20. THE MANUFACTURE OF FLINT IMPLEMENTS BY THE INDIANS OF NORTHERN AND CENTRAL CALIFORNIA

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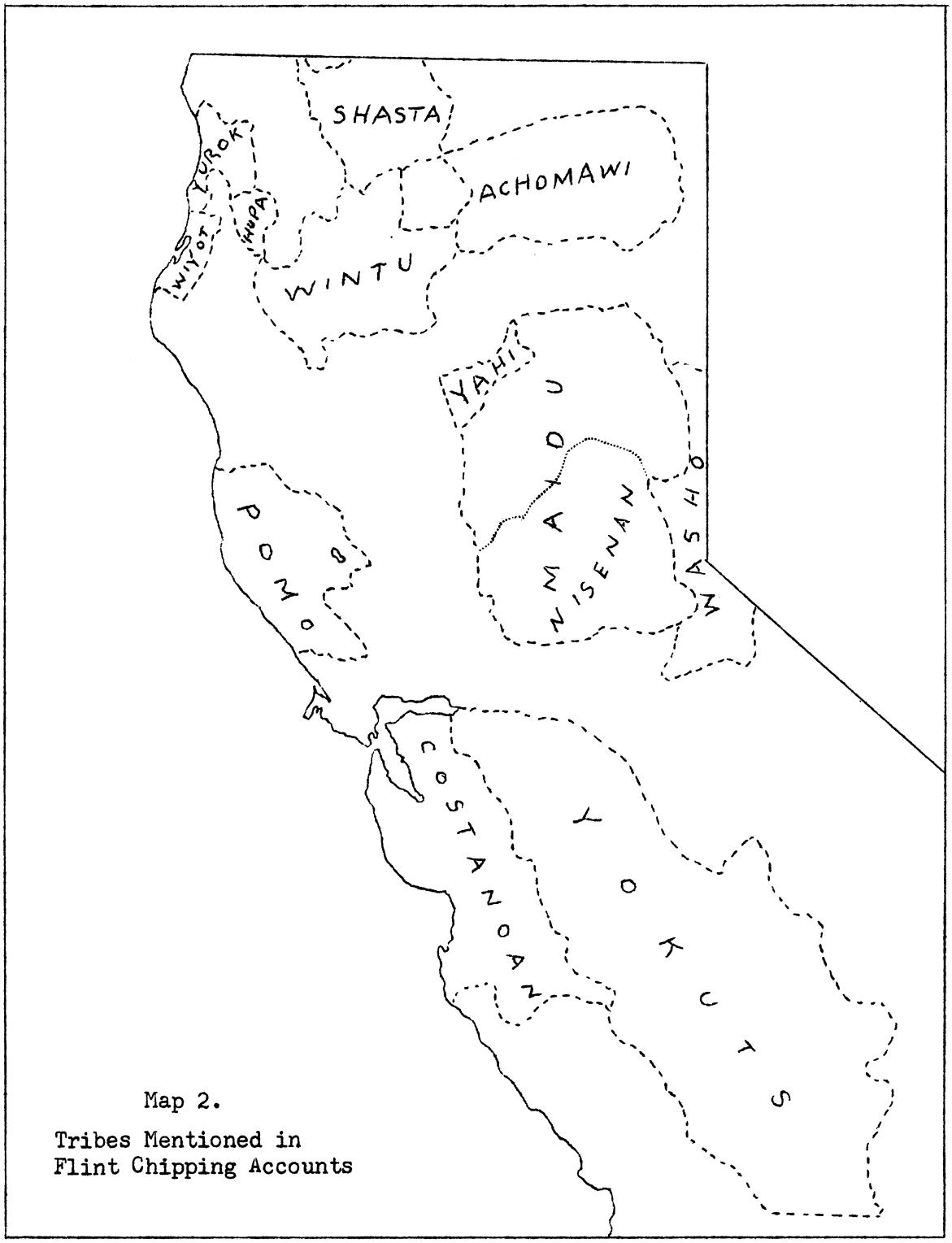
The widespread manufacture and use of chipped stone implements and weapons by the Indians of California appears to have been abandoned almost directly according to the spread of white influence in the state. In those areas most affected by missionization, priestly strictures against the making of weapons, the new availability of metal implements, and the overall cultural disturbance and decrease in population speedily combined to extinguish the art of working in stone. The subsequent exploitation of the state's agricultural and mineral resources in its central and northerly regions had the same effect among those aboriginal groups which did not flee these areas. It is not strange, therefore, that firsthand accounts of the actual techniques employed by the Indians in the production of chipped stone artifacts are rare in the ethnographical literature, nor that most of such accounts are concerned with tribes in the peripheral areas of the state. Actually, however, owing in large part to the general increase in interest in Indian life which became especially manifest in the latter part of the last century -- which period coincided in California with the settlement of whites in the more remote areas of the state -- California is relatively fortunate in having a more complete record of many of its aboriginal peoples than is usual for the remainder of the country. The diligence in recording of many of its early settlers and the thoroughness of its pioneer ethnographers must also be given full credit here. Thus it is that more detailed accounts of Indian flint chipping are available from California than from most other areas of the continent.

Sixteen of these accounts are brought together in the present paper. These concern eleven tribal groups in two areas of the state: the northern area (Northwestern and Northeastern California) and the central area (the Interior Valley and the regions on either side to the borders of the state). No truly exhaustive attempt at locating all such accounts in print has been made, the present purpose being only to make available together a number of descriptions of flint chipping, most of which are difficult of access in any but the largest libraries. Nor has an effort been made to compare these descriptions, all of which presumably are written by eyewitnesses, with others in the ethnographic literature obtained by word of mouth from informants. Aside from the brief analysis at the end of this paper, no interpretation of these data with reference to the general subject of flint chipping has been attempted. Readers interested in detailed treatments of flint chipping techniques are referred to Holmes (1919), Barbieri (1937), and Ellis (1940).

