The Corbiac Blade Technique and Other Experiments
by Francois Bordes and Don Crabtree

In September, 1967, Dr. Francois Bordes and the writer spent two weeks experimenting with many flintknapping techniques, replicating various artifacts, and analyzing and comparing our work to aboriginal tools. But our prime concern during this work session was the replicating of Corbiac blades and cores which had been previously defined by Bordes as being a method of detaching blades by indirect percussion with punch and rest. This paper will be primarily concerned with the Corbiac technique of blademaking, but will also include a description of the thinning of bifaces by first direct and then indirect percussion without rest; blademaking by indirect percussion with foot holding; blademaking by indirect percussion without rest; and, finally, a comparison of Clovis blades and cores to the latter technique.

Since this paper is primarily concerned with blademaking, it may be well to consider ~~here~~ ~~just what a blade~~ the tech aspects of a blade is. My personal definition ~~of a blade~~ is: a specialized, elongated flake with parallel to sub-parallel lateral edges; its length being equal to, or more than, twice its width. Cross or transverse sections may be either plano-convex, triangulate, sub-triangulate, rectangular, trapezoidal, and with ~~two~~ or more longitudinal crests, or ridges. Typical is trapezoidal. On the dorsal side of the blade there should be two or more scars of previously removed blades with force lines and compression rings indicating that force was applied in the same direction as blade detachment.

In the Summer of 1966, Dr. Francois Bordes, Professor of Prehistory at the University of Bordeaux, Talence, France, excavated an Upper Perigordian site at Corbiac in the Dordogne Valley in Southeast France. This proved to be a very important find, for the site yielded a vast quantity of blades, cores (approximately 1000), burins, and tools in various stages of fabrication; as well as broken, aberrant, and malformed cores. Being not only akeen observer and analyst, but also an inter-

~~national authority~~ on replicating ~~the stone tools of~~ pre national authority on replicating the stone tools of prehistoric man, Bordes realized that the blades he was unearthing were made by a technique other than direct percussion or pressure. These

Description of A Core:

~~The~~ Cores, unlike other artifact types which have definite form, outline, and functional purpose, ~~is~~ are variable. ~~Core~~ Their forms, styles and types are many and the technological patterns variable; each retaining multiple diagnostic traits. Because ~~of its nature~~ the core demands definite techs for blade detachment, it is consistently reduced in size & changing form and character from the time of the first to the last blade ~~removal~~. Then the exhausted or malformed core is either abandoned, or further modifi~~ed~~ into another artifact or simply reduced to useable flakes with sharp cutting edges. End products such as these ~~will~~ would hardly be ~~un~~recognizable as ~~a~~ former cores. A large population of either abandoned or malformed cores usually indicates an abundance of raw material and a blade or blade-tool industry. This paper exphasizes replicating the Corbiac cores and then later compares, by rational theory, the Clovis core style which produced the blades found at Blackwater Draw.

(Details and description of the Corbiac cores to be furnished by Bordes)

Our duplications of the Corbiac core were generally unifacial but a few were ~~bifacial~~ bi-directional. They were almost entirely made from either cobbles ~~and~~ or ovoid lumps of obsidian with outside measurements of from seven to fourteen inches before preforming. After the top of the cobble was removed to provide a platform area, the overall length averaged between six and ten inches.

blades were precision made; ~~they had~~ very small platforms which indicated a punch technique (later two stone punches were found in the site); the curve of the blade was lessened to such a degree that some could almost be called flat which indicated a rest. He carefully examined the vast quantities of tools, both complete and exhausted by use, flakes ~~and~~ and analyzed debitage which included the ~~workers'~~ toolmaker's discards, rejected either because of ~~either due to~~ flaws in the stone, ~~or rejected because of a~~ miscalculations, or an error ~~by the worker~~ in judgement. Always, the worker must either adapt ~~to the undetected~~ to these conditions and errors and, if they are insurmountable, then the piece must be discarded. ~~flaws or variables in stone, working miscalculations and errors in judgement.~~ Any one, or all three of these factors may be involved with any single piece, for There is no exact repitition of factors when one is reducing an irregular mass of flint to blades or tools. This is one of the reasons why debitage is always important because it provides the many stages of development of toolmaking and, in this case, the making of both blades and cores.

Bordes spent his evenings experimenting with and eliminating ~~with~~ various techniques ~~and~~ which included the many individual stages of manufacture in an effort to ultimately resolve the Corbiac technique and ~~to~~ replicate ~~these~~ the blades and cores. After much time and hard work, he was successful in almost consistently reproducing the cores and blades of this culture.

Following are my observations of and participation in the Bordes experiments ~~in the~~ of replicating ~~production of~~ Corbiac blades + cores by indirect percussion with rest.

