ~~my~~ billet and ~~gotten this same wear pattern~~. See Fig. __________ for characteristic flakes removed by the use of the wood and antler billets.

There are two techniques of using the antler billet - one is to use the arc like motion and the other the straight line movement. When the

slightly rounded so that the part of the billet that contacts the edge of the material being worked on will contact the curved part of the billet. As the billet becomes worn from use the billet may be rotated to prevent its becomming flat and large facets being developed. There seems to be a scarcity of billets that occur aboriginaly, Wood by nature could not be expected to endure the ravages of time, but those of antler or bone could be expected to endure. Many flakes occur in aboriginal sites that indicate that they were removed by the use of the billet technique. Their absence may be explinned that they were consumed through use. There is, however, an illustration of four of the typical antler billets pictured on Page 193, B#. A. E. 60 W#. H. Holmes, The wear patterns indicate that both ends of the billet were used in the same fashon as those used in our experiments in stone woking, they being used for thinning and forming the hammerstone rough out. See Fig. ###### for characteristic flakes removed by the use of the wood and antler billets.

There is another distinctive use of antler sections that is quite different from the use of the billet previously described. The former was the arclike motion of the baton held in the hand in the same manner as one would hold a common carpenter hammer, while this technique is to

~~hold the~~ the billet section is held vertically and projected ~~it~~ in a straight line to the point of impact. ~~########~~ The billet section is held vertically in the right hand and then projected in the same manner ~~that~~ as one would use a ~~####~~ hammerstone in the straight line technique. This method of using the billet section is useful for detaching blades from a core. The advantage of using the billet section in this fashon is that it dampens the shock normaly created when using the hammerstone. There is a difused bulb without the definition of the cone, a general absence of an eraillure flake scar and a wide lateral platform. The definition of the compression rings are about midway between those made by the use of a hard hammerstone and those removed ~~##~~ by pressure. The antler , because of the nature of the material, tends to prevent shattering ~~that~~ which is common to the hammerstone. When using the billet in this manner ~~it has been found to be an advantage to use a shorter billet than when using in~~ a shorter billet is desirable than that used in the arc method.

INSERT I first be came aware of this technique in the 1930's when assisting with a paleontological survey in the Walker Lake Region of Western Nevada with the late Dr. Ruben A. Stirton ~~in the Walker Lake region of western Nevada~~. While camped on the ranch of a Nevada pioneer ~~who came to Nevada as a boy,~~ he told of the Piute Indians stealing the wooden spokes of the waggon and buggy wheels to use for making stone artifacts. This elderly man dident know how or why but this is

Before aquiring what the Indians told him. ~~Up till~~ this bit of information I had used only hammerstones for roughing out preforms. I then began to experiment by using the broken handle of a prospector pick, and was soon able to see the advantages of this type of percussor over the simple hammerstone. The Australian# primitives have also been observed using a piece of hard wood to tap the flint-like material set in the ends of their throwing sticks, such was a common retouching or sharpening method. Others that have made use of the billet or baton #### in their experiments have been ## M. Leon Coutier, Professor A. S. Barnes, Andres Kreigh, L. S. B. Leakey, Jaques Tixier and Francois Bordes who has atained great control and understanding of the use of thebillet.

T he methods ~~in which the~~ of billet use ~~is used~~ is not two difficult ~~to understand~~. There are two methods. The arclike path of motion and the straight line motion. ~~The first or the arc~~, when the arc-like motion is used the billet is held in the right hand in the manner ~~that one would hold~~ similar to holding a club, with the forearm supplying the force and the wrist being held imobile. The blow is projected in a follow throughmotion. The objective material is held in the left hand either protected ## or unprotected. The novice should use protection, ~~while~~ but upon gaining experience the bare fingers are most useful for a feeling examining ~~by feel~~ of the underside of artifact ~~being formed~~. The objective piece