The reader will notice that all of the following descriptions refer to the manufacture of arrow points. It probably is only natural that the interest of white observers would be directed to arrow point chipping, in which form the stone flaking art reached its highest expression in California, rather than to the production of the more utilitarian objects of chipped stone. But it may also be that the availability of metal implements had rendered



Map 2.

Tribes Mentioned in
Flint Chipping Accounts

largely unnecessary the manufacture of the common stone implements by the time these reports were written. There are indications in several of the following accounts that the chipping even of arrow points persisted as much for sentimental as utilitarian reasons.

NORTHERN CALIFORNIA

YUROK. (K. von Loeffelholz) [1]

"The Indians now use thin points of metal for arrowpoints but more often employ splinters of stone, topaz, flint, or the like. Now they also use bits of broken glass bottles. The iron points probably came earlier through trade from Oregon or Vancouver Island."

"The stone arrowpoints were beautiful and artistic; they were made with sharp, sawtoothed cutting tools from flakes of different silica or semi-precious stones. There was no flint in the locality. Small flakes were pried loose from the edges of the siliceous splinters by means of a quadrangular piece of stag horn. The big flake was tied to a stick about fifty centimeters long to permit better handling. The end of this stick was held close to the body by the upper arm and the prying was done with the piece of stag horn held in one hand. The stone tip was held in a piece of deerskin between the thumb and the index finger of the left hand and thus could be twisted and turned. Later on they liked to use green bottle-glass, which could be chipped more easily and could be made more quickly into arrowpoints. They also prepared metal points from barrel hoops, etc. They shaped these by means of three-sided saw files and fixed them with long barbs."

YUROK. (P. Schumacher) [2]

" The manufacture of arrow and spear heads, knives, and adzes, and in general of all such implements as are made of flint, obsidian, jasper, etc., and which have sharp points and edges -- if we suppose that the ancient people were a kindred race with the present Klamath (Yurok) Indians -- may be described as follows: A piece of one of the above-mentioned stones, which breaks sharp-cornered, and with a conchoidal fracture, is heated in the fire, and then rapidly cooled, after which it is struck on the break-edge, by which means it is split into flakes. To such a flake a suitable rough shape is given by striking it with a tool. . . . the real manufacture commences. A piece of bone is fastened to a wooden shaft 1 1/2 feet in length, the working point of which is crooked and raised to an edge. The applications to be made of this instrument [require] . . . only a pushing force. To guide the instrument with a steady hand the handle is held between the arm and breast, while the point, with but little play-room, assisted by the thumb, works on the edge of the flake, which again is held, for greater safety, in a piece of deerskin. After the two sides have been worked down to a point, then another instrument is required, with which the barbs and projections are broken out. This is a needle or awl, of about three inches in length, and by a pushing motion the desired pieces are broken out in the same manner as with the first mentioned tool."

YUROK. (E.G. Waite) [3]

"The rock of flint, or obsidian, esteemed by the natives for arrow-pointing, is broken into flat pieces, after the manner usually described. When the pieces have reached a proper size for arrow-heads, the mode of finishing is in this wise: The palm of the left hand is covered with buckskin held in its place by the thumb being thrust through a hole in it. The inchoate arrow-head is laid on this pad along the thick of the thumb, the points of the fingers pressing it firmly down. The instrument used to shape the stone is the end of a deer's antler, from four to six inches in length, held in the right hand. The small round point of this is judiciously pressed upon the edge of the stone, cleaving it away underward in small scales. The buckskin, of course, is to prevent the flesh from being wounded by the sharp scales. The arrow-head is frequently turned around and over to cleave away as much from one side as the other, and to give it the desired size and shape. It is a work of no little care and skill to make even so rude an instrument as an arrow-head seems to be, only the most expert being very successful at the business. Old men are usually seen at this employment."

YUROK AND HUPA (P.H. Ray) [4]

"The bow-makers of both these tribes are specialists, and the trade is now confined to a very few old men. I have seen here no man under forty years of age that could make a bow or an arrow, and only one old man who could make a stone arrow-head."

"The arrow-heads used in war and for big game are usually made from flint and obsidian, and more recently of iron and steel. The flakes for the stone heads are knocked off by means of a pitching tool of deer antler. The stone heads are made with a chipper composed of a crooked handle to which is lashed a short piece of antler precisely similar to those which I collected at Pt. Barrow. The work is held in the left hand on a pad and flaked off by pressure with the tool in the right hand in exactly the same manner as I found the Innuits doing in Northern Alaska."

HUPA. (P.E. Goddard) [5]

"The points of the arrows are of obsidian, flint, bone, or iron, and are now sometimes made of bottle-glass. After a suitable piece of obsidian, flint, or glass has been removed with a blow it is worked into shape by placing it on a piece of buckskin laid on the left palm and held with the fingers of the left hand and applying pressure with an implement held in the right hand. The flaking tool consists of a piece of antler lashed to a stick of wood about fifteen inches in length. This handle passes back through the hand and along the fore arm, giving leverage for considerable pressure. Old Rodger, the only Hupa who can now chip stone, made two arrow-points of black obsidian in about two hours' time. One of these he condemned and the other did not satisfy him. He did the first flaking on each with a large flat file, applying pressure with the tip of the handle end. The latter part of the work he did with the primitive implement, finishing with a large blunt awl."

