A MANUAL FOR NEANDERTHALS

A MANUAL FOR

By H. MEWHINNEY

AUSTIN
UNIVERSITY OF TEXAS PRESS

NEANDERTHALS

The eponymous hero:
Neanderthal man flaking flint
with a hammerstone

Library of Congress Catalog Card No. 57–8821

Manufactured in the United States of America
by the Printing Division of the University of Texas

TO

ALEX KRIEGER

AND

TOM CAMPBELL

WITH BEST THANKS

FOR THEIR HELP

Foreword

THIS TREATISE on flint-flaking—the most ancient art of which we have, or ever shall have, any certain knowledge—propounds two theses and is thus addressed to two disparate and even mutually hostile audiences: people who like to work with their hands and people who study anthropology.

First thesis: It is not at all difficult to make better arrowheads than the average Indian or better cutting tools than the average Neanderthal ever made. As L'il Abner's Pappy might put it: "Any fool can do it; shucks, *I* can do it *myself*." But it is of course difficult for the average modern man to copy the occasional, the one-in-a-thousand, masterpiece of primitive handiwork.

Second thesis: Since, as Paul Fejos once noted, too many anthropologists take the attitude that tools soil the hands of a scholar, the standard texts and reference works for their discipline contain many erroneous statements and assumptions about the nature of flint and the skills that are needed to shape it. This treatise is an effort to correct a few of the errors.

H. MEWHINNEY

Houston, Texas
June 19, 1957

Contents

Illustrations

A MANUAL FOR NEANDERTHALS

I. Speech, Fire, and Flint

PERHAPS THE FINEST PREFACE in all the books that have come down to us is one written by Titus Livy two thousand years ago for his history of the Roman people, which he called *Ab Urbe Condita* ("From the Founding of the City").

Livy began by saying that he did not know whether or not he could accomplish anything worth the labor if he wrote such a history, since the tale was an old and familiar one and new writers were always trying to tell it better, either by excelling a rude antiquity in literary art or by making the facts more certain. But no matter how the thing might turn out, he said, he would enjoy doing his best to commemorate the deeds of the foremost people in the world. "And if in so great a tumult of writers, my repute shall be obscured, I shall console myself with the nobility and greatness of those who overshadow my name."

There is a tinge of the same thought in beginning this little book. The book may be trivial, but the theme is a noble one. It is the most fascinating and picturesque story in the world. For this is intended as a common-sense, down-to-earth study of how flint tools and weapons were made—or, for that matter, can still be made by any descendant of the Stone Age men. And the chiefest part of man's early story on earth—of man considered as man and not merely as another of the anthropoids—has come down to us only in the tools that he chipped from flint.

Nearly all the other records of the earliest men have perished. Their speech is lost forever. The ashes and charcoal of their campfires have mostly washed away. Whatever skins they hung from their shoulders, whatever huts or windbreaks they built, whatever clubs or spears they cut from tree limbs, those things have mostly rotted. In nearly all instances the bones of the earliest men have rotted, too, along with the bones of whatever game they killed. There are a few skulls from China, from Africa, perhaps enough to load a wheelbarrow or two. The rest is mostly guesswork. Until we come to Neanderthal man, who, however chinless and shambling, is so recent as to be almost our contemporary and who buried some of his dead in rock shelters, we have only fleeting glimpses of what the ancients looked like.

But the tools that the ancients chipped from flint endure. Flint will alter a little in color and texture if it is long exposed to sunlight, or to chemicals when buried in the earth. But that is all. You could take the oldest flaked cutting edge right now and skin a mammoth with it, if you could only find a mammoth. All the mammoths have perished, but the tough old implements remain.

> Not marble, nor the gilded monuments
> Of princes, shall outlive this powerful rhyme.

A noble thought. But the oldest flint tools may have lasted a million years.

It is believed nowadays that in the beginning there were three arts that differentiated the early men from the ground apes: speech, the use of fire, and the flaking of flint implements. To a two-thirds extent, this is only an enlightened surmise, not susceptible of proof. Speech would have left no evidence behind, no matter whether early man was as garrulous as the modern type or whether he educated his young merely by cuffings and bellows. As for his campfires, unless he built them in caves or pits, a few thousand years of rain and flood would wash away most of that evidence. Traces of fire are extremely scanty for the Lower Palaeolithic.

Among those three arts, then, flint-working must be regarded not merely as the one that left the most evidence behind but also as the one that was truly indispensable. *Flint-working*, rather than *tool-making*, is a term used advisedly. Flint is the fundamental material. All manner of tools and weapons, indeed, can be made from wood, bone, and horn. But something is needed to shape them. You cannot shape wood by beating on it with another piece of wood. You cannot shape bone by beating on it with another piece of bone. But you can shape flint by striking it with another piece of flint; and that is how the earliest fist axes and flaked cutting edges were made. As soon as you have flint tools, you can make all sorts of things out of wood, bone, animal hides, and the like.

Flint-flaking, say the patient, systematic diggers, is a technique that began half a million or perhaps a full million years ago, back in the dawning of the Pleistocene. Beside those rude beginnings, crumbled Nineveh seems a thing of yesterday.

Without the three arts, but most especially without a knowledge of flints, man would still be slinking through the bushes, naked and almost helpless, armed with but puny claws and none-too-formidable teeth. With flints, long ages before bronze and iron were in his hands, he had mastered the cave bear and the hairy mammoth. Man became man—not when he walked erectly, not when he got a shapelier skull, not when he shed the apelike coat of hair—but when he got tools and weapons in his hands. Whatever sort of men may have been the first to shape flint into cutting edges, it was they who first became truly human and that was the founding of our city, a larger and older community than Livy's Rome.

Conceded then, as it must be, that speech, the use of fire, and the shaping of flints are the three primal arts that separated men from ground apes, it is odd to see flint so little regarded nowadays. Speech still flourishes, even to excess. Soap opera befouls the air, newspaper presses devour the forests, and the ordinary citizen wags his jaw by the hour. This desire for utterance is so much stronger than the desire for knowledge that the species might better have been "taxonomized" as

Homo ululans. Fire, too, is still used far and wide, whether to fry eggs for breakfast or for fantastically huge and complex industrial processes. Even though it is most often done now by oversophisticated means, many a woodsman still prides himself on the ability to light his fire with a single match, and the hardier of the Boy Scouts can do the job with a bow drill. But not many woodsmen and not many Scouts can flake flint.

This little book is intended as a manual for Neanderthals or, for that matter, as a guide to flintcraft at any cultural level, whether that of the rude Abbevillian fist ax or that of the highly sophisticated Solutrean point. It can serve no immediate, no economic, need. For more than nine-tenths of man's stay on earth, a knowledge of flint-flaking has been the indispensable art, the indispensable science. But we have at last gone beyond that. To flake flint today is only to repeat—perhaps somewhat romantically and sentimentally—the history of the race; to study, but no longer with any sense of urgency, the conditions under which our rude and hairy forefathers lived and scuffled.

It is not to be expected that any such manual as this will result in the establishment of a Chair in Flintcraft at any of the nation's principal universities. Although many brilliant and devoted scholars have studied the Stone Age, few have deigned to bloody their fingers on the actual flint and learn the techniques that are required to shape it. Such experiments are left to a scattering of laymen. And it so happens that in the United States—noted for its inhabitants' practical turn of mind—a few of those laymen have become astonishingly expert. They can make flint weapons that often match, or even excel, the finest of those turned out thousands of years ago by the Folsom or the Scottsbluff workmen. The result has been that many a private collector has paid out good money for Folsom points that were made in A.D. 1950 rather than in 8000 B.C. It takes an extremely sharp eye to tell which is which.

I could not pretend here, even if I wished, to any especial skill in flaking flint. Some of those modern manufacturers of

Folsom points can do the work far better. But none of them have written a manual, whether from modesty, from unwillingness to betray a trade secret, or from lack of literary skill. I think that if some of the niceties of technique are explained, more men will learn to work flint. A man can make dart points or knives purely to while away his time, as his neighbor might make lamp stands or ash trays, without troubling about the larger implications of the craft. Or he can make the same implements with the serious intention of learning more about Stone Age life. There are many variations in workmanship that seem rather mysterious when one is looking at the artifacts in a museum but simple enough when he learns to make the same tools. The best reason of all for learning to flake flint is the insight it gives into the Neanderthal mind, the way those sturdy ancients reasoned in solving their technical problems.

One thing more needs to be said. Most people who have never tried it have the idea that flint-flaking is a difficult art. That is not true. It is hard to copy the masterpieces turned out by primitive workmen, such things as the finest of the Solutrean or the Folsom points. But it is easy to equal the handiwork of the average Indian, who seems to have been satisfied with a neat and efficient weapon rather than a beautiful one. By that standard, it is no harder to flake flint than to peel potatoes, once the workman clearly understands what he is trying to do and what sort of stroke is needed. And if there happens to be some reader who cares little enough about the antiquity of the art but would nevertheless like to learn to make some arrowheads, such a man may learn forthwith by turning to Chapter V.

II. A Synopsis of the Stone Age

SINCE THIS IS A TREATISE on flint implements, some of them made far off in place and time from one another, perhaps there ought to be some preliminary account of the Stone Age. Otherwise, it might seem as though Abbevillian fist axes and Clovis dart points had been made by men who were contemporaries and neighbors. Actually, they were separated by several thousand miles and by several hundred thousand years.

The account will be a simple one, even elementary. It will deal only with the Old Stone Age (the Palaeolithic), during which almost all stone implements were made by chipping. The techniques of pecking, grinding, and polishing stone, practiced to some extent during the transitional stage called Mesolithic, were not widely used until the Neolithic began in the Near East—and that was only seven or eight thousand years ago. Although this refinement was the formal distinction between the terms *Palaeolithic* and *Neolithic* when Lord Avebury coined the words in 1865, it is not now considered the really important one, at least in the Old World. The big differences are that Neolithic men learned to grow crops, raise livestock, make pottery, and live in settled communities. Axes and chisels of ground stone, being rather inefficient at best, would not have helped them much, whether for cutting down trees or shaping a dugout canoe.

The various peoples who learned to polish stone, in whatever part of the world, kept on making most of their knives and weapon points by flaking. A workman can flake an arrowhead in a few minutes, but it may take days or weeks to grind out an ax. What is needed is not skill so much as forethought and stubbornness. But the grinding technique does allow the use of the tougher stones, those not brittle enough to be shaped by flaking as flint can be, but for the same reason less likely to break when the implement is used.

The Palaeolithic is usually regarded as having consisted of three stages: Lower, Middle, and Upper. The Middle Palaeolithic is most clearly evidenced by the handiwork of the Neanderthal men. From what is known of their way of life, it represents no great advance over the Lower Palaeolithic and seems to have developed directly from it. In the Upper Palaeolithic the differences are startling. There are delicate and shapely implements, more skillfully made than anything known before them and most of them apparently made by men of the modern type. In part of western Europe at least, there was an astonishing florescence of art—paintings and engravings as fine as anything done in the world until the great days of Greece.