held loosly on the four fingers of the left hand, with the thumb just holding the artifact in position with very light pressure. ~~The blows delivered from the baton are then directed into the main body of the tool under construction. Such as the blow being directed~~ when making a biface. The blow is directed from the tip towards the base, and ~~those~~ from the base towards the tip~~# and those on the~~ then the piece is rotated the the blow delivered artifact is again half turned and the blow delivered from one lateral margen ~~side~~. There are several variations in ~~the~~ methods of holding and striking. One is ~~that~~ to strike with the tip of the billet ~~is used~~ at right angles to the artifact ~~and the other~~ is another to strike ~~that~~ with the edge of the billet ~~is used~~ and change the holding position of the left hand to line up the marginal edge for proper contact, ~~changed accordingly~~. When the latter method is used, the flakes are ~~removed~~ and the objective piece is held parallel to the arc of the blow and detached from the underside of the art. A thick (butt end) core tool may be made very thin by the use of these ~~###~~ techniques. ~~When the billet contacts the edge of the artifact, the flake is removed from the underside of the object being worked on~~, then, if the flake removed has the desired qualities, one can proceed to remove the balance of the flake -s from that margin, keeping the angle of the blow, the angle of the objective piece and the intensity of the blow constant. ~~If the artifact is turned after each blow~~ for at this point of flake removal the position of the ~~leading edge~~ must be maintained and the artifact not turned over. ~~much~~ skill ~~and practice~~ find it desireable to alternate the removing of flakes from both sides from the same margin. Each artifact presents

practice and the workers will

a new set of problems, and each must be dealt with in slightly different manners and modification of the techniques. For instance, it may be desireable to terminate a flake in the middle of the artifact by either a step or hinge fracture and then meet the flake by removing another # flake on the opposite side. Very thin bifacial tools may be made by this type of thinning. The thickness of the flake will depend on the distance from the edge of the artifact and the length, width depends on the exterior surface and the intensity of the blow. The amount of area contacted by the billet will also relate to the width of the flake, and the flakes termination is also related to the angle in which the objective piece is held and the angle the blow is ## struck. The materials from which the billets are made each leave characteristic platform atributes on the platform area of the flake. These characteristics may serve to identify the billet material, depending upon the hardness or softness of the material used. The softer the material, the greater the penetration of the flintlike material into the billet. Wooden billets will vary in hardness# depending upon what wooden material was used. There are a few of the exotic hard woods, such as the Mountain Mahogony, the sapodillia tree, and others, that will compare in hardness with# antler. The results of different materials with equal hardness will

therefore be similar. The geographical area will ~~in part~~ be, in part a deciding factor ~~of what materials were available~~ of materials used for billets for ~~per which to make a billet~~. Wether the materials be of hard woods, antler, horn, bone, or even stone, ~~an apraisial of what was~~ depends on the most available, at ~~the particular time~~ of material the time of mfg. Another consideration is ~~the~~ the Genus ##### of the antler bearing animals supplying the billet material. Those ~~and~~ heavier derived from the Caribou, Moose, and Elk are considerably larger, and more massive than ~~those from the deer resulting in billet material of increased weight that would~~ the deer antler which allow the knapper to remove larger flakes ~~by the billet technique than if only Deer antler was available.~~ The use of the bone billet should, also be ~~made~~ mentioned ~~of~~ in these experiments. I ~~have~~ found, that ~~the~~ cannon bone of the horse, because of its shape & weight is well adapted for a billet ~~the experiments because of its shape, and weight.~~ But ~~is not long enduring~~ will not survive because making more than one or two medium sized artifacts of the spongy nature of the ends, ~~making it unserviceable after making only one or two medium sized artifacts. The~~ When these ends become ~~unduly~~ unduly soft ~~making~~ it, in immpossible to remove any large number of flakes and When the spongy ~~part of the bone has been~~ is consumed, the ~~solid part~~ remainder is very brittle and lacks strength ~~because of~~ due to the marrow cavity ~~is~~ in the center ~~of the bone.~~ Fresh uncooked bone will withstand ~~the~~ impacts much better than ~~the~~ weathered, or altered bone.