WIYOT. (S. Powers) [6]

"It was often a source of wonder to me how the delicate arrow-heads used on war-arrows, with their long, thin points, could be made without breaking them to pieces. The Viard proceed in the following manner: Taking a piece of jasper, chert, obsidian, or common flint, which breaks sharp-cornered and with a conchoidal fracture, they heat it in the fire and then cool it slowly, which splits it in flakes. The arrow-maker then takes a flake and gives it an approximate rough shape by striking it with a kind of hammer. He then slips over his left hand a piece of buckskin, with a hole to fit over the thumb (this buckskin is to prevent the hand from being wounded), and in his right hand he takes a pair of buck-horn pincers, tied together at the point with a thong. Holding the piece of flint in his left hand he breaks off from the edge of it a tiny fragment with the pincers by a twisting or wrenching motion. The piece is often reversed in the hand, so that it may be worked away symmetrically. Arrow-head manufacture is a specialty, just as arrow-making, medicine, and other arts."

SHASTA. (C. Lyon) [7]

"The Shasta Indian seated himself upon the floor, and laying upon his knee the stone anvil, which was of compact talcose slate, with one blow of his agate chisel he separated the obsidian pebble into two parts, then giving another blow to the fractured side, he split off a slab some fourth of an inch in thickness. Holding the piece against the anvil with the thumb and finger of his left hand, he commenced a series of continuous blows, every one of which chipped off fragments of the brittle substance. It gradually assumed the required shape. After finishing the base of the arrow-head (the whole being only little over an inch in length) he began striking gentler blows, every one of which I expected would break it into pieces. Yet such was their adroit application, his skill and dexterity, that in little over an hour he produced a perfect obsidian arrow-head. I then requested him to carve me one from the remains of a broken porter bottle, which (after two failures) he succeeded in doing. He gave as a reason for his ill success, he did not understand the grain of the glass. No sculptor ever handled a chisel with greater precision, or more carefully measured the weight and effect of every blow, than this ingenious Indian, for even among them, arrow-making is a distinct trade or profession, which many attempt but in which few attain excellence."

ACHOMAWI. (E.G. Beckwith) [8]

". . . One of them seated himself near me, and made from a fragment of quartz, with a simple piece of round bone, one end of which was semi-spherical, with a small crease in it (as if worn by a thread) the sixteenth of an inch in depth, an arrowhead, which was very sharp and piercing, and such as they use on all their arrows. The skill and rapidity with which it was made, without a blow, but by simply breaking the sharp edges with the creased bone by the strength of his hands -- for the crease merely served to prevent the instrument from slipping, affording no leverage -- was remarkable."

POMO. (H.C. Dulog) [9]

"The old expert put on his left hand a piece of buckskin, with a hole cut in it to let the thumb pass through, something like the 'palm' used by sailmakers. This was of course to protect his hand while at work. In his right hand he took a tool of bone ground down to a blunt point. These tools, made often from the leg bone of a deer, are assorted in sizes, large ones being used for coarse work and small ones for fine work.

"A piece of obsidian of the right size was held in the left hand, then the right thumb was pressed on the top of the stone, while the point of the bone was strongly pressed against the under edge of the proposed arrow head, and a little splinter of obsidian worked off. The operation was similar to the opening of a can with one of the old-fashioned can openers that work without leverage. Oftentimes material is spoiled in the sharpening. Around deserted camps piles of rejected fragments are sometimes found, either broken in putting on the edge or not being near enough the desired shape to pay for working up.

"A good deal of the sharpener's work, too, consisted in freshening up the edges of points blunted by use. One arrow head, weather-worn by exposure, was shown me, with a border of fresh fractures extending from one-eighth to one-fourth of an inch in from the edge, where the sharpener's tool had been.

"There results from this process a serrated edge, which in the best specimens is beautifully fine and regular, but in rougher tools is often coarse."

WINTU. (B.B. Redding) [10]

"He brought, tied up in a deer skin, a piece of obsidian weighing about a pound, a fragment of a deer horn split from a prong lengthwise, about four inches in length and half an inch in diameter, and ground off squarely at the ends -- this left each end a semecircle, besides two deer prongs (Cariacus columbianus) with the points ground down into the shape of a square sharp-pointed file, one of these being much smaller than the other. He had also some pieces of iron wire tied to wooden handles and ground into the same shapes. These, he explained, he used in preference to the deer prongs, since white men came to the country, because they were harder and did not require sharpening so frequently. . . . Holding the piece of obsidian in the hollow of the left hand, he placed between the first and second fingers of the same hand the split piece of deer horn first described, the straight edge of the split deer horn resting against about one-fourth of an inch of the edge of the obsidian -- this being about the thickness of the flake he desired to split off: then with a small round water-worn stone which he had selected, weighing perhaps a pound, he with his right hand struck the other end of the split deer horn a sharp blow. The first attempt resulted in failure. A flake

was split off but the blow also shattered the flake at the same time into small fragments. He then repeated the operation, apparently holding the split deer horn more carefully and firmly against the edge of the large piece of obsidian. The next blow was successful. A perfect flake was obtained showing the conchoidal fracture peculiar to obsidian. ... The shape naturally taken by the obsidian when split off in this manner is that of a spearhead, and it could be put to use, for this purpose, with but slight alteration. The thickness of the flake to be split off depends upon the nearness or distance from the edge of the obsidian on which the straight edge of the split deer horn is held at the time the blow is struck.