Preforming the Core: insert page 7

Invariably the preforming of the core is the most difficult and important step of blademaking, and the Corbiac technique is no exception.

If the core is not made right, then the blades will either ~~not detach~~ refuse to at ~~all~~ detach; they will step or hinge fracture; platforms will crush, the end of the core will be detached, etc; or the results will not be replicas. I cannot emphasize too strongly the importance of core preparation. It is impossible to remove true blades from an improperly prepared core and no amount of skill can overcome pood preparation or conquer certain strains and flaws in the material.

A suitable piece of material relatively free of flaws of adequate size and proper texture is selected for the experiment. The size of the rough material selected will depend on just how large a blade is desired and, to some degree, on what is available. Since our experiments were done at my home in Idaho, we used obsidian for it is plentiful here and we had very little flint. We would have preferred to use the flint of the Corbiac culture as obsidian is considerably more brittle than flint and, therefore, more subject to breakage from end shock. However, this substitution of material ~~This~~ did not cause us to use a different technique but only to modify it to conform to the material. In this case we considered this good flintknapping practice and probably an aid to refining the tech, when applied to flint. Always, techniques must be adapted or slightly varied to suit the nature of the working material, for different textures and hardnesses require a variation of techniques. For example, because wer were working with obsidian, we had to strengthen the platform area by grinding; decrease the velocity of the blow, detach thicker blades and use a lighter percussor. This is not always necessary when flint is used.

After the cobble, or mass, of material has been selected for blade-making, the experimenter must mentally orient the proposed core within the cobble. That is, he must calculate to economically remove material from the mass in order to retain as nearly as possible the ultimate size of the nodule and yet properly prepare the core to the desire size and shape. One can never immediately start removing blades from a rounded mass and, therefore, the first step of core preparation is to eliminate the rounded surface and establish a working platform. for preparation of a ridge to guide the first blade. ~~for frugal removal of the cortex to prepare~~ a striking surface for establishing a working ~~ridge.~~

If the cobble is spheroid, an antler billet is used to strike the natural facet on the cobble to remove a flake and establish a working platform. However, if the cobble is rounded and, therefore, has no natural facet, then the worker must establish one - for this facet is needed to serve as the striking area; otherwise the blow will ricochet from the rounded edge when an attempt is made to remove the first flake. Material that is rectangular, blocky and without rounded surfaces is much preferred and more suitable for core and blademaking than round or spheroid cobbles. Angular material often has natural longitudinal ridges which may, after slight modification or unifacial trimming, [redacted] suffice as a ridge to guide the first blade. If the longitudinal ridge is at the corner of a rectangular block of flint-like material, it is relatively simple to prepare the proper platform to facilitate the removal of the first blade. A rectangular block eliminates elaborate preforming and just a slight grinding and polishing of the corner will ready the piece for blade detachment.

To get the first flake off the rounded cobble, the worker uses a medium-sized hammerstone of semi-hard texture. A hammerstone must be used for shaping the cobble for the antler billet would not deliver sufficient force to detach a flake from the rounded surface. The worker strikes an intense blow with the hammerstone almost vertical to the rounded edge of the cobble to remove a flake and thereby establish working angles for further shaping the core. Usually, only one break is necessary to eliminate this rounded surface and establish a working platform for further preparation of the core. After this has been done (either with an antler billet on a natural facet; or with a hammerstone on a rounded cobble to prepare a facet) then the worker is ready to establish a ridge.

Preparing the ridge:

To create the first ridge longitudinally from the top to the bottom of the core, the worker uses an antler billet and strikes with sufficient force on the natural or prepared facet (platform) to remove a single flake from the rounded side of the cobble. The antler billet and direct percussion is used for this flaking process to prevent the strains and shattering which would result from a harder percussor. This is the first step in a series of flakes to be removed along one margin of the cobble in this same manner to establish a ridge. Then the cobble is ~~inverted~~ reversed and struck in this same way from the other side, using the scar of the first flake as a platform surface for removal of the next flake. The worker continues to strike flakes alternately on the edge of the cobble from top to bottom until a ridge is established. An edge, or ridge, made in this manner will be sinuous, or wavey, from the alternate flake scars. If the waves are too accentuated, then the ridge will not be straight enough for blade removal. Therefore, the crests of the waves are removed by striking with the antler billet directly on the crests to detach them and thereby straighten theridge. This ridge will serve as a guide for removal of the first blade. Removal of the initial blade(ridge) will create two longitudinal ridges for removal of additional blades and so on around half the circumfrence of the core. Thispreparation and follow-thru is of the utmost importance because the form and shape of the core controls the type of blade detached.