B oth individual and traditional techniques of using the billet

will be ~~revealed~~ determined by an examination of the platform area of the flakes. ~~There will be~~ Major and minor variations ~~that~~ will depend on the manner of holding the artifact, the hardness or softness of the billet, and the character of the surface prior to recieving the force of the blow.

The salient bulb, ~~or~~ that is, one showing a conspicious, well-defined cone part, is ~~not common~~ uncommon ~~#########~~ on ~~the~~ flakes detached by ~~########~~ the use of the ~~##########~~ billet technique ~~while it is common from the application of the hammerstone.~~ but characteristic of the softer billet leaves. ~~The presence of a~~ a slight overhaning lip ~~is usualy found~~ directly beneath the ~~continuous curved~~ curve of the platform. This curve on the platform part is ~~caused by~~ the result of the billet contacting the platform and penetrating surface ~~on the core as it~~ pulling away the flake. ~~Because of the nature of~~ the ~~##########~~ billets, ~~material~~ is softer yeilding, the cone is ~~caused to spread~~ spreads leaving a ~~known~~ area ~~or to be known as~~ a diffused bulb. Much of the flake character ~~is~~ depends dependent on the preparation of the platform ~~which will be detailed~~ (see platforms) in ~~another part of flake analysis~~. Granular materials can also cause bulb diffusion. Since the billet is commonly used ~~to finish~~ in the intermediate steps between hammerstone preforming and the final ~~other than~~ pressure flaking, ~~and was preformed by the use of the hammerstone,~~ the dorsal surface of the flakes will bear ~~the~~ scars of previous ~~flakes removed in the stage prior to using the billet.~~ preforming ~~The~~ billet flakes are usualy rapidly expanding with feathered edges and an accentuated curve.

60

(17)

Billets (with punch)

~~In the following method~~ The billet ~~is used~~ to transmit force to an intermediate tool ~~that~~ will be called a punch, usualy an antler tine ~~without a curve or formed~~ rodlike ~~from~~ bone or ~~other~~ antler part. ~~One end~~ of the intermediate tool ~~will be flat to recieve the blow from~~ the billet, ~~while~~ the ~~other will be~~ slightly acuminated ~~to be placed~~ ~~on the material being worked on.~~ ~~The~~ billet ~~will generally be of a~~ hard wood ~~or of~~ antler or bone. Its dimentions will depend on ~~the~~ type of work it ~~is to perform~~. A long billet ~~may be used with greater~~ velocity, ~~than~~ a short ~~one~~, ~~while one of a larger~~ diameter will ~~increse~~ the amount of force. ~~The use of~~ the billet ~~and the~~ punch permits the worker to select ~~with accuracy~~ a given area to recieve the force, which is not possible when using the billet ~~directly on the material being worked on.~~

~~A method of stoneworking using~~ the punch ~~was~~ described by B. B. Redding in the American Naturalist, 13, No. , 11 (1879) Quote" Holding the piece of obsidian in the hollow of the left hand, he placed between the first and sec ond fingers of the same hand, a split piece of deer horn, the straight edge of the split deer horn resting against about one-fourth of an inch of the edge of the obsidian,;then

with a small stone he, with his right hand, struck the other end of the split deer horn a sharp blow." I found that by using an antler billet rather than a small stone I found I could strike with greater accuracy and increased velocity and but the method described by Redding when using a small stone. Such a method leaves much to be desired for as the first and second fingers canot apply sufficient pressure necessary to provide good contact between the tip of the punch and the edge of the artifact. This It is a method that is unduly cumbersom and it is hard to simultaneously manipulate both the angles of the punch and the artifact in the left hand and at the same time strike the punch with the right arm. It is difficult to hold an object larger than an punch with the right hand holding the billet. Any object larger than an arrow point is most difficult to hold in one hand with the punch in the and also the punch in the same hand same hand. However By slightly changing the style of holding, I found the method has merit. I found that By placeing the artifact either between the knees or between either the heels of the feet, the punch may be used with accuracy and satisfactory flakes can be detached. may be removed. But for To obtain satisfactory results the blow must be delivered with considerable velocity to prevent the artifact from becoming out of allingment and moving with the blow .