"He now squatted on the ground, sitting on his left foot, his right leg extended in a position often assumed by tailors at work. He then placed in the palm of his left hand a piece of thick well-tanned buckskin, evidently made from the skin of the neck of a deer. It was thick but soft and pliable. On this he laid the flake of obsidian, which he held firmly in its place by the first three fingers of the same hand. He then rested the elbow on the left knee, which gave the left arm and hand holding the flake, firm and steady support. He then took in his right hand the larger of the two deer prongs, which, as has been stated, had its point sharpened in the form of a square file, and holding it as an engraver of wood holds his cutting instrument, he commenced reducing one edge of the circular form of the flake to a straight line. With the thumb of the right hand resting on the edge of the left palm as a fulcrum, the point of the deer prong would be made to rest on about an eighth of an inch or less of the edge of the flake, then with a firm downward pressure of the point, a conchoidal fragment would be broken out almost always of the size desired. The point of the deer prong would then be advanced a short distance and the same operation repeated, until in a few minutes the flake was reduced to a straight line on one edge. As this operation broke all the chips from the under side of the flake, if left in this condition the arrowhead would be unequally proportioned, that is, the two cutting edges would not be in the center. He therefore with the side of the deer horn firmly rubbed back and forth the straight edge he had made on the flake until the sharp edge had been broken and worn down. The flake was now turned end for end in the palm of his hand and the chipping renewed. When completed an equal amount was taken from each side of the edge of the flake and the cutting edge was left in the center. It was now plain that the straight edge thus made was to be one side of the long isosceles triangle, the form of the arrowheads which is used by his tribe.

"With the flake of obsidian firmly held in the cushion of the left palm and the point of deer horn strongly pressed on the edge of the flake, the effect was the same as the blow which split the flake from the larger piece. While, however, he was not always sure of the effect of the blow in splitting off the large flakes out of which to make the arrowheads, he in no instance appeared to fail in breaking out with the point of deer-prong the exact piece desired. The soft thick pliable piece of tanned deer skin on which the flake in his left palm was held, may have added to the cushion, but seemed to serve no other purpose than to save his hand from being cut by the countless sharp chips as they were broken off. One of the long sides of the arrowhead having been thus formed, the flake was turned over and the other side formed in the same manner. As, however, very much more of the obsidian had to be chipped away, he brought more pressure upon the point and broke out larger chips until the flake began to assume the shape desired, when the same care was exercised as when the first straight edge was made. In

breaking out large or small chips the process was always the same. The pressure of the point of deer horn on the upper edge of the flake never appeared to break out a piece, which, on the upper side, reached beyond where the point rested, while on the under side the chip broken out might leave a space of twice the distance. Invariably when a line of these chips had been broken out the sharp edge was rubbed down, the flake turned end for end and the chipping renewed on the other side. By this process the cutting edges of the arrow head were kept in the same line. The base was formed in the same manner. . . .

"The chipping out of . . . (the side notches) . . . was the last operation to be performed. It seemed to me more difficult than any other part of the work, and I thought that in this would be the danger of the loss of all the patient labor that had been expended. In practical operation it was the simplest, safest and most rapid of all his work. He now held the point of the well-shaped arrowhead between the thumb and first finger of his left hand with the edge of the arrowhead upwards, the base resting edgewise on the deer-skin cushion in the palm. He then used the smaller deer prong, which had been sharpened in the same form as the larger one, but all its proportions, in every respect, were very much smaller; its point could not have been larger than one sixteenth of an inch square. He rested this point on the edge of the arrowhead where he desired to make the slot, and commenced sawing back and forth with a rocking motion, the fine chips flew from each side, the point of the deer horn descended, and in less than a minute the slot was cut. The arrowhead was turned over and the same operation repeated on the other edge. It seemed that by this process, if he desired, the arrowhead could have been cut in two in a very few minutes. He now examined his work in the strong sunlight and, being satisfied, handed me the completed arrowhead. It had taken him forty minutes to split the two flakes from the large piece of obsidian and chip one of them into the arrowhead. A younger man, equally expert, would probably have done the work in half an hour."

YAHI. (S.T. Pope) [11]

"Ishi breaks these (obsidian) boulders by hitting them with another rock, but he recognizes the danger of flying glass, and dislikes the job. Having obtained fragments varying from 2 to 4 inches long, 1 to 1 1/2 inches wide, and about a quarter of an inch thick, he is prepared to flake his haka or heads.

"Sitting down with his elbows steadied on his knees and the palm of his left hand protected by a doubled piece of buckskin or leather, he holds the obsidian pressed between the fingers and palm in supination. Then with a piece of deer or elk horn filed or rubbed to a flat point he presses upon the lower edge of the obsidian, evenly and with increasing force, downward and outward until a fracture of the glass occurs. These fractures take a semi-lunar shape, thinning to a fine edge, and vary in size from a sixteenth to a half an inch in their greatest diameter. The first flakes are large and freely made, calculating to give by wide transverse lines of cleavage, and to establish the fundamental outlines of the point. Later these flakes are smaller and more like finishing touches. As he flakes, he turns the stone from side to side, working the opposite faces alternately, all the time

keeping a sharp eye for nicety of form and taking advantage of the natural shape. The flaking tool he now uses is not horn but iron or soft steel. Hard steel is no good. He uses quarter-inch galvanized wire, a piece a foot long, bound with cloth two inches from the point to form a handle. This large tool he rests under his forearm, deriving leverage thereby, and uses it to flake the hardest portions of his stone.

"Smaller tools are made of wire nails driven into wooden handles six inches long. All of these are filed to a flat rounded point, something like a blunt screw-driver. In working the obsidian this edge is held vertical to the stone and the shaft of the flaking tool in the plane of the left palm. Apparently the soft metal permits the glass to make a small dent in it which engages the two and allows pressure being applied to the edge to be flaked.

"As Ishi develops the form of his arrow head to a graceful acute angle, he changes to a finer flaking tool and resting the stone on his protected thumb, he then makes the little indentations near the base, which permit the sinew to hold the head of the arrow. Never once during this process does he hit or beat the obsidian. No rough force is required, just patient, artful dexterity and strength of fingers."