Severing the Top of the Core:

After the ridge is formed, then the top of the core is removed by any of three methods:

1. Striking the core on an anvil stone
2. By direct percussion with a hammerstone
3. Preparing a platform on the longitudinal ridge and then severing the top by indirect percussion with punch technique.

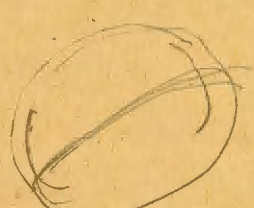
Bordes preferred method 2 but method 3 was more accurate for me.

When a core top is severed, the angle of the blow must be calculated and delivered to create a platform area with an angle corresponding with the core type to be replicated. The top (or platform) surface of the Corbiac core is severed to result in less than a right angle to the long axis of the core. This platform angle is the result of the angle at which the force to remove the core top is directed and this blow must be in line with the pre-established ridge. Since the Corbiac core is prepared with a single ridge and the platform angle is less than forty-five degrees, it will be unifacial and not entirely polyhedral or cylinderical. The back, or the side opposite the working face of the core, usually retained the natural cortex surface. As blades were removed from the working face, they created new ridges, causing the working face to assume a rounded, polyhedral appearance with longitudinal facets. The working edge of the core top then had the appearance of a semi-circle. Sometimes we were successful in detaching as many as thirty useable blades from a core, depending on its size and proper application of manufacturing techniques. Our cores were abandoned when the platform surface was exhausted and they were left with blade scars on the rounded side and cortex on the other.

Angle of Core top:

The top of the core is designed to slant at less than a 45 degree angle away from the apex (~~high point~~ working edge) This provides a bearing surface for seating the punch and prevents the tip of the punch from slipping and ricocheting from the platform part of the working face when the blow is delivered. Because of the acute angle at which the punch is held, it would be impossible to remove a flake or blade if the platform surface slanted toward the working edge.

Other core types which generally do not have the top at this angle overcome the slippage of the punch either by grinding, removing small flakes, to leave ~~to make~~ small depressions ~~leaving~~ (bulbar scars) in which to seat the punch, or by using rough natural erroded surface, but the Corbiac ~~blade requires this~~ core shows none of these characteristics.



Platform Preparation:

A small hammerstone is substituted for the ~~larger one~~ antler billet to isolate the platform area. ~~This~~ Isolation is accomplished by holding the hammerstone in the right hand; the core in the left hand; and pressing and thrusting the hammerstone downward against the top and toward the outer edge of the core above the pre-established ridge. This action will remove small flakes from the leading edge without causing hinge or step fractures. This operation is continued until the center of the platform is oriented above the ridge and in line with the center of the proposed blade. This preparation strengthens the platform part as well as removes any overhang. If isolation is not complete, then small flakes are removed from the top of the core on each side of the platform area until it is properly oriented and isolated. Note that these flakes are removed from the top of the core rather than the leading edge. For additional strength, the platform is then abraided on its top by rubbing with a granular stone other than a flint-like material. This dragging motion of the abrasive stone across the platform part will round the edges and give it a polished appearance.

If the core is prepared on both ends in the above described manner and blades are removed from both ends and terminated by feathering at the middle part of the core, a bi-directional core will result which is sometimes called bi-polar but which, in reality, is not. Bi-polarism is the result of force being subjected simultaneously to the core from both ends.

(Cultural sequence of bi-directional and unifacial cores to be explained here by Bordes)

Seating the Core on Rest:

When the core has been completely preformed and the platform prepared for the first blade removal, it is then placed between the feet on a resiliant support to eliminate shock at the distal end. For our experiments, we used a piece of pine approximately 2 X 2 X 14. The straightness of the Corbiac blades is the result of using a rest ~~which~~ prevents movement of the core as the blades are detached and simultaneously causes force to be exerted at the base of the core when the blow is delivered to the prepared platform. Cores not supported on a rest will produce strongly curved blades. ~~The~~ Corbiac blades are further characterized by the absence of undulaions and waves of compression which are characteristic to those detached from the core by direct percussion with a hard hammerstone. Another distinct feature of the Corbiac blades is their distal end termination. ~~They~~ feather out ~~at their ends~~ without removing any part of the distal end of the core. This is due, in part, to the rest or anvil and can be controlled to a degree by the angle at which the punch is held.

The ~~worker~~ assumes a seated position slightly elevated above the core, holds the core tightly between both feet with the side to be worked away from the worker ~~and pointed toward the toes~~, and its distal end supported ~~on the edge of the wooden rest and its edge overhanging~~. This allows the blades to clear theplank and thereby eliminates breakage. The core is held by the feet in almost a vertical position (or to suit the convenience of the worker) with the longitudinal ridge away from the worker. This vertical position may vary slightly with the worker's preference.