So far as has yet been ascertained, there was neither a Lower nor a Middle Palaeolithic in the two Americas, and the first people to cross Bering Strait were men of the modern type. But some evidence is now being found that these people did arrive just about the time their remote kinsmen dispossessed or succeeded the Neanderthals in Europe and introduced the crafts and skills known as Upper Palaeolithic. In North America that stage, or a somewhat similar stage, is called Palaeo-American or Palaeo-Indian rather than Upper Palaeolithic. What may have been going on in the rest of the world at that time is thus far very little known.

In a general sense it can be said that the Palaeolithic began and ended at about the same time as the period that geologists call the Pleistocene—the era of the hairy mammoth, the saber-toothed tiger, and many other huge and picturesque mammals now vanished from the earth. The usual estimate is that the Pleistocene lasted 1,000,000 years, though some recent estimates reduce the figure to about 600,000. During the Pleistocene there were four great southward thrusts of glacial ice, separated by three interglacial stages during which the world's climate was as warm as it is now or even warmer. There is

He may have used a spear like this one.

some reason to believe that men had appeared in the world and were chipping flints at the beginning of the Pleistocene.

But how many breeds of men were doing the work, even fairly late in the Pleistocene, remains extremely uncertain. Some authorities believe that the modern type of man or somebody very much like him—complete with a distinct chin and a high forehead—was among them from the first, sharing the land with several kindred species and chipping the same crude implements. Other authorities believe that *Homo sapiens* appeared rather recently. Too few complete skulls have been found to decide the issue. If *Homo sapiens* did arrive as early as the others, he seems to have contented himself until the fourth glaciation with much the same equipment that his backward cousins were using.

It may be forever impossible to identify the earliest and the crudest implements made or used by men. To be recognizable as an implement, the stone must be broken in some kind of pattern, show signs of use, or be found with some other sort of evidence. A lump of utterly nondescript shape may be quite efficient so long as one edge is sharp enough for cutting or scraping.

The most startling characteristic of the flint implements that have come down to us from the Lower Palaeolithic is that not a one of them is readily identifiable as a weapon. There are tools that could have been used, and almost certainly were used, for chopping, cutting, scraping, and the like, for working wood, bone, horn, and hide, for cutting up meat, and for splitting bones to get the marrow out. But there is nothing that looks like a serviceable spearhead or ax blade. This is not to say that the men of the Lower Palaeolithic had no weapons of the chase. Likely enough, they used their flint implements to shape spears, clubs, and digging sticks from wood. Wooden spears, sharpened and fire-hardened at the tip, would have been efficient enough to kill the largest game. In comparatively recent times, they have been used by primitive peoples in many parts of the world. One thing seems certain. Only a quite foolhardy man would tackle anything as big as a bull bison with no weapon but a stubby, unhafted piece of flint, hoping somehow to beat the animal's brains out before being gored or trampled.

Whatever sorts of wooden weapons were used in the Lower Palaeolithic, and whether they were few or numerous, it could not be expected that many of them would have come down to us. Except under unusual conditions, wood rots too fast. However, two actual wooden spears from the Lower Palaeo-

A core tool. Made with a hammer. No other flaking implement is needed for this sort of work.

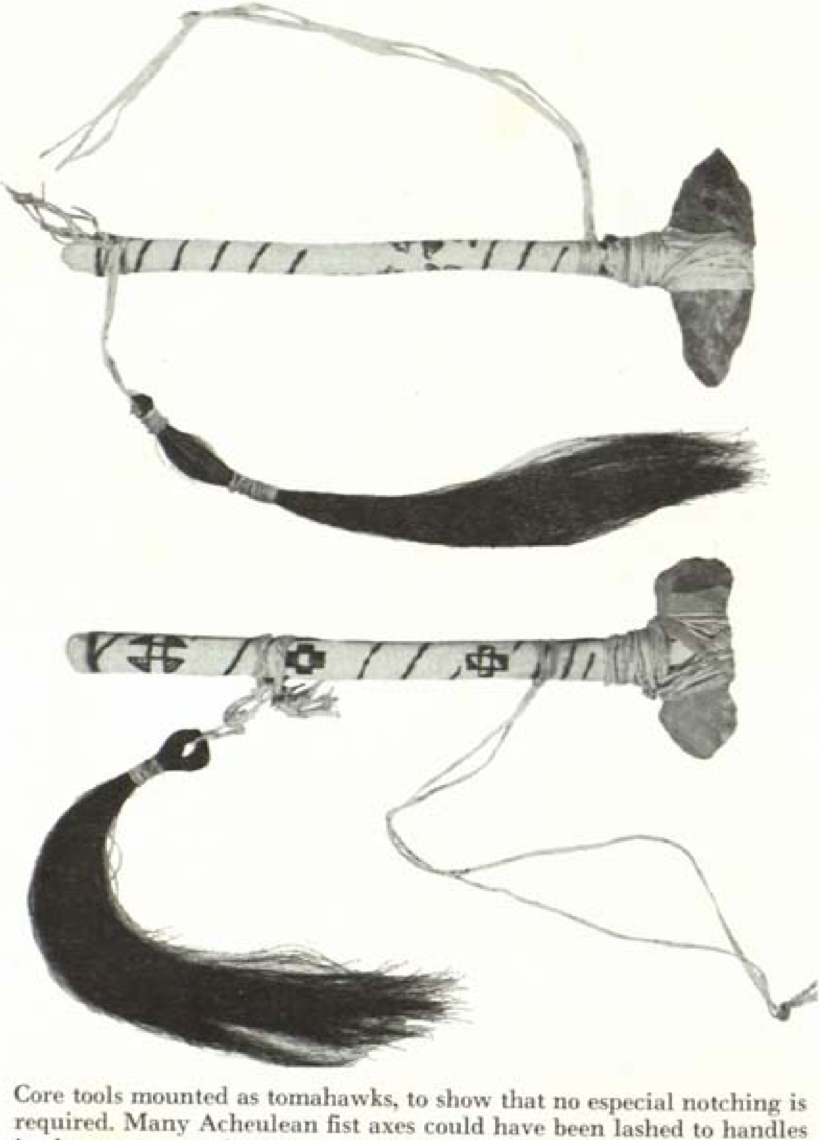
lithic have been found in Europe—one in England, the other in Saxony. Possibly, thousands of them have long since rotted.

As for the much more durable implements made of stone, it may be that the oldest ones clearly identifiable as the handiwork of men are some of the so-called "pebble tools," found in Africa. Apparently, they were being made very early in the Pleistocene. Some are simple pebbles with one end knocked off, as if to furnish a cutting edge. Others are roughly spherical and may have been used as hammerstones.

The next stage in flint-working technology, apparently beginning as early as the first interglacial, involves the use of both core tools and flake tools. This calls for definition: A core tool is one made by trimming the original nodule of flint, or any similar thick and heavy chunk of stone. A flake tool is one made from a more or less thin chip that has been struck off a core. In general, core tools are heavier than flake tools and therefore more suitable for a chopping or hacking stroke. The blade of a steel hatchet is something like a core tool, and a jackknife is something like a flake tool. A hatchet as light as a jackknife would hardly work.

The Old World seems to have been divided into two great cultural or technological provinces during the Lower Palaeolithic. In eastern and southeastern Asia and in a small part of India most of the core tools were big, clumsy choppers, trimmed only on a single working edge. In Burma some of the choppers were made from squarish blocks of petrified wood rather than from flint. But in the other province, which includes Africa, Europe, the Near East, and most of India, the usual core tool was what is variously known as a fist ax, hand ax, *coup de poing*, or biface. This western type of core tool was trimmed not only at the tip but on both edges and both faces. It was not necessarily more efficient than the other type but it was a good deal more symmetrical.

Oddly enough, the fullest evidence about any of the peoples who may have lived during the Lower Palaeolithic comes from the eastern end of the chopper-tool province. There are abundant remains of a primitive and small-brained breed of men



Core tools mounted as tomahawks, to show that no especial notching is required. Many Acheulean fist axes could have been lashed to handles in the same way, though there is no evidence that they actually were.

who lived in caves at Choukoutien, near Peking (Peiping), during the second glaciation, the second interglacial, and the third glaciation. There are numerous choppers and quartz flake tools made by these Peking men, much charcoal and ash from the fires that they built, bones of deer and other animals that they ate, and pretty good evidence that they also ate one another. That is, the long bones of both animal and man had been cracked to get the marrow out, and the skulls had been opened at the bases to get the brains out.

The fist axes so characteristic of the western province of the Old World must have served much the same function as the choppers. Whether large or small, the implement is usually heavy in proportion to its size. On many specimens, the crust of the original nodule was left on the butt, as if to furnish a smooth hold for the hand. Even the shapeliest implements of later times lack any recognizable provision for being lashed to a handle. Of course, quite crude core tools can be hafted as hammers or axes; but such an implement is not sharpenea along the sides like a fist ax.

The earlier and simpler fist axes are called the Abbevillian type; the later and shapelier, the Acheulean. Most of them, early or late, had the same basic design of bilateral and bifacial symmetry. That is to say, a fist ax usually has two faces, two edges, a tip, and a butt. In this it resembles such otherwise quite dissimilar instruments as an arrowhead, a dagger, and a putty knife. The tip of a fist ax may be brought to a point or shaped into a sort of cleaver edge.

Flake tools of many shapes and sizes, the earlier ones poorly made but no doubt serviceable enough for cutting and scraping, are found almost everywhere in the fist-ax province. Investigators have distinguished a good many regional variations in workmanship. Not even the fist axes are universal in the area. There is one group of tools, called the Clactonian and found mostly in England, that consists of thin and rather well-made flakes, accompanied by core tools sharpened only on the end.

Somewhere along about the middle of Acheulean times, when the fist axes were being made in shapelier forms, there was a corresponding but more spectacular development in the other category of tools. This was what is called a Levallois flake. A Levallois flake is the result of an elaborate technical process and differs somewhat from other flint implements, early or late. Apparently, what the maker had in mind was to get a flake as sharp as possible almost all the way around its circumference. The method was to trim the outer face of the flake completely before striking it off the nodule.

Accordingly, the workman chose a nodule of flint somewhat flatter and thinner than most, evened the edges, and then trimmed one face into a sort of flattened dome, which has often been compared to the upper surface of a turtle's shell. Next, he knocked one end off the nodule with strokes running at right angles to the curve of the dome. Finally, with a single stroke running at right angles to the previous series—which had furnished him with what is known as a "striking platform"—he knocked the pretrimmed dome loose from the core. Now he had his Levallois flake. One face, made by the last stroke of the hammer, was almost flat, and it intersected the flake scars forming the domed face at very acute angles. So the implement was sharp around most of its circumference.

The Levallois flake looks so much like the top half or bottom half of an expertly made fist ax which has been split in two that Gabriel de Mortillet, one of the famous French investigators of the last century, thought it had actually been made in that manner. Later studies showed that it had not. Nevertheless, it does seem to be the handiwork of men who had been thoroughly and even excessively indoctrinated in fist-ax theory. There are easier ways of getting a sharp-edged flake.