Another A simular technique is one that requires two persons instead of one as in the previous method. One person holds either the punch or artifact and the second person delivers the blow. George Catlin related such a described this technique in, Last Rambles Amongst the Indians of the Rocky Mountains and the Andes. New York; D. Appleton and Co., 1867. Quote," The master

workman, seated on the ground, lays one of these flakes on the palm of his left hand, holding it firmly down with two or more fingers of the same hand, and with his right hand, between the thumb and two forefingers, places his chisel (or punch) on the upper end, flaking the flint off on the underside, below each projecting point that is struck." This method described by Catlin is one that shows close observation on the part, even to the use of projections used as platforms to place the tip of the punch. Such a method is most usefully for thinning and finishing ######### artifacts preformed by the direct percussion technique. The length and width of the flakes are governed by the exterior surface of the artifact and the angle of the punch is held as well as the intensity of the blow. The size of the platforms will conform with the contact point of the punch, and the cone part (bulb of percussion) will #### be Salient with good definition and not diffuse. Such a technique allows the workers freedom of manipulation and one drawback is that of ##### of coordinating their actions and synchronous punch placement with the blow. Upon completion of the flaking by the use of the punch, the irregularities may then be eliminated by the use of the pressure technique. The pressure technique permits the knapper to remove the ridges left by the accentuated bulbs of percussion, straighten the edges and sharpen

and make the artifact more uniform. ~~The method of using~~ (2) Using the punch as an intermediate tool not ~~###~~ only permits the knapper to make knives, spears, and assorted unifacial and bifacial impliments; but, it is also ~~is~~ useful for ~~making~~ detaching blades from cores. Flakes or blades ~~removed by the use of~~ detached by this technique will vary according to the the type ~~of tool and the needs of the maker~~ of artifact the worker needs. The character of the platform, the bulb of percussion, the dimension and the termination of the flakes or blades will depend on the workers individual ~~traits~~ and ~~###~~, traditional traits and the implement being formed. ~~However there is~~ However there will be a certain cons#stancy and ~~a certain~~ uniformity of the flakes removed by this method. Their major and minor deviations being a reflection ~~of~~ the particular type ~~of work being done~~ of manufacture. ~~In ######## order~~ To relate this technique to the flake or blade, one must examine the platform for ~~features~~ pertinate characteristics such as special platform preparation — grinding, isolation, ~~platform~~ angle, limited ~~platform~~ area and ~~being close to #~~ the distance of the platform from the leading edge of the artifact or core. ~~The~~ Flakes will reveal ~~show~~ that the punch was placed with ~~precision care on a preselected platform with percession~~ accuracy and an established platform which is the case, ~~accuracy; not found when the~~ direct free# hand percussion is ~~used.~~ the technique

18. Billets with punch rest and ~~###########~~

~~The~~ Use ~~of~~ the billets with ~~the~~ punch ~~rest and ########~~ and rest. ~~Will be ###~~ is much the same as No. 17 ~~using the billet with~~ the punch. ~~The~~ Flakes or blades

~~that are~~ made by ~~the use of the~~ this technique will ~~be~~ have a slightly ~~rest or anvil will have a slightly~~ less accentuated ~~flatter~~ curve and some may be almost flat with little or no curve at ~~there~~ their distal end. The anvil provides inertia and affords a means of imobilizing the working material ~~being worked on and at the same time causes inertia to the~~ which decreases the amount of force necessary to detach a flake or blade ~~object. Upon~~ The impact of the billet also causes the rest or anvil to exert ~~imparts force in the opposite~~ direction ~~from that in which the force is directed causing~~ in an opposite direction resulting in a shearing action ~~to take place~~ of the material. ~~Such an action causes the~~ This produces a flatter flake or blade ~~to~~ be ~~flatter~~ and terminates at a point just ~~beond~~ beyond the edge of the anvil, ~~so that the material being worked on will not be compressed by~~ which avoids compression of the material by the anvil and the force of the blow. ~~Since the anvil causes the material being~~ worked ~~on to become inert~~, ~~less force is nessary to remove the blade~~ causes inertia of the material, needed or flake.