Detaching Blades:

The indirect tool is a cut section of reindeer antler about six

It is possible to use a stone punch when working flint but this would not be satisfactory to use on the more friable materials such as obsidian

inches long with one end shaped to a blunt point. This punch is held in

Two stone punches were found at the Corbiac site where the blades were made of flint. (Bordes to describe)

the left hand and its tip placed and held on theplatform at a low angle. (exact angle to be calculated).

Using a heavy section of antler about fourteen inches long for the percussor, the right hand delivers a blow of sufficient force to the proximal

When working flint, a soft hammerstone may be used in lieu of the antler percussion because some siliceous rocks are not as brittle as vitreous stone

end of the punch to detach the blade. The angled punch as well as the angler percussor acts as a shock absorber and causes the force to be delivered more slowly to the platform of the proposed blade. At present, there is no means of measuring the amount of force necessary to remove a blade from a core, for much depends on the type and size of the material and the blade length desired. Since the blade is first detached at the proximal end of the core and then literally peeled down its face, the amount of force is reduced if the platform is isolated from the core prior to blade detachment. A quick rule of the thumb method to determine the necessary amount of force is to calculate the area on the ventral side of the proposed blade in relation to the material and then formulate the amount of force necessary for detachment. When making blades, the same material should consistently be used, for one becomes accustomed to controlling the blow on a given material and it may take several days to correlate the amount and kind of force necessary when material is used which is different in texture and elasticity. Some materials are worked best with a short high velocity blow with no follow thru; while others are best worked by using a slow blow with a heavy percussor and a follow thru. When working flint, a soft hammerstone may be used in lieu of an antler percussor because some silicious rocks are not as brittle as vitrious stone. Also, it is possible to use a stone punch on flints but this would not be satisfactory to use on the more friable materials such as obsidian. Two stone punches were found at the Corbiac site. (Bordes to describe) Blades leave the core at considerable velocity and must be recovered on some type of soft, yielding material to prevent fracture.

Then the blades are studied and their character compared to aboriginal blades being replicated and each detail noted and evaluated.

The Corbiac blades have very small platforms with the angle corresponding to that of the core before blade detachment. There is a general absence of eraillure flakes on the bulb of force and no fissures radiate from the point of force in the bulbar part. The blades have one or two longitudinal ridges (can't give the percentage) and the curve is so slight as to be almost flat and they are free of undulations on the ventral side. (Further description of blades and dimensions to be inserted here by Bordes) One cache of blades found at Corbiac were as much as forty centimeters long. For our experiments, we had no rough material large enough to attempt replications of this dimension. Corbiac blades are usually feathered and terminated without removing the distal end of the core. At the proximal end, the blade is the width of the platform area which is minute in relation to the size of the blade. At each lateral platform margin, the blade rapidly expands in a curve until it reaches its width limitation and runs longitudinally parallel to the opposite edge to its termination and can vary from parallel to sub-parallel.

In our experiments, the widths of the blades were variable and were controlled by the form of the working face of the core. The more attenuated the ridge and the narrower the core, the narrower the blade. The thickness of the blade is controlled by theposition of the punch and the design of the platform in relation to the core. The nearer the punch is placed to the leading edge of the core, the thinner will be the transverse section of the blade. A blade that is triangulate will have the platform oriented in line with the single ridge on the core and the blade that is trapizoidal in transverse section is one that has had the platform oriented between two longitudinal ridges. The proximal ends of the blades are characterized by very small platforms (relative to the blade size) [of a uniform consistency which cannot be replicated by using direct percussion and a hammerstone or billet.] The size of the platforms are the contact area of the punch's semi-pointed tip. The ~~platforms are of a uniform consistency that can not be replicated by the use of direct percussion and a hammerstone or billet. This technique would not leave consistent platforms of this size.~~ The bulbs of force are not prominent and are generally in line with the ventral surface of the blade. Also, the bulbs are smooth, ~~and~~ usually without eraillure flake scars [and have] ~~There are~~ no signs of shatter scars radiating from the point of force ~~on the bulbar part~~. These features indicate that the interval of contact was [more prolonged] ~~over a longer period~~ than ~~if a~~ [when a] hard blow ~~was~~ [is] delivered by [direct percussion with] a hard hammer ~~using direct percussion~~.