Levallois flakes are found throughout the huge area where Acheulean fist axes occur. At some stage during the third interglacial, the Acheulean and Levalloisian techniques developed slowly into the Mousterian. At least that is what happened in Europe, part of north Africa, and a large part of western Asia. Wherever the bones of the people have been found thus far, the Mousterian is identified as the flint technique practiced by the Neanderthal men.

For the first time in the western province of the Old World there is plentiful evidence to show what the people looked like and how they made their living. No longer is the story written almost entirely in the flints. The Neanderthals carefully buried some of their dead, as if they had an idea of an afterlife. In some of the Swiss caves they decorated altar-like structures with the skulls of slain bears, as if practicing some sort of early religion. They were bold and hardy hunters, killing the largest and fiercest of the Pleistocene mammals and littering their shelters with the bones. They knew the use of fire, whether or not they could kindle it and whether or not they roasted their meat on the coals. Some of their scraping and piercing tools hint that they may have clad themselves in hides, though there is no evidence for fitted garments.

The tools made by the Neanderthals indicate a practical rather than an artistic turn of mind. In part, they kept up the Acheulean tradition by making fist axes, mostly small ones and some of them heart-shaped. They also kept on making Levallois flakes. They made various other cutting, scraping, and piercing tools, usually small, often well trimmed, but many of them shaped from rather nondescript flakes. Their most interesting implement, called a Mousterian point, is something of a puzzle for two reasons.

Quite often, the Mousterian point was made from a flake that was actually a crude blade. That is, one face was shaped by two strokes of the hammer going in the same direction but in different planes, and the opposite face by the blow that took the flake off the core. Skill in the blade-making technique was the most valuable possession of the Upper Palaeolithic peoples who later succeeded the Neanderthals. It seems odd that the Neanderthals, having seen the advantage of the technique, did not develop it further.

The other part of the puzzle is the use to which the Mousterian point was put. It is sometimes described as a spearhead, but it would have been more suitable for a knife. It is reasonably narrow but not quite so flat as it should have been, usually trimmed only on the outer face. The edges are trimmed and brought to a sharp tip. It would have made a poor spearhead because the butt would have been hard to lash securely to a shaft. The butt is usually thick, and its base is usually formed by a lopsided curve. It is true that a projectile point does not need notches or a stem before it can be hafted snugly; thousands have been made in the form of an unnotched isosceles triangle. But a projectile point should at least be thinned at the base and either squared off or curved symmetrically, else it will tend to slip sidewise in the lashings.

The queerest thing of all is that in north Africa some of the later Neanderthals seem to have made projectile points with actual barbs and stems—an extremely advanced technique. Apparently they did this at a time when the presumably more intelligent people of modern physical type had already taken over France, dispossessing whatever Neanderthals had been there, but were still contenting themselves with spearpoints of bone.

It was something like 35,000 or 40,000 years ago—well along in the fourth glaciation—that men of the modern type invaded western Europe and introduced the crafts and skills known as Upper Palaeolithic. Whether they drove out the Neanderthals or merely took their place after some calamity had befallen them, nobody really knows. That modern men soon took over most of the inhabitable world is clear enough. But where and how the Upper Palaeolithic originated is not by any means clear, one reason being that much of Asia and Africa has not yet been well explored.

There is hope that the radiocarbon dating technique, developed after the Second World War, will eventually clarify the order of events, though thus far it has not been used to date anything much older than 40,000 years. It works only with organic materials, such as charcoal, wood, or bone. Flint implements, far more commonly found than anything else, cannot be dated unless charcoal, or something organic, is found with them. The datings made thus far indicate that modern men got into Europe somewhat later than had previously been thought and into North America a good deal sooner. There is one dating of more than 37,000 years on two samples of charcoal from Denton County, Texas. A Clovis point was found nearby. If the charcoal, as its finders believe, comes from actual campfires and not from a brush fire, and if the Clovis point is coeval with the campfires, then expert craftsmanship in the shaping of flint weapon points began earlier on this continent than in Europe, where it is known only from Solutrean times onward. Utter certitude must wait for some kind of corroboration. In the meantime, there are datings of more than 29,000 years on charred mammoth bone from Santa Rosa Island, off Santa Barbara, California. No weapon points were found with the bones.

Since the Upper Palaeolithic sites in western Europe, especially those in the rock shelters, were studied sooner than those in the rest of the world, it was once thought that whatever series of changes could be observed there—whether in styles of making weapons or in other arts and crafts—might also be found on other continents. But later studies have not borne out this idea. There is no consistent world-wide sequence of any kind, and there are very few world-wide resemblances. Even in so small an area as France the sequence is not so simple as was formerly thought.

The Upper Palaeolithic of Europe is commonly described as a blade-and-burin culture. A blade is the particular kind of flake that the Neanderthals never learned to strike off with expertness. Ideally, though not always actually, it is long, straight, narrow, flat, and thin. One face is shaped by two or more strokes of the hammer (or whatever tool is used) going in the same direction but in different planes. The other face is shaped by the last stroke, still going in the same direction, that detaches the flake from the core. A little trimming will convert a blade into a knife, a scraper, a javelin point, or a burin, as the workman may desire. Commonly, the blade is sharp on one edge or both. The workman can dull one edge, to keep from cutting his fingers on it, and have an efficient knife.

He can trim one end to make an end scraper. He can bring one end to a sharp tip and have a javelin point. Or he can knock a strip off one end or one side and make a burin—a slablike implement with one corner forming an abruptly sloped chisel edge. Burins were used for cutting or carving bone or antler or for engraving softer stones.

Most of the peoples who lived in Europe during the Upper Palaeolithic trimmed the blades very little and used them for knives, scrapers, or burins in much the same form as they were originally struck off. Most of them made their lance or javelin points out of bone or antler instead of flint. They also made needles, awls, and the like from bone.

Until recent years it was generally thought that, in France at least, the Upper Palaeolithic consisted of three more or less orderly and consecutive stages: Aurignacian, Solutrean, and Magdalenian. The Solutrean was regarded as the result of an invasion by a people who made their lance points from flint and trimmed the prettiest ones completely, that is, over both faces rather than merely along the edges. The work was done mostly by pressure flaking, and on the best examples the flake scars were narrow and evenly parallel, giving a beautiful effect. The principal forms were the narrow willow-leaf points, the broader laurel-leaf points, and the single-shouldered points. The first two had neither barbs nor stems. The third, rather than having two barbs or shoulders and a stem, was shaped so that there was only one shoulder, and the stem—sometimes long, sometimes short—was off-center.

Some authorities now believe, however, that the Aurignacian really consisted of two more or less contemporary cultures—the Aurignacian proper and the Perigordian; that the Perigordian began somewhat the earlier; and that the Solutrean was not a distinct culture, much less the handiwork of a particular tribe, but merely a style of flaking flint, sometimes quite expertly, that flourished in late Perigordian or Aurignacian times. According to this system, the Perigordian is divided into five stages, the first four of which are distinguished by various modes of trimming blades into knives. The last is identified by the appearance of a flint projectile point, called the Font Robert type. It is long and narrow, with a slender stem and indistinct shoulders, trimmed only along the edges. The Aurignacian proper is also divided into five stages, identified by five variations in the manner of shaping bone lance points.

Under this system, the Magdalenian is the final and more or less unitary stage, beginning about 14000 B.C. and ending about 8000 B.C. It is marked by the finest examples of engraving and cave painting. But the expert Solutrean flintwork disappears. Instead, the Magdalenians made handsome lance and harpoon heads out of bone and antler.

At some stage of the Upper Palaeolithic, a stage not yet definitely known, the implement usually called the "spear-thrower" came into use. In the Americas this implement is often called by its Aztec name, "atlatl." Made in many shapes and styles in many parts of the world, this is a shaft, usually of wood, commonly a foot and a half long, with a knob or a hook at one end to engage the butt of a dart or javelin. It acts as an extension of the arm, adding leverage when the hunter throws the dart. Atlatls may have been used from the beginnings of the Upper Palaeolithic or even in earlier times, but there is no way of making sure except by finding the actual atlatls. Finding the projectile point, whether of bone or flint, is no proof, since one of the same size could have been used with almost any kind of spear—thrown with the atlatl, thrown with the unaided hand and arm, or thrust rather than thrown. At any rate, it is certain that the Magdalenians not only used atlatls but carved them from bone and ivory, sometimes with beautiful decoration in relief.

The radiocarbon datings indicate, if they have not yet definitely proved, that Pleistocene hunters were in North America about as soon as the Upper Palaeolithic began in Europe. But evidence of the Early Americans is extremely scattered and scanty, consisting mostly of flint implements, found on or near the surface of the ground wherever the old-time hunters happened to lose them. Recognizable campsites, with charcoal from the fires, are hard to find. Burials are unknown. On the

Great Plains and in Central Mexico, however, there are known sites, in moderate numbers, where the people killed and butchered such Pleistocene big game as Columbian mammoths, unthriftily leaving behind dart points and skinning knives—as well as most of the carcass—when they went away.

Of the weapon points made in definite styles, the Clovis point may or may not turn out to be the oldest, but at least it is the kind most widely used. Specimens have been found over the greater part of the North American continent, from Alaska to Costa Rica and from California to the Atlantic and Gulf coasts. In the eastern part of the United States they have not yet been found with the bones of mammoths. The Clovis point is decidedly sophisticated and some simpler style may well have preceded it. Specimens of the Sandia type, at least partly contemporary with Clovis, have been reported from several states but the concentration seems to be in New Mexico.

The Folsom points, which succeeded the Clovis type on the Plains and were made by a refinement of the same technique, have been found from south central Canada to central Texas. At several sites they occur with the bones of a Pleistocene variety of bison, straight-horned and bigger than the modern kind. There is one radiocarbon date of about 8000 B.C. for Folsom points. Apparently, they were no longer made after about 7000 B.C. or thereabouts but were followed by Plainview, Scottsbluff, Eden, Angostura, and other styles of points.

The North American implements have little resemblance to Aurignacian or Magdalenian work. The projectile points are made of flint, not of bone or antler, and they are trimmed over both faces. There is no such prevalence of blades dulled on one edge to make knives as occurs in Europe, though occasional blade knives are found with Clovis points. Burins are rarely found outside the Arctic regions. There are a few bone implements, but no early one is identifiable as a projectile point. There are no engravings or paintings like the Magdalenian masterpieces.

Most Clovis and Folsom points are finished in a style never yet found in the Old World. From each face of the piece, or sometimes from only one face, a long, broad flake is struck off, running from the base toward the tip. This is called a "flute" or a "channel flake scar." When the flute is expertly struck, the result is highly decorative.

A Sandia point is single-shouldered and thus has a vague resemblance to one of the Solutrean types. Clovis, Folsom, Plainview, and Eden points have no shoulders or stems. A few Angostura points have almost imperceptible shoulders. The Scottsbluff type has small but definite shoulders. The technique of decorating the point with parallel flake scars, as used by the best Solutrean workmen, also occurs on some specimens of the Eden, Scottsbluff, and Plainview types.