19. Billets with punch , rest and clamp.

This technique eliminates the need ~~for~~ of a second person ~~to hold~~ for holding the ~~material ######~~ being worked on. ~~The clamp, or holding devise,~~ may ~~be~~ There is a varity of ~~methods~~ ways to ~~secure~~ make the core or artifact ~~secure~~. The simplest ~~and most uncomplicated~~ is ~~accomplished by the worker using~~ for the worker assuming a sitting position his heels to hold the objective piece ~~of material while in a sitting position.~~ according to D. Clark ~~Such~~ This a method ~~was~~ has been recently used ~~in recent times~~ by the Africans to make gun flints ~~and was both illustrated and described by J. Desmond Clark,~~ (personal communication) Dr. Clark has conducted numerous experiments on the function of Paleolithic implements, ~~the results ######~~ will be

SEE page 120 "Early Man" LIFE NATURE LIBRARY

By F. CLARK HOWE

(insert on PAGE 48)

most
a# important contribution. Feet and heel holding has also been noted in recent times by Norman Tindale (Stone Implement Making among The Nakako, Ngadadjara and Pitjandjara of the Great Western Desert. From records of the South Australian Museum, Vol. 15, No. 1, 6th Oct. 1965. Also the method of holding is noted by Donald F. Thompson, pp. 400-422, Proceedings of the Prehistoric Society for 1964, Vol. XXX. Francois Bordes and myself have both conducted experiments with this technique resulting in much greater control than the use of simple direct percussi -on,. ## ####### ####### ####### ##### ## ##### ######## ######## ### quite

The technique of holding with the feet alows the objective piece to move slightly and it is hard to excert downward pressure hold the objective piece firmly on the anvil. The slightest movement will cause the flake or blade to be malformed. A holding devise made from two lashed poles and a fulcrum permits a minimum amount of movement and allows the worker to remove blades and flakes with much more accuracy than when using the feet. The intermediate tool or punch may be placed accuratly on a preselected platform area, both the vertical angle and the angle of fracture can then be calculated. Then the velocity of the hammerstone relitive to the size of the hammerstone or billet is calculated to the area of plane of fracture and the texture of the material. The form of the flake or blade is controled by its dorsal surface. A flat dorsal surface creates an expanding flake while a prepared longetudinal crest or ridge will cause a blade to be formed.

The use of the billetwith punch rest and clamp is ~~most useful~~ used for making blades and for the refined percussion flaking of artifacts, ~~usually~~ following direct percussion preforming and prior to final pressure retouch. ~~The flakes and blades detached by this method are characterized by the~~ Characteristic of this technique can be found on the proximal end ~~and particularly the platform~~ or platform of flakes & blades part. The size of the platform is governed by ~~the surface contacted by~~ the size of the tip of the punch or by a special ~~isolation~~ preparation which isolates of the area contacted by the punch. ~~The~~ platform can be the natural cortex, An unalterd plane of fracture, ~~concave~~ a part that has been from the removal of one or more flakes; ~~crested~~ or a crest left from the removal of a flake on either side of the crest; or it can be ground or polished. Should the platform be convex, it usualy indicates that the platform was either isolated, ground or polished. The angle of the platform is variable and is signifigent in determining the core type depending on how the core was formed. , yet should be constant if a single technique was used. The angle is at right angle ~~#####~~ or less than a right angle to the longitudinal axis of the core. The apex of the angle begins at the dorsal side of the flake or blade, ~~and the angle~~ will never slant twards the dorsal side, but rather toward the ventral side.

In general flakes and blades made by the ~~use of the~~ billet, ~~and punch and the aid of a clamp will have uniformity~~ clamp technique are uniform, have generaly small platforms, a salient bulb of percussion and a general absence of erraillure flake scars, which are ~~not found~~ on assemblages made by direct percussion.