Marginal striations on the ventral sides were not noted on flint blades but were quite obvious on blades of obsidian. Any deviations of straightness of the ridge, or ridges, caused the blades to follow the irregularities [and a misdeformed blade resulted.] If [differential resistance within the material caused] the previous blade scars on the core ~~were~~ [to be] deviant, ~~so were the blades~~ [then subsequent blades would also be deviant.] In some cases, the ridge could be straightened by placing the platform further back from the leading edge of the core and then by placing the platform further back from the leading edge of the core and then increasing the normal amount of force. This detached a thicker blade and thereby straightened the ridge. If an imperfection was encountered on the ridge, it could be ~~altered~~ by ~~removing~~ a series of flakes to straighten the ridge. Some imperfections could not be overcome and then the core had to be abandoned. Should a blade terminate in a step or hinge fracture ~~before reaching the distal end of the core~~, a platform ~~was made~~ on the distal end ~~of the core~~ and the force ~~was directed~~ to intersect, terminate, and detach the blade at the step or hinge fracture. Each error, miscalculation, or imperfection in the material must be considered individually because each presents a different set of problems to the worker. No amount of skill can overcome some of the problems encountered.

When appraising both aboriginal and experimental artifacts to resolve the approximate teahnique, we would agree on manufacturing methods but our ~~personal and~~ individual experiments were somewhat different, yet replication ~~was~~ almost duplicate. As previously mentioned, Bordes had resolved the manufacturing technique of the Corbiac blades, which involved a seated position with the core held between the feet, placing the punch on the platform above the prepared ridge at a low angle and striking away from the body. ~~Although~~ I could ~~make~~ Corbiac blades with this technique ~~I found~~ it more comfortable to ~~slightly vary the seating position~~ of the core and the striking pattern. I assumed the sitting position and placed the core on the rest between the feet with its edge clearing the support but with the working face of the prepared ridge facing me. Then I seated the punch on the platform above the ridge at the same angle previously described in the Bordes' method but with the tip of the punch pointed toward me. The velocity of striking was not changed, but the blow was delivered ~~For the striking pattern, I reached across the core and struck the blow~~ to the punch toward me. This was easier and more accurate for me because it does not require leaning as far forward and also ~~probably~~ because I ~~had~~ been doing a similar but varied blademaking technique for the last six months. This position is more dangerous than the Bordes technique as the blades detach toward the worker, but it has the advantage of being able to see what you are doing. ~~less breakage of the blades~~. This slight variation permitted me to ~~I found it was easier for me to~~ align the punch ~~with~~ the guiding ridge with much greater accuracy and actually view the blade detachment ~~on the face of the core~~. Since a rest was used in both ~~these~~ experiments, the angle of seating the core, striking pattern, punch & rest were the same but only reversed, the termination and flatness of the blades was much the same.

Indirect Percussion Without Rest

When the above described ~~seated~~ position became unduly tiring, I experimented with a more comfortable body position ~~tried sitting on a~~ a l[illegible] little taller stool, placed ~~placing~~ the core on a pad of folded layers of buffalo hide & held it between my knees for both the preforming of the core and detaching blades. This position was more comfortable ~~for me~~ and I was able to make blades with less effort than in the seated position with the core held between the feet. However, the blades made by knee-holding had an entirely different character than those made by the Bordes' technique for this method lacked the ~~with~~ solid support of the core. ~~Many things were the same such as~~ Even though the angle of ~~applying the~~ applied force, the type of blow, the platform preparation were the same, ~~but~~ the lack of support on the base of the core allowed it to be partially projected from the force of the percussor and therefore, ~~Because of this core movement~~, the curve of the blades was more accentuated ~~than those detached with a solid rest.~~ Also, the blades did not feather out and they often terminated with a part of the distal end of the core adhering, ~~and they do not feather out~~ as when the core is supported. This knee-holding experiment did show, however, that fewer blades were broken ~~from shock~~ because the leather pad dampened the shock, and more blades were recovered intact because ~~of~~ the leather pad ~~(support)~~ acted as a cushion for the dorsal side of the blades.

Bordes observation of this technique resulted in additional experiments and slight modification of the Corbiac technique. He tried wrapping the core in a cloth, or any soft material, to ~~relieve~~ lessen the shock ~~to the blade~~ and prevent ~~the~~ projection of the blades and this did reduce ~~the~~ blade breakage. The ideal way, of course, to remove blades intact and reduce breakage ~~without breakage~~ is to regulate the amount of force of the blow ~~so the~~ to a ratio which will detach but not project the blades. ~~blade is detached without being projected.~~ This skill can only be attained by practice and repeated experiments.