When all these styles of workmanship are considered, it becomes apparent that there was no regular evolution in flintcraft during the latter part of the Pleistocene, no progress from rude to delicate or from simple to complex. Flint points were not derived from bone points nor bone points from flint points. The Magdalenians renounced or ignored the Solutrean skills something like 16,000 years ago and betook themselves to making harpoon points of antler. On the North American continent the pretty Scottsbluff work was followed by dozens of new dart-point styles, neat but commonplace, most of them side-notched or corner-notched, and presumably originating with a later wave of immigrants from Asia. But the Solutrean-Scottsbluff technique of decorating the flint with parallel flake scars reappeared with Neolithic work in Egypt and Scandinavia and with quite recent work in California and Mexico. Some tribes, late as well as early, seem to have had a distaste for flaking flint. Various of the Indians in the eastern part of the United States were making projectile points of bone and antler when the white men arrived.

III. The Nature of Flint

FLINT IS A FORM OF SILICON DIOXIDE, usually deposited from sea water. Because it is easy to chip and because it is abundant in many parts of the world, it is the mineral that was most often used for Stone Age implements. Scarcer forms of silicon dioxide were also used on occasion. But there are various other hard stones that are either too tough or too granular to be chipped in any regular pattern. Accordingly, they were seldom used until the techniques of grinding and polishing had been developed.

Flint is harder than the steel in most knife blades, and a thin edge of the stuff is sharp enough to shave the hair on your arm. But flint is also decidedly brittle. It can be made to break quite evenly and can be shaped into symmetrical implements.

When Europeans began to explore and occupy the Americas and Australia, they found the native workmen flaking flint with a great diversity of tools and in an even greater diversity of attitudes. Quite as many variations may have been practiced even in Neanderthal times. But despite all differences in detail, there are only three fundamental methods of flaking flint:

1. By a blow with a hammer or some other kind of striking tool. This method is formally known as "direct percussion."

2. With a hammer and chisel, or mallet and punch, in combination, that is, by "indirect percussion."

3. By mere pressure, as with a tool of bone, buckhorn, tough wood, or the like.

The other forms of silicon dioxide that can be shaped in the same manner as flint include chert, quartz, quartzite, chalcedony, agate, jasper, and obsidian. Some of these terms are rather ill defined; *chert*, for instance, may be taken to mean an impure flint, a light-colored flint, or a flint that was deposited during some period other than the Cretaceous. Except for obsidian, all these stones resemble flint, and it is sometimes hard to tell which is which by the naked eye. It is easy to tell that obsidian is an igneous rather than a sedimentary rock. It is much more brittle than flint and therefore easier to flake, but it is also more likely to shatter. The list given here is not exhaustive; various other siliceous stones can also be used.

Flint often occurs in chalk or limestone deposits, usually in the form of more or less rounded nodules but sometimes in continuous layers. If the limestone dissolves or disintegrates, the nodules of flint may be left behind. Such nodules are commonly found in woods or prairies where no limestone is visible. And they are abundant in the gravel beds of many rivers.

For the implement-maker's purposes—regardless of any delicate distinctions that may be drawn by either mineralogists or lapidaries—all these various forms of silicon dioxide may be considered as merely different sorts of flint. In the Neanderthal sense, flint includes all sorts of siliceous stone that can be made to break in an even pattern. And because from the beginning until the end of the Stone Age the flaking or chipping technique was the really important one and flint was the stone chiefly used, it behooves us to consider the nature of flint, to understand what qualities make it the choicest mineral, and to learn why some kinds of flint are better than others.

It is set forth in a hundred textbooks that flint breaks with a conchoidal fracture and that this is the property that pleased the Stone Age implement-maker. But the famous postulate is not entirely true. Flint does not always break with an obviously conchoidal fracture. Indeed, the implement-maker's art consists chiefly in making the flint break with a fracture that is nearly plane, still conchoidal but almost imperceptibly so. The word *conchoidal* means nothing more than "shell-shaped"; and flint, when struck at random, actually does break in a three-dimensional curve. The flake that comes off is curved something like the shell of a clam. But the workman who tries to make delicate and shapely instruments will do his best to make the flint break along a *straight, flat* surface rather than in a curve, whether he is striking off a blank or trimming

Left, a flake of black flint, showing the bulb of percussion and the concentric arcs. Right, a flake of glass, showing that it breaks in the same manner as the natural mineral. The more nearly flint approaches the amorphous structure of glass, the easier it is to flake.

the blank into the finished implement. Even for pressure flaking, the same principle applies. Short, stubby, curving flakes, thick at the point of pressure and tapering sharply down to nothing, are the wrong kind. What the workman must learn to produce is the long, straight, thin flake, the kind that runs across the surface of the flint and comes loose from it as thin as a potato peeling or even thinner.

When flint is struck at random with a hammer, the pure and ideal form of that conchoidal fracture is rather an odd thing. The flake that comes off will consist of sections of two very much flattened cones, the one on top of the other. On the surface of the flake are ripple marks, which in effect are the arcs of successive concentric circles. On a smaller scale, they look something like the ripples that appear when you throw a pebble into a pond. Apparently, some kind of wave motion is involved. The radius of all the little ripples on the flake will be an imaginary line running in the same direction as the blow that struck off the flake. Or, sometimes, actual radii are visible in the form of tiny straight lines running out and intersecting the arcs. Sometimes, also, the upper of the two cones composing the flake will show on its surface the scar of a much smaller, thinner, narrower flake, the little one being broken off by the same blow that produced the big one. Quite rarely, there will be more than one such miniature scar. The upper of the two conical sections is known in formal language as the "bulb of percussion."

If the flint is pure, there may be hundreds of the tiny ripple marks, and the wave length may be less than a hundredth of an inch. If the flint is impure, or if the workman is trying to get a plane fracture rather than a conchoidal fracture, the ripples may be few, large, far apart, and almost imperceptible. If the workman is extremely skillful, he may strike off a flake so flat that the bulb of percussion is invisible except under a microscope. If the hammer is used at random, there being no deliberate effort to produce a plane fracture, the purest flint will show the greatest number of ripple marks. Or, if the flint is being flaked by pressure, the purest grade will show the greatest number of ripple marks. But these are uncertain methods of testing the flaking quality of flint. The simplest method is a literal rule of thumb. Knock off a flake and rub the scar with your thumb. The slicker it feels, or the shinier it looks, the better the flint will be.

Flint is technically described by mineralogists as being a cryptocrystalline form of silicon dioxide. That is, there are crystals in it but they are very small, so small that flint breaks in the same way as an amorphous mineral, such as glass. To the arrow-maker, innocent of any knowledge of mineralogy and interested only in the flakability of the stuff, flint is one of the most variable of substances. Not only does it come in different colors—gray, brown, and black being the commonest—but it also comes in all imaginable grades of excellence. Some of it is pure chemically and structurally; some is decidedly impure. Some is almost as smooth as glass; some is coarse and granular in texture. What makes matters still more confusing is that a nodule of flint no bigger than your fist may be pure and smooth at one end, impure and granular at the other. Sometimes there are even thin layers of flint and limestone, alternating, none much thicker than a post card.

But with all these variations, the simple test is dependable: just knock off a fresh chip with a hammer. The slicker it feels, the better the flint. Put little dependence in the feel of an old chip, stolen from the Indians. Some kinds of flint are slicker after they have been lying around for a few hundred years.

This extreme variability in the excellence of flint will not matter much if the workman relies mostly on percussion flaking. Almost any flint can be broken pretty well with a hammer or with a hammer and chisel. The man using these tools is applying more force and making bolder strokes than the man who uses a pressure-flaking tool. There is, of course, a lower limit. Some of the granular quartzites from the eastern part of the United States made serviceable but sorry-looking implements.

The workman wishing to show his skill in pressure flaking should use the best flint he can lay his hands on. If it is granular, the pressure-flaker will still work it; but the delicate, even strokes will no longer be so apparent to the eye. They will be lost in the roughness of the stone. Practice in flaking flint trains the eye remarkably. After the workman has made a few hundred projectile points, he will be sharply aware of something he might not have noticed before, no matter how many museums he may have visited. All of the prettier pressure-flaked pieces are made of high-quality flint.

Although flint is extremely durable and will long outlast flesh and bone, it does in the end decay. Exposed to the weather or to chemicals in the soil, it will finally begin to dissolve. A sort of thin, often whitish, film forms on the surface. Some few of the points made by the Palaeo-Indians have been exposed to the weather so long that the film itself is thicker than the undisturbed center of the artifact. However, this process, called "patination," is a very slow one.

It may have been the awareness that flint does decay, no matter how slowly, that has led to the misinterpretation of an Indian custom. Anyhow, some of the Indians used to take large numbers of flints—whether finished or only partly finished is not always wholly clear—and bury them in the ground. Why those Indians did that, there is no telling. Perhaps they were only traders, hiding their merchandise when they had to leave the place unguarded. Or maybe they really thought the flints would deteriorate if exposed to the weather. Whatever the reason may have been, a white man came along and decided that the Indians were burying the flints to keep them from becoming patinated or from drying out, so that their flaking quality would not be impaired if somebody wished to trim them further.

A widespread fable has resulted. Many a modern experimenter blames his ill success on the dryness of his flint, insisting that he could do better work if he could only get flint fresh from the quarry, flint still damp from contact with the mother earth. Attempting to restore the flint to its imaginary pristine freshness, such an experimenter will sometimes soak the stuff for weeks in water, or even in gasoline or crankcase oil, hoping that such treatment will compensate for his lack of skill. But it never does.

Nor is this the only fable related of flint. There are other experimenters who will do half or a quarter of the work required to shape an arrowhead, then put the chip of flint away for a day or two to let it "rest" before finishing the job. Tired flint, they say, is irresponsive to the pressure-flaking tool. Still other experimenters have somehow convinced themselves that hot obsidian is easier to shape than cold obsidian, and they warm it in an oven before trying to work it.

All these ideas are wrong. Offhand, there might seem to be some trace of reasonableness in the first one, that flint fresh from the quarry would be easier to shape than dry flint. But all experience disproves it. There have been numerous artifact-fakers in this country who got their flint by picking up scraps and broken implements from Indian campsites, never having learned to strike off good blanks of their own. The same practice was followed by my first and only teacher in the art of flaking flint, Captain Jerry Pierce, of Houston. And I myself have picked up dozens of scraps and pieces of broken artifacts, old enough to be patinated on both faces, and reflaked them into projectile points or scrapers. Such patinated scraps are actually easier to flake than the average of fresh flint—but only because they were chosen in the first place by expert judges. Even though the broken pieces have been lying on the old campsites a thousand years or more, exposed to all the ravages of the weather, their flaking quality has been impaired very little if at all.