MAIDU. (E.E. Chever) [12]

"The arrows are of two kinds, those with a head of hard, pointed wood for common use and those reserved for extreme cases of attack or defense, having points of agate or obsidian, which are carefully kept in the skin of a fox, wildcat or otter. The stone arrowheads are made with great care, and the materials from which they are made are often brought from long distances. Obsidian and agate are probably selected not so much for beauty or coloring as for their close grain, which admits of more careful shaping. They use a tool with its working edge shaped like the side of a glazier's diamond. The arrowhead is held in the left hand, while the nick in the side of the tool is used as a nipper to chip off small fragments. An Indian usually has a pouch of treasures consisting of unfinished arrowheads or unworked stones, to be slowly wrought out when industriously inclined."

MAIDU. (M.L. Miller) [13]

"Not every Indian could make an arrowhead, for it required a skillful workman. The process of manufacture was as follows: The material for the arrowhead was heated to a certain temperature, when it was chipped as desired with a spikelike stone implement, which was dipped in cold water, placed quickly upon the hot flint, and the necessary stroke given. The drop of water coming in contact with the hot flint and the simultaneous strcke cut the chip off about as desired. A rough stone was used to grind the points and edges into shape."

NISENAN (SOUTHERN MAIDU). (J.F. Snyder) [14]

". . . holding the quartz splinter on its edge with his left hand, on a smooth bowlder as an anvil, he gently tapped the stone, first on one edge,

then on the other, striking off a tiny chip at each stroke until he soon had it reduced approximately to the dimensions he required. He had before seating himself removed his quiver from his shoulder, and at this stage untied from its strap a buckskin string that suspended the point of a deer's horn, 7 or 8 inches in length, notched or grooved at its small end in a peculiar manner that I had not before noticed. . . . Now spreading the broad tail flap on his quiver in the palm of his left hand, with its inner or dressed side up he placed upon it the quartz splinter he had blocked out, and held it firmly in place with the two smaller fingers of the hand clasped over it. With the point of his horn punch he then, by firm and careful pressure, broke from the edges flake after flake from the point of the embryo arrowhead along to its base. Stopping a moment to inspect the stone, he would reverse it and repeat the cautious pressing on the other edge until directly its outline was that of the ordinary leaf-shaped, flint implement. He now reversed his deerhorn punch, when I noticed that it was ground, at its upper or large end, to an obtuse or diamond point at one side, somewhat like that of a wood carver's bruin. Applying this stout point, by the same mode of pressure as before, to each side of the broad end of the stone alternately, the stone now resting for solid support on the heavy muscles at the base of the thumb, he soon chipped out the indented, lateral notches, defining the shank of the arrowhead, which was now finished as completely, and perfectly proportioned, as any I ever saw."

YOKUTS. (F.F. Latta) [15]

"The most common method of chipped point manufacture depended upon the breaking from a large piece of stone of a suitable flake. This flake was thrown off from the stone by means of a heavy blow. The hammer generally used was a heavy piece of bone, often the shin bone of a deer or elk, the blow being struck with the end of the bone.

"By some manufacturers the large fragment of stone was held against a lump of stiff clay and the flake thrown off between the clay and the stone. It is explained that this kept the blow from fracturing the flake itself. If the flake was quite large and a large spear point or knife was to be made from it, it was placed against the same lump of clay and further reduced by blows. These chips were removed with the bone hammer in the same way that the first flake was obtained. In this manner the flake was roughly reduced to shape.

"The remainder of the chipping was done by pressure and not by blows. The method by which this was done probably varied, but the principle was always the same. It is stated by one authority that the Indian squatted with his knees on either side of an upright stake which had been driven securely into the ground. The work was rested on the top of this stake. The implement used in pressing off the small flake was generally the tip of a buck horn.

"The flake which was being reduced by shaping was held in the left hand between the tips of the fingers and the base of the thumb with the edge toward the worker, the hand being protected by a piece of buckskin. The buck horn was held in the right hand. It was sometimes lashed to a stick, which extended up as far as the elbow and was held between the upper and lower arms, with the elbow bent almost double.

"The side of the flake was placed upon the edge of the top of the stake, which extended several inches above the knees of the worker. The buck horn was placed across the opposite edge of the stake with the tip resting upon the edge of the flake where the chip was to be removed. The point where these two met was elevated approximately one half inch above the top of the stake.

"By bearing down strongly on both buck horn and flake so that they could not slip on the stake and then raising their outer ends gradually, the worker could secure tremendous leverage, and bring great pressure to bear upon the edge of the flake. As the flake cut into the buck horn, and as both were lowered toward the top of the stake, the pressure became so great that a chip was thrown off the flake. By varying the direction of the pressure exerted against the flake, the direction of the fracture could be controlled. The fracture was almost directly in the line of pressure.

"The writer has seen arrow and spear points made in this manner. In less than four minutes of measured time a flake was removed from a large piece of obsidian and reduced to a finely worked point."

WASHO. (H.N. Rust) [16]

"The arrow-making implement was merely a greasewood stick, 12 inches long, 1/4 inch in diameter, to which is firmly attached by buckskin thongs a piece of buckhorn about the same diameter, six inches long, and with its rounded end projecting half an inch beyond the stick.

"Doubling a piece of buckskin upon his left hand, Tom laid upon it the obsidian flake, which he held in place with his third finger. Placing the horn implement under the edge of the obsidian, he gave it a rotary movement, gliding down the edge. This process chipped off very fine particles. To remove larger 'chips,' he placed the end of the implement against the edge of the obsidian, directing the pressure endwise. Now and then he rubbed the end of the implement on a coarse granite boulder to keep it in form. To notch the edges of the arrow-head (the finishing touch) he used pressure alternately upon each side with the point of a butcher-knife."