Our eexperimentsin blade makeing revealed technological differences which were significant when related to those of the aboriginal. For instance, we noted that blades made by this technique were similar to# the Clovis blades illustrated and described by F. E. Green(The ClovisBlades, American Antiquity, Bol.29, No.2 pages 145-165, Oct.1963 . The major differences between the Corbiac blades and those produced by this technique is the degree of curvature of the blade and, enigmatically, the [is] same [difference] ~~this difference~~ is noted between the BlackwaterDrawbladesand the Corbiac Blades. ¶ ~~Those of~~ The Blackwater Draw [blades] had most of the characteristics of the Upper Paleolithic ~~Corbiac~~ blades, except that they were strongly curvedand they [have] ~~had~~ a marked resemblance to those made by our indirect percussionwithout rest technique. [It] ~~There~~ is no [the] intention [of the writer] to imply that there is [a] ~~any~~ merging of Old and New World techniques but only parallels in methods of [blade] ~~removing blades from cores~~ [detachment]. This may appear to be a minor technological trait but, in reality, this prounced curve in the blde could actually indicate a [the] major difference infabrication. Strongly curved blade are [the result of core] ~~caused by permiting the core to move~~ [moving when] with the blow [is] imparted to the punch. Our experiments [indicated] ~~have shown~~ that ~~in order to~~ remove [of] blades with a [gentle] ~~gentel~~ curve, [was the result of] ~~the core must be~~ imobilized [securly] [the core] ~~by secure holding and the~~ use [of] ~~of~~ a support at [to] ~~the~~ distal end ~~od the core~~. It is interesting to note that a minor change in technology can cause a major technological trait.,which can serve as an archeological tool to determine invention or tradition##, and cultural differences in time and space.

If we mentaly reconsstruct the core [from which] ~~that yeilded the~~ [The] curved Clovis blades [were detached, The Core] ~~it~~ would be quite conical with a pronounced ~~curved, working surface~~; ~~if~~ the platform surface [and related] ~~is related~~ to the angle of the platforms on the blades, and the long axis of the core. There is the possibility that the cache of blades from Blackwater Draw represent the first stage of blade makeing as many still retain the cortex or the natural surface of the natural material. The blades were generaly triangulate, in transverse section indicating that the worker took full advantage of the additional strength provided by the single ridge rather than the weaker trapzoidal cross section when two ridges are used.

It is a common practice to form a regular surface on the working face of a core by first removing cortex flakes and blades. ~~Any~~ Blades made during preforming ~~while makeing~~ to make the surface of the core regular are ~~most~~ useful as cutting implements using ~~with~~ the cortex as backing ~~to serve as~~ for knives ~~and~~ cutting implements.

Strongly curved blades are generaly unsuitable blanks for projectile point manufacture for it would be impossible to flake both surfaceswithout further accentuating this curve. Clovis projectile points vary ~~have a great range~~ in dize and form but ~~and~~ only the smallest could be derived from blades of the dimention of those from Blackwater Draw. (James M. Warnica, New Discoveries at the Clovis Site, Vol.31, no.,3, Part 1, Jan. 1966) The majority of ~~the~~ Clovis projectile points indicate that they were derived from preforms considerably larger than the finished artifact. (Distribution of Fluted Points In Arizona, Larry D. Agenbroad, The Kiva, Vo.32,No., 4, April 1964. An Early Man Site At Big CamasPrarie, South Central Idaho, B. Robert Butler Vol.6,No. 1, 1963. Elephant-hunting in North America, C. Vance Haynes, Jr. Scientific American, June, 1966. and Ancient Man In Notth America H. M. Wormington Most of these Clovis projectile points indicate that they were not derived from blades but rather large primary and secondary flakes ~~or by the core technique rather than being derived from blades~~ or by the core technique. None bear the characteristic ventral surface of a blade and there ~~but~~ ~~only~~ are occasional scar remnants of the initial preforming which indicates that the actual points were made from material larger than the Clovis blades represented at Blackwater Draw. Therefore at present one can assume ~~for now~~ that blade makeing encompased s seperate group of technological traits not related to projectile point manufacturing. However, the Clovis blades ~~as~~ represented in the Blackwater draw ~~Green's~~ cache is incomplete and until future blades and, hopefully, cores are unearthedmany technological details will remain uncertain.

Also in ~~this same paper by~~ Green, report there is an illustration (Am. Ant. Vol 29, No.2, Page161, 1963) showing one face of a core from a surface collection in ~~sirface cp;;ectopm on~~ Comanche County, Texas. This core is almost duplicate to cores we produced with the Corbiac technique. The blade scars indicate that the same platform and core preparation was used and, therefore , the blades removed from the core should have been comparatively flat and feathering at their termination. The Texas core still bears the lateral flake scars which are the result of preparing the ridge to guide the firstblacd. This core is typical of a Corbiac core and , therefore, should######## produce blades that have a slight curve, small striking platforms and unaccentuated bulbs of force.