Still another misconception—and this one is frequently repeated in textbooks—is that flint possesses some kind of grain, more or less resembling the grain in wood, and that flint will split along the grain, as wood does. Most writers mention this supposed quality only in a sentence or two and pass on to other matters. A few discuss it in moderate detail, arguing that the growth-layer pattern of the nodule is what causes this supposed grain in the flint and that, when a flake is struck off, its surface follows this grain or growth-layer pattern.

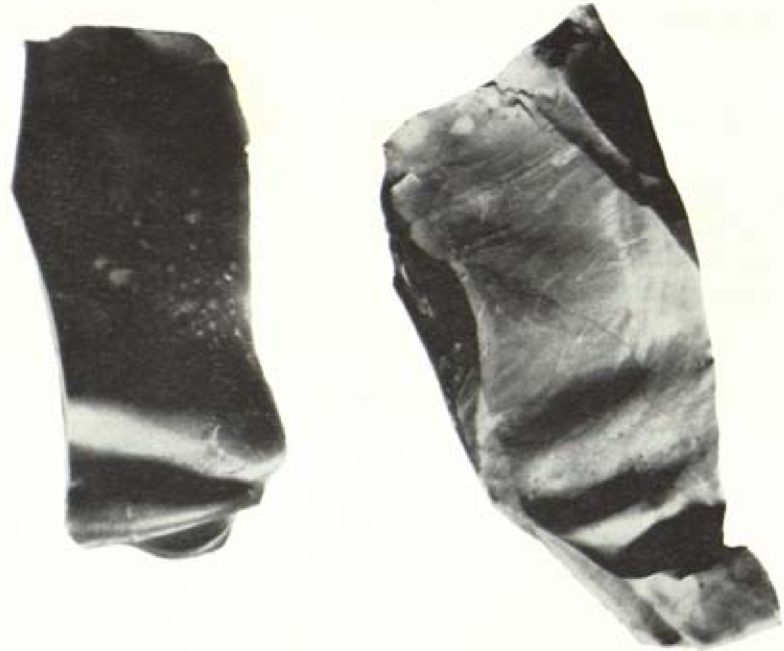
No theory could differ more widely from the observable facts. Nine times out of ten when a nodule of flint is struck at random with a hammer, the inner surface of the flake curves in a direction *opposite* to the outer surface or growth-layer pattern of the nodule. In cross section, this first flake taken off looks like a pair of parentheses: ( ). If the workman is expert, of course, the inner surface of the flake is not going to curve either with or against the growth-layer pattern of the nodule. It will run in a plane. But whether the work is skillfully or unskillfully done, it is easy to show that the inner surface of the flake has nothing to do with any growth-layer pattern of the nodule. For flint formed in nodules and flint deposited in continuous layers break exactly alike. So does obsidian, which is not formed in nodules. And so does glass. The so-called "conchoidal fracture" of these various natural and artificial minerals has nothing to do with any kind of grain.

Indeed, if there had been any grain in flint, the peoples of the Old Stone Age would have been sorely handicapped. To shape flint into symmetrical implements, the workman must have flint that is readily flakable in three principal directions, each of them at right angles to the other two. If there had been any grain in flint—as there actually is in a piece of timber—the workman could have flaked it in one direction but would have had to grind it, saw it, or break it at random in the other two. In short, then, if any grain actually exists in flint, the indications of its presence are so subtle that they will have to be detected by instruments in the physicist's laboratory. For practical purposes, flint has no more grain than a drink of water. The stuff is amorphous.

But although there is no grain, it is quite common to find flint that is cracked in more or less regular planes. Such cracking or splitting occurs both in flint exposed at the surface and in flint taken from limestone quarries, ten, twenty, or thirty feet underground. Since frost and sunshine are not likely to have had much effect twenty feet underground, it may be that such splitting is caused by shrinkage rather than by changes in the temperature. At any rate, it will be found that the flint is cracked into more or less right-angled hexahedrons, though not into cubes. The surfaces will be almost plane rather than obviously conchoidal. Sometimes the cracks will be invisible to the naked eye until the stone is tapped with a hammer. Sometimes they will be open enough to have admitted water, so that the surfaces are stained by weathering.

One might think that because such flint is cracked in three planes it will have three separate grains or will be easier to flake in those three directions than in some other direction. But that is not true. It can be flaked with equal ease in any imaginable direction.

In one respect, the cracks are something of a nuisance. They are often only two or three inches apart, and as soon as the craftsman starts working a piece of the stuff, it will break in two at every crack. Thus it can be used only for rather small implements. In another respect, the cracks are merely confusing to the novice. Not uncommonly, such flint is found



Multiple hinge fractures, or repeated waves, in flint. Left, a blade. Right, a core.

lying at the foot of a cliff or in the middle of a canyon, already broken apart into those nearly regular hexahedrons. It looks like the work of man rather than the work of nature, unless the beholder has had some experience in breaking up flint with a hammer. The first time I saw such a supply of hexahedral flint, I was utterly convinced that I had blundered upon an aboriginal quarry. When I learned how wrong I was, I felt pretty foolish.

One odd property of flint is that a flake or flake scar will often end in what is called a "hinge fracture." A hinge-fractured flake can be big or little and can have been made either by percussion or by pressure. Since hinge fractures often occur at the ends of the flutings on Clovis or Folsom points, there is frequent mention of them in the literature on these points. But they also occur on other sorts of artifacts, notably on occasional blades struck from cores. They are most easily understood, indeed, if one looks at a hinge-fractured blade and at the core from which it was struck.

Let us say that a workman is striking flakes—but not necessarily blades—off a core. The end of any particular flake will be formed in one of four ways:

1. The force of the blow will travel all the way through the core, ideally almost in a plane, so that the resulting flake is as long as the core is deep. This is the basic technique involved in striking off blades, that flower of Upper Palaeolithic craftsmanship.

2. The flake will curve away from the center of the core, thinning out gradually into nothingness, and thus will be shorter than the core is deep. This process is sometimes called "feather-edge flaking." It is the most common of the four.

3. The flake will shatter, breaking off short with a jagged end. Often this will be an accident, resulting from a faulty stroke or from a flaw in the flint. But on a miniature scale the Neanderthal workmen sometimes did the same thing deliberately. They would trim the edge of an implement with light blows directed toward the center of the piece. The little flakes would snap off short. This is called "step flaking."

4. Or perhaps the downward force of the blow will be absorbed before it travels all the way through the core. In that case, again, the flake will be shorter than the core is deep and it will come off the core in a sudden curve, or wave, almost at a right angle to the direction of the blow.

This wave, or curve, that creates or constitutes the hinge fracture is most easily understood if it is regarded as an actual wave in the blow that strikes off the flake. Some physics professor will have to test flint with the proper instruments before we can be sure that the thing, by all the canons of physics, really is a wave. But it looks like a wave, it works like a wave, and we might as well consider it as a wave. It occurs under much the same conditions as the waves that come rolling up a seabeach. At any great distance from shore, the sea waves are so flat that they are hardly noticeable. When their forward progress is checked by the shelving beach, they rise into high crests. Much the same thing happens when the downward force of the hammer blow is absorbed by the mass of the flint. There is a sudden crest in the wave and the flake breaks off short.

When a flake is being struck from a core, it is the flake that hinge-fractures off the core rather than the core that hinge-fractures off the flake. That is because the flake is thinner than the rest of the chunk of flint and the crest (or trough) of the wave can go through it more easily. But this is not necessarily true if what we should ordinarily call the core is something as thin as a projectile point. If a workman starts to flute a projectile point, that wave may curve out to either face of it. If it curves the right way, one face of the projectile point acquires a flute ending in a hinge fracture. If it curves the wrong way, the projectile point breaks in two, the break being caused by a hinge fracture. Investigators have found a good many fluted points that actually did break in two when the hinge fractures went the wrong way.

Now if the flake comes loose from the rest of the flint at the first crest (or trough) of the wave, the hinge fracture will have a deceptive look of simplicity. But the flake does not necessarily come loose at the first crest. There may be several crests (or troughs) before the hinge fracture is complete. There are also hinge fractures to be found at the ends of a great many pressure flakes, but these are so miniature that they are hardly noticeable.

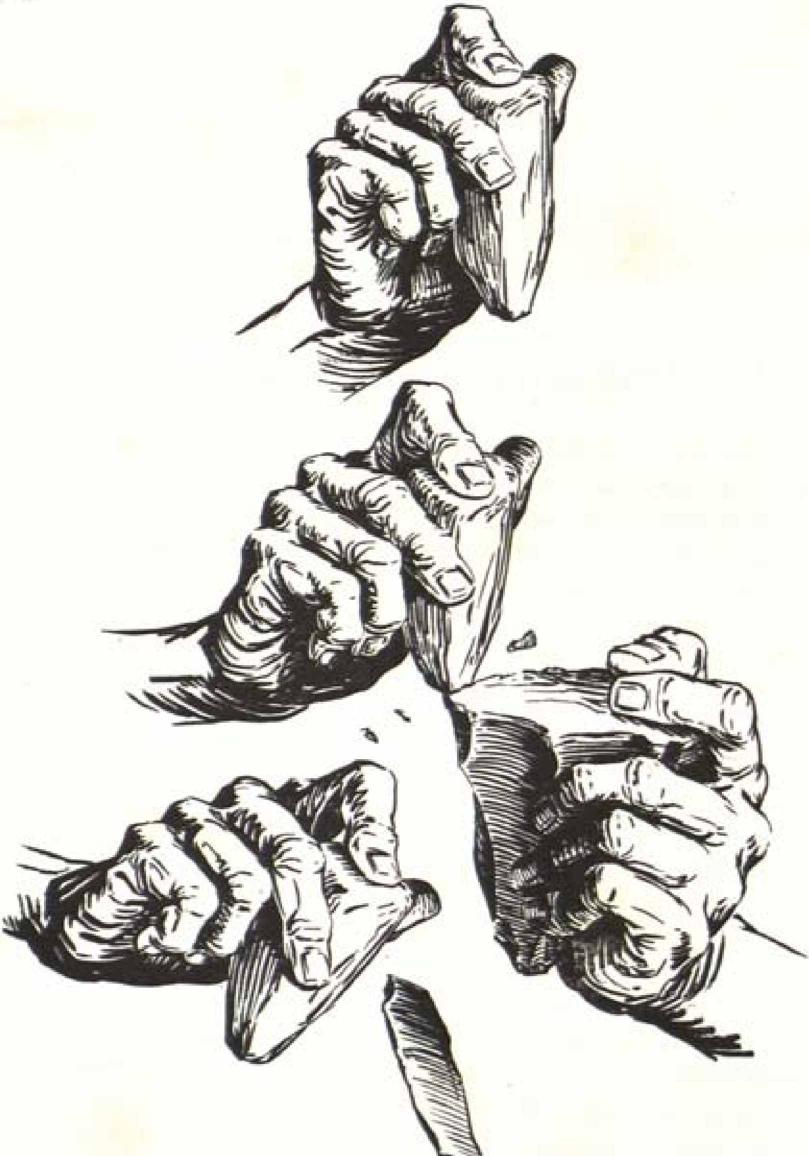
IV. Percussion Flaking: Blade and Core

THERE MAY BE SOME FEW READERS—those living in large cities or on sandy seacoasts—who will not have ready access to supplies of flint. If any such man is eager to start chipping arrowheads and is too impatient to wait till he gets hold of some flint, he might as well skip this chapter and turn to the next one. For that chapter explains that it is quite feasible to chip arrowheads out of plate glass, out of beer bottles, out of snuff bottles, or even in some instances out of the slag from iron foundries.