ANALYSIS OF TECHNIQUES DESCRIBED

It is apparent that the method of flint chipping most favored in these accounts, for the manufacture of arrow points, is that of pressure using an antler or bone flaker, either unhafted or hafted to a short stick for additional control. Twelve of the sixteen accounts are concerned with this method. One account [17] describes a method of pressure chipping using a "spikelike stone implement." Percussion flaking, as a method of production of the entire artifact, is claimed in only one case, that of the Shasta,[18] but the use of percussion in roughing out the flake preparatory to finishing by pressure chipping is noted in three instances [19] and very likely was employed although not recorded for others among this group of descriptions.

Chipping by means of a wrenching action using a pair of antler "pincers" is recorded by Powers for the Wiyot. Chever reports a similar method for the Maidu in which a side-notched tool (probably of bone) is used. Both of these methods were tried by H.H. Ellis with the following results:

> The notched and pincer-like tools all detach small and deep flakes, the side-notched instrument working best. All must be used on thin edges. This technique is well adapted for the rapid shaping up of thin flakes into small projectile points, but to achieve a fine cutting edge and sharp point, pressure with a bone tool must supplement this breaking out of chips. [20]

It would appear, therefore, that both methods are satisfactory where a finely finished product is not especially desired. The results probably would be similar to those obtained where percussion flaking is used throughout, as recorded by Lyon for the Shasta.

The method used in breaking the flakes away from the core is reported definitely in only seven of the accounts. Of these, two (Yurok and Hupa, and Wintu) were by the use of an antler punch; one (Shasta) employed a stone punch (or "chisel"); two (Yahi and Yokuts) used direct percussion with a hammerstone or bone hammer; and two (Yurok and Wiyot) were by a thermal process. This last deserves some comment. Schumacher, in describing the Yurok method, claims that the core"is heated in the fire, and then rapidly cooled." [21] Powers says that the Wiyot "heat it (the core) in the fire and then cool it slowly, which splits it in flakes." [22] Both the rapid-cooling and slow-cooling techniques were attempted by Ellis, with negative results:

> ...microgranular quartzes, such as flint, as well as the obsidians, have no inherent planes of cleavage. Any planes of least resistance are caused by fossil or mineral inclusions.[23]

> ...the flint which has been subjected to fire is so filled with tiny fire cracks and the surfaces of the material so roughened due to the differential expansion of the crystals caused by the heating, that it is impossible to use it to any practical advantage in the shaping of stone implements. [24]

Holmes [25] frankly doubts that Schumacher actually witnessed the use of fire as described. These objections, and others not cited here, weigh heavily against the use of fire in fracturing flakes from the core as a general practice among the aboriginal peoples.

Miller describes for the Maidu a method in which the flake is heated and then chipped by the use of cold water in conjunction with what appears to be pressure chipping with a stone flaker. This is the only account among the present group in which the much disputed use of cold water in flint chipping is claimed. After experimentation using cold water, Ellis remarks, "The usual result of the application of cold water to hot flint is the boiling and rapid evaporation of the drops of water. Occasionally small

chips may fly off, but their direction and position can not be controlled." [26] No apparent harm to the job results from the practice of dipping the flaker in cold water. Perhaps its greatest benefit, in the case reported by Miller, was to help in cooling off the hot flake of flint so that it could more comfortably be handled! There are some grounds for doubt that Miller actually observed such a procedure. It should be noted that similar explanations of Indian flint chipping were current at the time Miller wrote her account; perhaps she observed an Indian washing adhering material off of his stone flaker preparatory to its actual use, and connected this in her mind to the use of cold water in chipping flint. This does not, of course, account for her claim that the Maidu heated the flakes before chipping them.

The same writer states that the Maidu used a rough stone to grind the points and edges of the arrow points into shape. Another instance of this among the Northern Maidu is suggested by Dixon, who notes, "Some of the stone implements seem to have been ground after being chipped." [27]

Arrow point manufacture as a specialized activity is reported by Waite and Ray for the Yurok and Hupa, by Powers for the Wiyot, and by Lyon for the Shasta. Specialization in a number of activities has been reported for certain tribes in Northwestern and Central California. Among these specializations has been that of arrow point making. It has not been shown, however, that all groups in any one tribe followed the same pattern in this regard; indeed such is known not to be the case in certain tribes. Mention of this specialization in the above accounts, therefore, may have held only for the group or groups visited by the authors. The omission of this note in certain of the other accounts may, on the other hand, be due to actual absence of this trait, to partial or complete abandonment following white contact, or to simple failure on the part of the writers to observe and record such among the groups in question.

The sixteen accounts reprinted here suggest that a basic similarity in the flint chipping process ran throughout much of Northern and Central California in recent times. Occasional differences from the common pressure flaking technique are recorded, but these appear to be about evenly distributed over the two areas. Thus no regional preferences in flint chipping techniques, in any way corresponding to the known areas of general cultural difference in Northern and Central California, are indicated by these few data. [28]

NOTES

1. Loeffelholz, 1952, pp. 171-172. The author's statement that the flake to be chipped was tied to a stick "held close to the body" is open to some question, inasmuch as this would directly interfere with the chipping process. This statement perhaps may be attributed to the author's hearing of, but not observing, the method of chipping with the flaker hafted to a short stick. It is possible that he mistakenly understood the hafting to be on the flake, rather than the flaker.

2. Schumacher, 1874, pp. 355-356. For another account by the same author, see Schumacher, 1877, pp. 547-548.

3. Waite, 1874, pp. 185-186.

4. Ray, 1886, p. 833. No indication is given in the article from which this description is extracted as to which tribe, Hupa or Yurok, belonged the old man mentioned by the author. Ray was stationed for some time at the Hupa Reservation and here the account was written. It is probable, therefore, that he is referring to a member of the Hupa tribe.