Conclusions: The technique without rest resulted in typical Blackwater Draw Clovis style blades and the Corbiac technique produced cores much the same as the core found in Comache County, Texas. The presence of Clovis blades in the New World does not necessarily indicate a blade culture, but only an industry and ~~[illegible]~~ the knoweledge of blademaking. Blades ~~being~~ are suberb cutting implements , particularly for dismembering large games ~~and~~ They upon becoming dulled, they may be modified into other assorted tools with a minimum of effort. The limited ~~finding~~ finds of whole blades and cores would seem to Indicate a shortage of suitable raw material; for blademakeing is a conservation measure as well ~~aiding portability~~ as a means of avoiding transporting surplus material a long distance from the quarry.

Blade industries are represented in many parts of the New World from the Arctic into South America. Technologically, blademakeing encompasses a wide range of variations and modes of detachment, ~~from the core,~~ various flintknapping tools methods of applying force-such as direct percussion, indirect percussion, pressure, and any combinations of the three, ~~and the implements used to apply the force~~. Numerous techniques and technological traits are represented in both forming and preparation of the surfaces prior to removing blades. Last but not least is ~~raw material, quality and orign~~ the of the raw material - the relationship of technique to the raw material

Thinning of Bifaces:

The use of indirect percussion with punch technique was further tried for thinning large bifacial implements such as knives, lance and spear points, large thin discs and flaked scrapers. The artifact is first preformed from a large thick flake, or by removing most of the surplus material from a large nodule or rough mass of quarry material by direct percussion with an antler billet or hammerstone; and then later refined with the indirect percussion technique.

Preforming by Direct Percussion:

(1) The rough material is placed on the thigh of the left leg which is covered with a pad of several layers of buffalo hide. This padding supports the objective piece and, at the same time, dampens the shock induced by the percussor. During the preforming stage of manufacture, the objective piece is held on the outside of the left thigh (and not on top). The support provided by the padded thigh relieves the left hand of entirely supporting the objective piece and the hand is then free to manipulate the piece into position to receive the blows of the percussor. The pad also prevents the left hand from being bruised or cut from the flakes as they are detached from the objective piece.

When maximum thinning and forming has been accomplished by direct percussion, then the marginal edges are turned or beveled. This is done by pressing the edges of the artifact on a basalt cobble until the correct angle is attained. (The angle is variable, depending on the form of the piece being worked) Then the longitudinal edge is rubbed on the basalt cobble until the leading edge is slightly rounded. This beveling and grinding strengthens the edges so that any part of the edge can be used as a striking platform and, therefore, individual platform preparation is eliminated during the next step of further thinning the artifact by indirect percussion.

Thinning by Indirect Percussion with Punch:

(2) Now that the worker has reached the limitation of thinning and forming the artifact by the direct percussion technique (1), he further refines the piece by indirect percussion with punch. (2)

Now The objective piece is placed on the pad on the inside of the left thigh with its flat side resting on the pad and the leading edge upright for striking to detach flakes on the side resting on the left thigh. The knees are pressed together to hold the artifact in position. Only the edge of the objective piece is exposed to permit the tip of the punch to be placed on the prepared platform part. I find that the artifact being supported lengthwise on the leather pad & held firmly by the pressure of the thighs has a dampening effect which reduces the amount of breakage when detaching large, thin, wide flakes. The angle of the punch is approximately the same as that used in detaching blades from the core.

However, unlike the detaching of blades from a core, we are not using a ridge to guide the flake removal. Therefore, without this guiding ridge, two angles of force must be considered. Since there is no ridge, the flake is allowed to expand and the force must be directed across the face and into the body of the mass. The punch is held on the platform edge at the same angle used for detaching blades from cores (vertical to the long axis of the artifact) but the tip of the punch is pointed toward the distal end (tip) of the artifact. The blow is delivered to the punch to direct the force across the face toward into the center of the artifact toward the distal (tip) end of the artifact. The angle of the punch is gradually increased as flake removal nears the middle of the artifact.

When flakes have been removed along the first marginal edge to approximately midway between the distal and proximal ends, then the punch is held at an angle with its tip pointed toward the proximal end (base) and the force is directed across the face toward the center and proximal end of the artifact. The punch is held vertical to the long axis of the artifact, otherwise the artifact will be broken in the same manner a stoneworker uses to make a cutting edge on a trancient cleaver. The flake will have to terminate in the midsection of the artifact, otherwise it will remove the opposite edge. Again, the angle of the punch is increased as flake removal nears the tip of the artifact. This reducesbreakage.