To begin by making projectile points from glass, however, is to study the technological history of the human race hind-end-foremost. And it amounts to giving yourself a tremendous advantage over all Stone Age men, whether early or late, in that you are starting to work with ready-made blanks—and those of the very choicest kind. The word *blank* is not much used in the technical literature. Instead, the writers discuss *core tools*, *flake tools*, and *blade tools*. But those are merely the three principal kinds of blanks. A blank is any piece of flint that is to be trimmed into a finished artifact. Suppose we redefine the three kinds, even though this involves some repetition from Chapter II:

1. A core is the original round pebble, or boulder of flint, or any similar thick and clumsy-looking chunk. Most of the Lower Palaeolithic fist axes were made from cores.

2. A flake is any more or less flat chip of flint knocked loose from a core or from a bigger flake. It may be of any size.



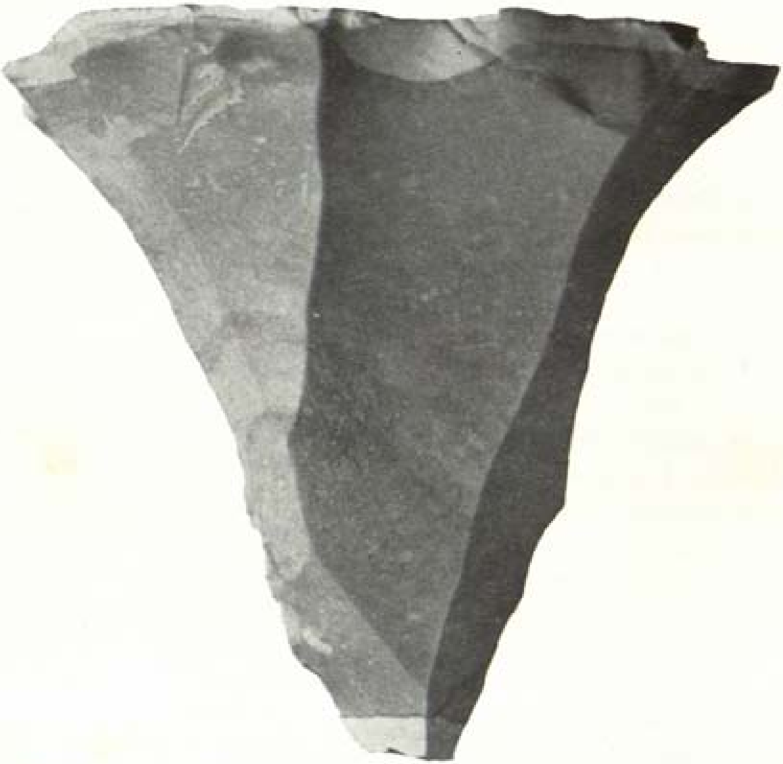
A drawing, more or less in the style of a stroboscopic photograph, to show the kind of stroke that is needed to strike a blade off a core. The idea is to strike all the way *through* the core, so that the flint will break in a plane rather than in a curve.

3. A blade—sometimes called a "prismatic flake" or "lamellar flake"—is a flake of a specialized type. Its outer face is formed by two or more strokes going in the same direction but in different planes. Its inner surface is formed by the single stroke that detaches it from the core. If skillfully made, it will be quite flat, straight, and thin. It will have almost the same form as a little slab of plate glass. It is the perfect blank for conversion into the finished artifact, whether trimmed only on the edges, as in the Aurignacian style, or completely over both faces, as in the Solutrean.

To strike several blades off a chunk of flint will naturally involve leaving some kind of core behind as a by-product. This is an entirely different kind of core from that considered previously. The Abbevillian workman made his fist ax out of the core and threw the flakes away, though he may have saved a few of the best ones for cutting tools. The Aurignacian workman kept striking off blades until he had whittled his core down to a nub. But he kept the blades and threw the core away. In its shapeliest form, the nub that he threw away is called a "polyhedral core." Perfectly good blades can be struck off without leaving so symmetrical a core behind. An extreme symmetry attests to the workman's thriftiness as much as to his skill. He was trying to get as many blades as possible off the same chunk of flint.

Some writers have argued in recent years that the blade-and-core technique is so precise and delicate that it could hardly have been discovered independently by different tribes of men in different parts of the world. Their argument is quite illogical. Blade-making, at least on the Aurignacian level, is by no means a delicate art. Anybody who goes at it delicately is wasting his time. The blade-maker should go at it in a relaxed, loose-jointed, and even reckless manner—more or less like a winehead falling down a stairway. The more reckless the approach, the better the result will be.

What you do is this: Get hold of a chunk of flint that has one flat side—which in technical language is called the "striking platform." Or if the nodule is almost spherical and has no flat



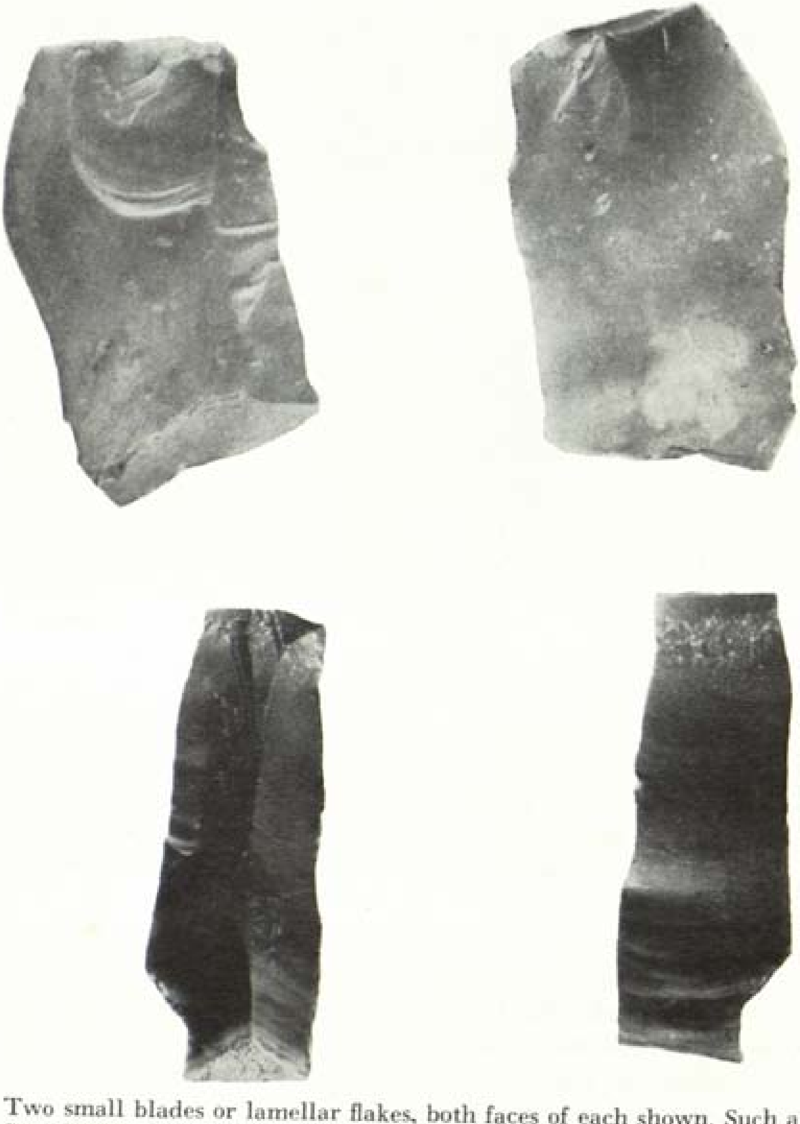
A polyhedral core. Part of the crust of the original nodule still shows, at both the top and the bottom. That is, the maker did not trouble himself to prepare a striking platform but merely used one surface of the nodule.

side, the simplest thing to do is to crack it in half. Then you will have two pieces, each with one flat side. Hold one piece in your left hand, with the flat side uppermost. Take a hammer in your right hand. Hit the flat top of the flint, near the edge, striking downward. Hit it hard, without forethought or hesitation. Most of all, hit it with a decided follow-through. The force of the blow must travel cleanly, all the way through the core. The principle is the same one that tennis coaches repeat so often: Don't hit *at* the ball; hit *through* it.

It is not necessary to take a long swing with the hammer, like a woodcutter swinging an ax. A short, sudden flick of the wrist and forearm will do the work. That is all you need to do except that as you keep knocking off successive blades, you keep revolving the core of flint in your left hand around its vertical axis. If a piece of flint is struck hesitantly near its edge, the flake tends to come off in the three-dimensional curve that the textbooks call a conchoidal fracture. The more resolute the blow, the more the curve flattens out, until finally it is almost a plane. To make a long, thin, symmetrical projectile point, you should start with a long, thin, symmetrical blank. That is the reason for learning to strike off blades, which are the ideal kind of blank.

Naturally, blade-making involves some minor considerations. Most Stone Age men seem to have done the work with hammerstones, which were simply pebbles plucked from the river gravels. Anyone seriously interested in the primitive techniques ought to put in a few hours of practice with a hammerstone, if only to convince himself that the thing will really work. It will. It is not so clumsy as it looks. In one respect, it is better than most steel hammers. A sphere resting on a plane touches it only at a single point. A hammerstone, being more or less round or egg-shaped, has the same effect when it strikes a flat surface of flint. The force of the blow is concentrated on a very small area. Of course, a modern man will have been accustomed all his life to using hammers that were mounted on handles. A hammerstone, having no handle, will seem awkward at first. But after a few hours of practice, or perhaps only a few minutes, the workman will learn to adjust his stroke accordingly.

The hammerstone, or any other kind of hammer, will work better if it is lighter than the core of flint. Then the core will be steadied under the blow by its own inertia. A light hammerstone is needed for delicate work, a heavy one for coarse work. For that reason, the hammerstones found near primitive quarries will range from the size of a walnut to that of a grapefruit. The best pebbles for such work are of quartzite or some similar tough stone, rather than of flint. However, a flint hammerstone will get the job done. It will, of course, be quite



Two small blades or lamellar flakes, both faces of each shown. Such a flat, slablike piece of flint can easily be trimmed into a finished implement.

as brittle as the core it is reducing to flakes or the implement it is being used to trim. But its small striking surface will have the whole weight of the pebble behind it, whereas the core or the unfinished implement will be struck only along its edge. Thus a flint hammerstone will stand up under a good deal of battering.