5. Goddard, 1903, p. 34.

6. Powers, 1877, p. 104.

7. Lyon, 1859, p. 214.

8. Beckwith, 1855, p. 43. The author states, p. 43, that the Indians to which this description refers were called by the whites the "Pitt River Indians," but that the Indians referred to themselves as "Pah-Utahs." Beckwith encountered this group of Indians along the Pit River in the south end of Round Valley. This is well within Achomawi territory (Kroeber, 1925, p. 307) and some distance from the nearest Northern Paiute territory. It may be suspected that language difficulties between Beckwith and this Indian group resulted in agreement by the Indians that they were indeed "Pah-Utahs." The term "Pitt River Indians" was at this time and for long afterward applied to the Achomawi.

9. Dulog, H.C. See Anonymous, 1907. It is possible that Dulog's description refers not to the Pomo but to a member of the small isolated group of Wappo, identified by Kroeber (1925, p. 219) as the Lile'ek, who occupied the region around Mt. Konokti (Kanaktai). Dulog places the scene of his account at the base of "Mount Uncle Sam," a name formerly used by some to designate Mt. Konokti. The Pomo are known to have used the obsidian quarry on Mt. Konokti (see Heizer and Treganza, 1944, p. 305), and it is probable that, being vastly superior in numbers to the Lile'ek Wappo, the Pomo were in possession of the quarry at the time of Dulog's visit, which occurred some time after white penetration of the area.

10. Redding, 1879, pp. 667-674. The same author, 1880, pp. 125-128, gives a somewhat more brief account of stone flaking by the same tribe.

11. Pope, 1913, p. 796. Several accounts of Ishi's activities while with the University of California Museum of Anthropology have been written. Two additional excellent descriptions of Ishi's method of making arrow points are those of Nelson (1916) and Pope (1918).

12. Chever, 1870, pp. 139-140. A method of chipping similar to that described by Chever is mentioned by Stevens (1870, p. 78) for the Shasta: "Mr. T.R. Peale, of the Scientific Corps, United States Exploring Expedition, witnessed the making of arrow-heads among the Shasta and North Californian Indians. He says that the flakes were struck off from the mass of jasper, agate, or chalcedony, by a blow with a round-faced stone, and that the edges were chipped by the application of a notch in a piece of horn, as a glazier chips glass. The notches in the horn tool were of different sizes and depths, in order to suit the work to be done."

13. Miller, 1896, p. 207.

14. Snyder, 1897, pp. 231-232.

15. Latta, 1949, pp. 139-141. Permission to reproduce this account was kindly granted by Mr. Latta, to whom the thanks of the author are due.

16. Rust, 1897b, p. 15. This is one of two almost identical descriptions of Washo flint chipping by the same author.

17. Miller, 1896, p. 207.

18. Lyon, 1859, p. 214. A stone flaker ("chisel") was used throughout this process.

19. Schumacher, 1874 (Yurok); Powers, 1877 (Wiyot); Snyder, 1897 (Nisenan).

20. Ellis, 1940, p. 43.

21. Schumacher, 1874, pp. 355-356.

22. Powers, 1877, p. 104.

23. Ellis, 1940, p. 56.

24. Ibid., p. 55.

25. Holmes, 1919, p. 364.

26. Ellis, 1940, p. 54.

27. Dixon, 1905, p. 134.

28. One further account, although undoubtedly differing in some of its details from methods actually employed in California, is of interest in connection with Central California flint chipping. Sir Edward Belcher (1861, pp. 138-139), in command of H. M. S. Sulphur, visited the port of Monterey in 1837. During this visit he observed Indians

chipping arrow points by a method which he previously had observed among the Eskimo of Cape Lisburne, Alaska. His description of this Eskimo method is as follows: "It (a vein of chert) is broken in vertical shivers, or conchoidal plates, by a slight tap with the hammer formed of a very stubborn jade, or nephrite, the splinters affording a ringing sound like glass or pottery. . . . Selecting a log of wood, in which a spoon-shaped cavity was cut, they placed the splinter to be worked over it, and by pressing gently along the margin vertically, first on one side, then the other, as one would set a saw, they splintered off alternate fragments until the object, thus properly outlined, presented the spear or arrow-head forms, with two cutting serrated sides . . . this instrument (the flaking tool) has a graceful outline. The handle is of fine fossil ivory. That would be too soft to deal with flint or chert in the manner required. But they discovered that the point of the deer horn is harder, and also more stubborn; therefore, in a slit, like lead in our pencils, they introduced a slip of this substance. . . . It is the point of deer horn which refusing to yield, drives off the fine conchoidal splinters from the chert. I cannot here omit remarking that the very same process is pursued by the Indians of Mexican origin in California with the obsidian points for their arrows. . . . I myself witnessed at the Convent of Monterey the captured Indians forming their arrow-heads out of obsidian exactly similar to the mode practised by the Esquimaux."

It would be extremely difficult, if not impossible, to name the tribal affiliations of the Indians to whom Belcher refers. During both the Mission and Mexican periods in California, Indians from the interior tribes were forced to resettle in the missions. Thus the Indians whom Belcher observed may have been from any of several Central California tribes. It is somewhat unlikely, at this relatively late date, that they were Costanoans -- the original inhabitants of the Monterey coast -- since the practice of flint chipping appears to have been abandoned by this group shortly after establishment of the missions.

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BAE-B	Bureau of American Ethnology, Bulletins
SI-AR	Smithsonian Institution, Annual Reports
SM-P	Southwest Museum, Papers
UC-PAAE	University of California Publications in American Archaeology and Ethnology

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APPENDIX

THE TERMINOLOGY AND MINERALOGY OF CHERT AND FLINT*

H. Holmes Ellis

[Accompanying the preceding article of R. Squier on California Indian flint flaking are reprints of two discussions of the chemical nature and use of the terms "chert" and "flint."