The punch is struck a sharp quick blow with no follow through. If a heavy blow is struck with a heavy percussor and a follow through used, the opposite edge of the artifact will be removed. For extreme thinning, a caribu antler percussor is used because caribu has a flared, flat surface and the blow can be delivered on the flat part. ~~giving a~~ This gives a greater contact surface , thereby increasing the accuracy of the blow. Because the weight of the artifact is less than a core, the blow is modified. The worker strikes the punch a short quick blow with greater velocity which prevents undo movement of the artifact. This allows extreme thinning because it removes a thin,rapidly expanding flake which will terminate in a hinge fracture at the median line of the artifact. The curvature of the flake determines the convexity of the transverse section of the implement. Usually, one entire margin is worked in this manner and then the artifact is reversed and the same technique applied, but having the flakes intersect the previously struck flake scar.

Thinning a biface with this technique is difficult and requires much experimenting to judge the proper intensity of the blow and to dissipate the force before the flake travels across the entire surface of the artifact and removes the opposite side. This technique produces flake scars which are very similar to those found on the Simon site material (Tebiwa, Vol)

and Debert bifaces (D.S. Byers and G.F. MacDonald)

Indirect Percussion with Foot-Holding

Thisexperiment involves the further thinning of a biface which has been previously preformed ~~by~~ with an antler billet and simple direct percussion ~~using an antler billet~~. After this initial step, the preform is placed on the ground, (or a layer of damp sand) held in place by the foot and further thinned by indirect percussion with an antler billet and an antler punch. In this instance, the percussor was a splayed section of reindeer antler.

The platform surface of the preform is ~~further~~ prepared by beveling and grinding the edge to strengthen it to withstand the force. Then the artifact is placed ~~on the ground~~ in a horizontal position with the long edge of the beveled side flat on the ground, carefully nested until it is evenly supported by the earth or sand. Then the worker kneels on the right knee with the body bent forward. To stabilize the body, The left knee is positioned at the left side of the upper chest ~~to stabilize the body,~~ and the left foot is placed on top of the artifact, but with the beveled edge exposed. Only slight pressure is exerted on the artifact by the left foot, as too much pressure, or an irregularity of the support, will cause the artifact to be broken when force is imparted to the punch.

The punch is grasped in the left hand by the thumb and fingers and held vertical to the long axis of the artifact but slanted away from theoperator at an obtuse angle. The exact angle is determined by the cross section of the artifact and by experiment. To insure firm seating, ~~of~~ the tip of the punch isplaced as near as possible to the leading edge and yet not into the body of the artifact. If the punch isplaced too far in from the edge, either an excessively thick flake will be removed or the objective piece will break. Also, if the tip of the punch is placed too far inward from the leading edge, the platform part of the flake will expand and a large lunate section will be removed from the lateral margin of the artifact causing malformation.

Generally, for the first flake removal, the punch is placed on the lateral margin at the base of the artifact. This is the strongest part of the artifact and, therefore, permits the experimenter to be fairly bold with the first blow without danger of causing an unpredictable fracture of the objective piece. This blow will be the criteria for further blows and, therefore, one should examine the results to determine if the flake and scar have the anticipated character. If the flake is too short, then the angle of the punch may be re-positioned to direct the force more inward into the body of the implement being fabricated. If the flake is too long, then the angle of the punch is held closer to the body of the worker. The amount of force is delivered in accordance with the size of flake desired. Only experiment can determine the amount of force needed.

Flakes are removed bilaterally from both margins in this same manner and the force is gradually dissipated as the flakes conformingly are reduced in size as the thinning process nears the tip of the artifact. When one margin and one face has been flaked, then the edge is re-prepared for removal of the next series of flakes from this same edge but detached from theopposite side.

Our experiments with this technique were successful and we concluded that it had possibilities of having been used aboriginally. However, we felt that additional experiments were necessary before any definite conclusions could be reached.

The techniques of foot-holding and knee-holding (previously described) are the same, except for the manner in which the artifact is held. The one major disadvantage of foot-holding is that the flake is removed from the blind side of the artifact, whereas the knee-holding technique permitsinstand examination of both flake and flake scars.

For those who are not familiar with working stone it seems fitting to mention here a few points regarding blade scars which ~~that~~ may help with analysis. To determine the sequence of blade removal from a core, it is well to make note of the striations found on the lateral margins on the ventral sides of the blades and their opposite, or negative, duplications on the lateral margins of the blade scar on the core. The striatons, or minute fissuring, is caused by the compression of the blade material as it is removed from the face of the core. Striations are generally more obvious on vitrious materials than they are on stone of a coarser texture. Marginal striations are tangent and oblique to the marginal edge and slant upstream toward the proximal end of the blade to the point of applied force. Only a complete blade scar will have the striatons on both sides, or the lateral margins. For example, the last blade removed from a core will have striations on the lateral margins of both the core and blade. On the other hand, a core scar with striations on one lateral margin will indicate that a second blade was removed which eliminated the striations from one edge of the blade scar on the core.