Although the serious experimenter should at least practice with a hammerstone long enough to learn how to use it properly, the plain truth of the matter is that it is simpler to buy a steel hammer at the hardware store than to hunt among the river gravels for quartzite pebbles. Rather amusingly, the best kind of steel hammer is the one that most nearly resembles a hammerstone. Get a ball-peen hammer and strike with the little end of it. Then the weight will be concentrated on a small area, as with a hammerstone. Hold the handle close to the head and you will have better control of the stroke, once again more or less as if you were using the primordial hammerstone. Of course, if you are a strict purist and in no hurry, you may as well stick with the hammerstone, first and last.

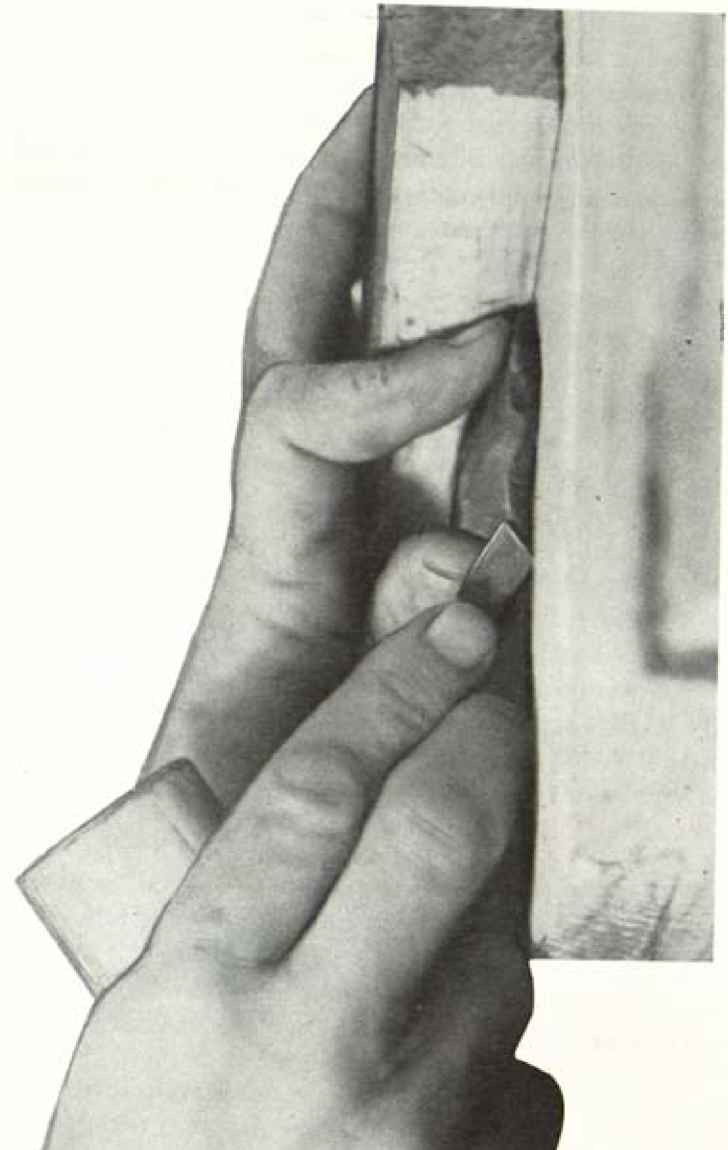
The basic technique involved in percussion flaking—no matter whether the workman is striking fair-sized blades off a core, a little strip flake off the edge of a burin, or miniature trimming flakes off a half-finished projectile point—depends on motor-sensory perception. Detailed instructions can hardly be given verbally. Not even a motion picture of the process would be of much use. One man can stand beside another and watch him execute the process without clearly perceiving how and why it works. It is something that has to be learned with the hand and not with the ear or the eye. But the same thing is true for hundreds of other techniques: throwing a baseball, hitting a tennis ball, tying a bow tie, rolling a Bull Durham cigarette, striking a match with your thumbnail. You can learn very little by watching the other fellow. You have to do your own practicing. Nobody can do it for you.

To get sufficient practice, you will need sufficient flint. With only one cartridge, you could not learn to shoot a rifle. With only one nodule of flint, you cannot learn how to break it properly with a hammer. Get three or four dozen nodules and then start practicing.

Disabuse yourself of the idea that it makes any enormous difference what kind of hammer you use—whether a big one or a little one, or whether it is made of stone, steel, bone, buckhorn, or what not. A man who actually knows how to shoot a rifle can kill game with any kind of rifle in the world—with telescopic sights, peep sights, open sights, or no sights at all, with anything from a puny little .22 short to a .475 elephant cartridge loaded with cordite. Billy Dixon shot that Indian off his horse at Adobe Walls with black powder and open sights—seven-eighths of a mile away. It must have been a wonderful thing to see, but the explanation for such skill is simple: Dixon had had plenty of practice with open sights.

There is still plenty of flint in the world, the Neanderthals having used but a small fraction of the available supply. Therefore the way to learn how to break it right with a hammer is to get a fair quantity and actually start breaking it. The more you break, the better you will train your hand. Disregard the talk about angles and vectors and striking platforms and all that sort of thing. As your hand acquires skill, the flint will begin to break more and more in the direction of the blow. Just keep on hitting the flint and you will inevitably learn how to hit it right.

Blades are the best kind of blank for trimming into finished implements but are by no means the only kind that will serve. Any flat, thin chip can be used. It is on record, as reported by eyewitnesses, that some of the peoples in Mexico and some of the Plains Indians knew how to make blades, or lamellar flakes, with a huge pressure-flaking tool. This was a crutch-shaped or T-shaped apparatus, three or four feet long. The workman would hold the core between his feet, put the point of the T against the edge, put his chest, and with it the weight of his body, over the cross of the T, then lunge downward suddenly. The sudden pressure would take a blade off the core. Now this is something that I, for one, have never learned to do, perhaps because, being a little man, I lack the necessary weight or perhaps because I am simply not skillful enough. But there is no reason to doubt that some of the workmen in Mexico once knew how to do that. And perhaps some reader, bigger or more dextrous than most men, can rediscover the Mexican technique. Fortunately, no such virtuosic skill is really necessary, since perfectly good blades can be made with a hammer or a hammerstone.



V. Pressure Flaking

THIS CHAPTER IS MEANT for the man who would like to get started, right here and now, on learning how to make knives or arrowheads, without any further philosophical disquisitions.

The simplest way of learning the art is to go at it hind-end-foremost, that is, to reverse the technological history of the race by learning pressure flaking first and percussion flaking afterwards. It was not thus that our rude forefathers learned; but it is the easier way. And it is, indeed, the way in which most men who nowadays make arrowheads learned the art. The trouble with this method of study is that many who follow it learn how to convert a blank into a projectile point without ever learning how to make the blank itself. They thus remain lazy and imperfect craftsmen, familiar with only half of the art.

Since this, however, is simply a treatise on flintwork, rather than one on ethics or artistic ideals, let us rebuke lazy men no more but get on with the instructions for pressure flaking. A man wishing to make some arrowheads by pressure flaking can obtain his blanks by any of several methods:

Pressure-flaking with an iron tool (opposite), the flint braced on top of a worktable. The pressure will be applied in the direction in which the tool is pointing, it will be accompanied by a twist, and the flake will come off the *bottom* face of the flint. Damage to the table will be prevented if a piece of rubber or thick leather is kept under the flint, but for the sake of simplicity this is omitted from the photograph.

Pressure-flaking tools made of buckhorn. Top, a T-shaped piece. Center, a straight piece. Bottom, a buckhorn tip lashed to a wooden handle.

1. He can make his own blanks out of flint with a hammer.
2. He can steal the blanks—any flat, thin chip of flint will do for a blank—from dead Indians. That is to say, he can pick up second-grade blanks from almost any Indian campsite. The Indians, of course, will have used up most of the good blanks.
3. He can pay a lapidary to saw some blanks.
4. He can use glass—the easiest method of all. Plate glass, construction glass, beer-bottle glass—almost any kind will do.

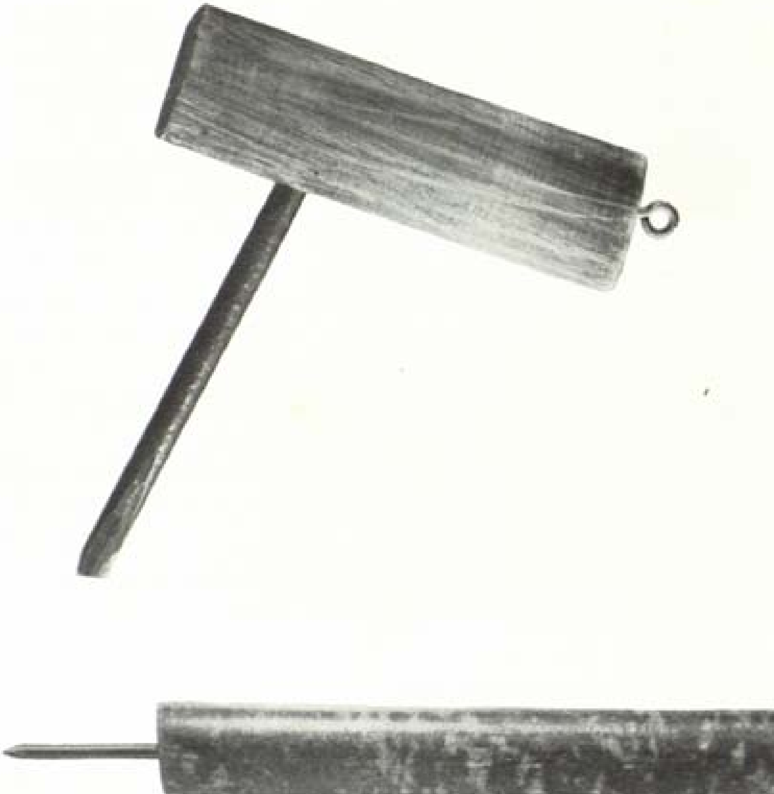
Captain Jerry Pierce, who gave me my first lesson in flint-craft, is a devoted believer in method 2; that is, he invariably steals his blanks from dead Indians. Happily for the Captain, his favorite scene for such depredations is Real County, Texas; and the Indians who once inhabited Real County had tons of flint ready at hand and struck off quite shapely scrap flakes. In any area where the Indians had to use a granular quartzite, the Captain's method would not work so well.

Pressure flaking consists in chipping flint or any similar material with a tool of bone, buckhorn, or something of the sort. That anything as hard as flint can be shaped by anything as soft as buckhorn will seem odd only to the man who has not yet tried it. Flint is harder than most tool steel. But it is brittle enough to break easily and so nearly amorphous in structure that the breaking can be controlled.