Archaeologists are rarely expert mineralogists, and tend to be confused by the two words, often arbitrarily selecting one or using the two as synonyms. For this reason it is thought that a reprinting of the statements by Ellis and Tarr is worthwhile.

A valuable contribution to the study of flint is by G. Deflandre, "Etude microscopique des silex." Sciences naturelles, Vol. 1, pp. 259-264, 1939. (Editor).]

"The first consideration in an investigation of aboriginal flint fracture should be an attempt to discover the exact nature of the lithic material from which the Indians fashioned their implements.

The substance most widely used, while basically similar in its various outcrops, has a varied homogeniety and a myriad of colors. This substance has travelled under many names, flint, chert, basinite, touchstone, silex, pthanite, hornstone, Lydianite, chalcedony, and jasper, and it is the present intention to point out the necessity for the archaeologist to pick arbitrarily some definite basis on which to make his identifications of stone material.

In order to answer the question of the differences, if any, between flint and chert and these other allied rocks, a selection was made of a number of the most prominent students in the field of mineralogy. Unfortunately, however, they seemed to be divided in their views. Moreover, they appeared to be split into at least six schools of thought on the problem. These six are: (1) those who maintain that flint and chert are synonymous; (2) those who understand flint as a Chalk formation, chert as Pre-Chalk; (3) those who claim that flint is a variety of chert; (4) those who consider that chert is an impure flint; (5) those who declare that chert

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* Reprinted from H. Holmes Ellis. Flint-working techniques of the American Indians: an experimental study. Ohio State Archaeological and Historical Society, The Lithic Laboratory, Dept. of Archaeology, Ohio State Museum, 1940, pp. 1-5. (Works of the authors mentioned by Ellis are cited at the end of the extract).

is more pure than flint; and (6) those who simply distinguish between flint, chert, et cetera on a color basis.

The first school is represented by several authorities. A.P. Brigham asserts that "dark, massive quartz is often known as flint or chert." G.M. Price calls "flint and chert . . . amorphous, dark colored forms of silica, usually opaque." A.F. Rodgers specifies that "flint (is) a massive chalcedony rock, practically the same as chert." W.B. Scott explains that "chert (flint or hornstone) . . . are seen to be made up of very minute grains of chalcedony and crystals of quartz."

The second school finds a supporter in A.W. Grabau who imparts the information that silica "occurs as concretions of flint in chalk beds, or as chert nodules . . . in limestone." Philip Lake and H.B. Milner also belong to this school. The latter, however, introduces his discussion of the dissimilarity of the two rocks with this statement: "The difference between chert and flint is probably more apparent than real, and to some extent is a matter of nomenclature."

Members of the third school are rather decisive in their declarations. According to J.F. Kemp, "cherts are also called hornstone and flint." S.J. Shand instructs that "flint is merely a dark gray to nearly black chert . . . ." And James Park asserts that "flint . . . is a form of chert . . ." and "Lydianstone is . . . black chert used as touchstone . . ."

The fourth school seems to be the most popular and includes Sir Charles Lyell, F.B. Loomis, E.H. Kraus and W.F. Hunt, Sir Archibald Geikie, W.H. Emmons, G.A. Thiel, C.R. Stauffer, and I.S. Allison, T.C. Chamberlain and R.D. Salisbury, Eliot Blackwelder and H.H. Barrows, J.D. Dana, F.R. Van Horn, R.S. Tarr, L.V. Pirsson and Charles Schuchert. All echo in some form the thoughts of David Page who wrote in 1867, "Flint is impure nodules of silex . . ." and "chert is the name given to an admixture of flint and limestone." In other words, chert is a calcareous or impure flint.

The fifth school apparently has a lonely member so far as the literature examined goes. Nevertheless, W.A. Tarr declares with conviction, "chert is defined . . . as an impure flint. The writer wishes to express the view that this much quoted statement is wrong and that flint is an impure chert."

The sixth school takes life from Bernhard Von Cotta and P.H. Lawrence according to whom "chert, hornstone is distinguished from flint by its colour, which is grey, yellow, green, red, or brown, resembling jasper." W.H. Twenhofel affirms this view with the following statement:

> "In the strict sense chert includes those cryptocrystalline varieties of quartz which are white, gray, or other light color. Flint includes the dark gray and black varieties of the same material. Jasper is a variety colored red by iron oxide."

To a mineralogically untrained mind it would appear that there has been in the past much unnecessary difference of opinion over the point of

distinguishing between such similar materials. To say that one is more pure than the other, since all specimens of both have a virtually pure silica content is hardly a definite criterion. Then too, a color definition leaves an indefinite dividing line.

Thus we are seeminly left with five alternatives: use flint and chert synonymously; delete one and use the other to include both; delete both and coin or borrow a new term to include both; use the terms as applied in British stratigraphy; or leave both flint and chert in their present states and coin or borrow a new word to include flint and chert and similar materials.

In July, 1938, a definite stand was taken on this matter:

> " . . . in an attempt to bring some semblance of uniformity into the nomenclature where it will apply in studies of the Lithic Laboratory, and since it is apparent that the aforementioned geologists, petrologists, and mineralogists have not reached a satisfactory agreement, we will refer to James Dwight Dana as our authority in making definite and specific identifications; but for a general term to include such widely used and closely allied siliceous materials as chert, hornstone, basanite, pthanite, touchstone, Lydianite, silex, novaculite, jasper, et cetra, 'flint' will be employed, since we feel that it is a term more generally known and with a more distinct meaning for the average person than any other of the more or less synonymous terms expressed above."

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