Various tribes of men have pressure-flaked flint with a weird diversity of tools and in an even weirder diversity of attitudes. An Australian blackfellow may even flake it while holding it against his left heel. Another blackfellow may hold it on top of a sizable boulder. An Eskimo may hold it on a driftwood log. Many an Indian simply held it in his left hand, sometimes bracing that hand against his left knee. If the modern artisan objects to squatting down beside a boulder, he can use an ordinary worktable, nailing a short piece of plank on top of it to keep the flint from slipping sidewise.

Two things remain to be considered: the most suitable tool for pressure flaking and the nature of the stroke. As for tools, I recommend a ninetypenny nail mounted in a wooden handle, as being the easiest to acquire and much the most durable. It will outlast a dozen bone or buckhorn tools. Stone Age men made the latter sort in many shapes and sizes. A simple one consists of part of the legbone of a deer. A very good one is the kind used by my old teacher, Captain Pierce. He saws out a T-shaped piece of buckhorn from a pair of antlers and holds it by the cross of the T, as a man would hold a large corkscrew. Still another friend, Dr. H. J. Sawin, who is a palaeontologist as well as the former graduate dean at the University of Houston, gets good results with an ordinary beer-can opener.

The Captain's implement is somewhat better than the



Pressure-flaking tools made of iron. Above, a ninetypenny nail set in a wooden handle—a tool copied from the T-shaped piece of buckhorn. The tip is filed into a sort of flat chisel edge. Below, a smaller nail set in a wooden handle, for making narrow notches and the like.

Dean's and indeed is perhaps the finest kind obtainable, for buckhorn is ideal for pressure flaking. It is tough enough to break the flint but elastic enough not to mar it. Iron tools have a tendency to crush the edges and are not quite so good for really delicate work. But despite the long and heroic history of buckhorn, it is scarce nowadays and hard to come by. Also, it wears out too fast.

The tool copied from Jerry Pierce's T-shaped piece of buckhorn consists of a ninetypenny nail mounted in a four-inch piece of pick handle. The tip of the nail is filed into a somewhat flattened cross section. The leading edge, instead of being at a right angle to the long axis of the nail, is more or less parallel to the handle. This allows for a better grip if the edge of the flint is thick. Nail iron, being soft, if not so soft as buckhorn, works better than tool steel. After a few strokes, the leading edge becomes rough enough to grip the flint firmly. Tool steel, being harder, keeps its slick surface and has a tendency to slip.

None of this is intended to discourage you if you want to work flint in the pure, primordial manner. If you wish to use a bone or buckhorn pressure-flaker, by all means do so. If you are seriously interested in the Upper Palaeolithic techniques, you should make and use some bone and some buckhorn tools and also learn to pressure-flake flint while holding it in your left hand, holding it against your heel, or holding it against a log or a boulder. There are skilled modern experimenters who insist that they get better results by holding the flint in the left hand than by bracing it against something heavy.

The delicate variations in method can wait for a later experiment. Let us assume that you, an apprentice, are content to begin by learning to pressure-flake flint on an ordinary worktable and with an iron implement. In one way or another, you have got hold of some blanks, whether by stealing them from dead Indians or by picking up broken beer bottles. Follow the directions below and follow them rather carefully; some elementary principles of physics are involved:

1. If the table is a light one, brace it against the wall.

2. Put a rubber heel, a piece of shoe-sole leather, or something of the sort under the flint. This makes it easier to twist the tip of the flaking tool. Also, it keeps the workman from eventually gouging a hole in the top of the table. This precaution is not indispensable, but it is convenient. An Indian holding the flint in his left hand would keep a piece of buckskin under the flint for an entirely different reason—to keep the chips from cutting his hand.

3. Brace the flint itself against the piece of plank and hold it down with the fingers or the thumb of the left hand. Hold it

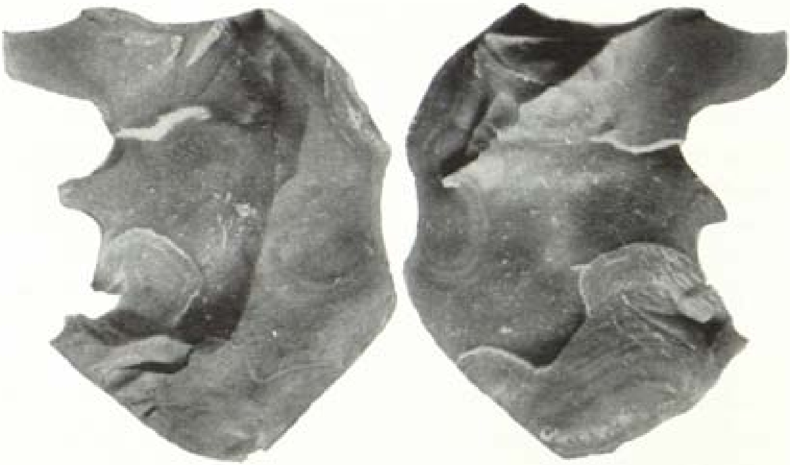
firmly; if it slips, you are going to cut yourself. Indeed, you would be well advised to wear a glove on your left hand for the first few days of practice. If you are going to break beer bottles with a hammer, you had better wear spectacles, too. It is one of the minor mysteries of Stone Age life that Columbus somehow failed to report that the woods were full of three-fingered and one-eyed Indians when he landed.

4. You will have to peel the pressure flake off the bottom of the flint—not the top. If the tool was used on top, it would slip. If the edge of the flint is thin, seat the tool so as to overlap it. Then, as the flake comes off, its butt end will include a tiny section from the upper face of the flint; but for most of its length it will run along the lower face. If the edge of the flint is thick, seat the tool so as to reach only part of the way to the top, that is, without overlapping. Flint is almost always pressure-flaked off the bottom face, and the flake starts at the edge of the blank. If you see a projectile point with a flake scar isolated in the middle, this means only that a later stroke wiped out part of the original scar.

5. The force should be applied as nearly as possible in the direction in which you are trying to make the flake run. In actual practice, you will have to slant the tool and apply the pressure 30 to 45 degrees above the horizontal to keep the blank from buckling upward. But if you try to make the flint flake horizontally by pressing downward with the tool at 90 degrees (which is what the unskilled workman often does), your flakes will be short and stubby.

6. To make the flake come loose, simply seat the tool firmly against the edge of the flint, then push. Push fairly hard. But

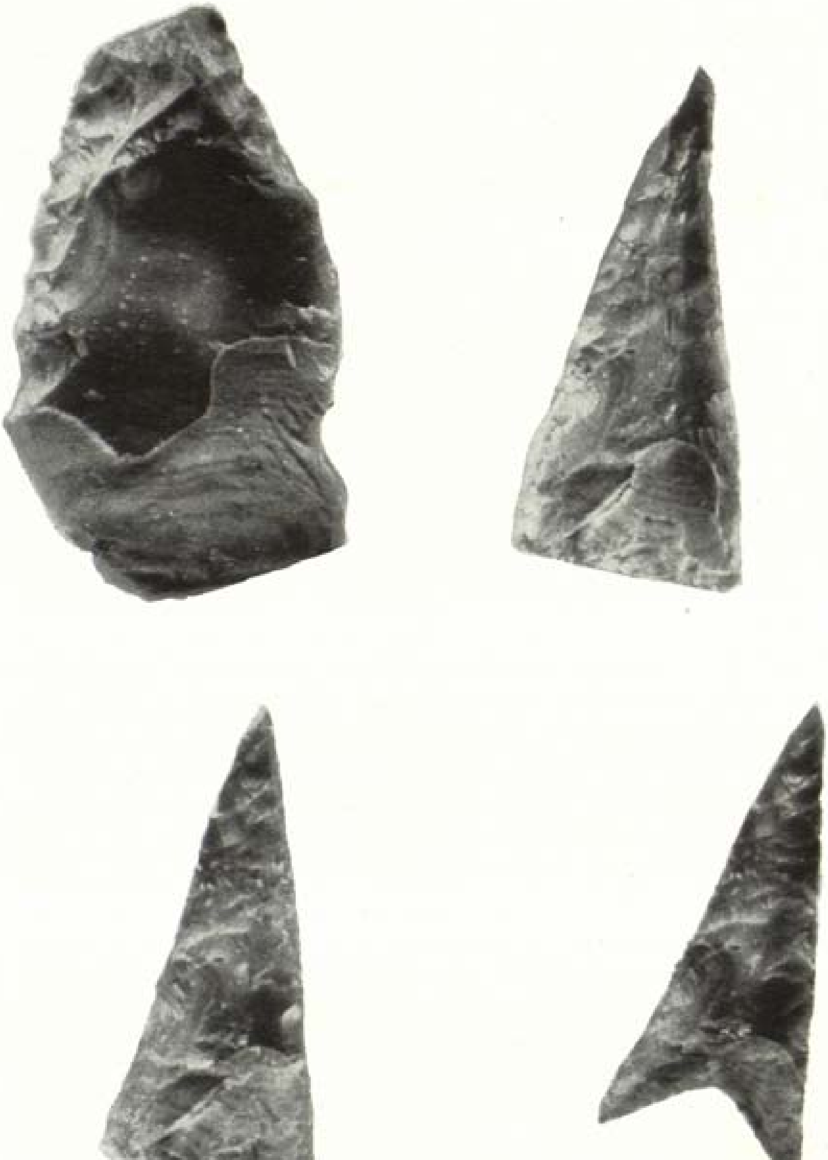
Pressure-flaking with a buckhorn tool (opposite). The pressure will be applied in the direction in which the tool is pointing and will be accompanied by a slight twist. The flake will come off the *bottom* face of the flint. The piece of leather under the flint is to keep the workman's hand from being cut by the sharp flakes. This is called the "freehand" style of flaking but the term is something of a misnomer, since the workman will usually rest his left hand against his left knee or against a log or on the ground. The workman may stand, squat, kneel, or sit, as he chooses. The precise position of the thumb and the fingers makes little difference.



On this page, the top and bottom faces of a rather ill-shaped chip of flint. On the opposite page, four views of the same chip while it was being pressure-flaked into a dart point. Note that there are no distinct stages. The process is continuous, like whittling on a stick. Also, bear in mind that this is a minority technique. Most of the artisans who lived during the so-called Archaic stage in North America would have done part of the preliminary shaping by percussion, and some percussion-flake scars would have remained on the finished dart point. On the other hand, if you find an artifact completely covered with pressure-flake scars, there is no way of telling how the preliminary work was done unless you can find all the tiny scrap flakes and put them back together.

use the weight of the body rather than the strength of the wrist, more or less like a man pushing a wheelbarrow. That sudden, strong pressure will peel the flake off the bottom of the flint.

7. The stroke will work better if the push is accompanied by a slight but distinct twist of the flaking tool. Indeed, twist, rather than pure pressure, is the big medicine. This can be a clockwise rotation of the flaking tool, a downward deflection of the tip, or a combination of the two. Apparently, the twist starts some kind of vibration on the under surface of the flint and makes the flake come off more readily. What kind of vibration it is may remain uncertain till some physicist makes a test with the proper instruments. Or perhaps the vibration is only an illusion. Anyhow, the principle works.



8. Bear in mind that the tip of the flaking tool moves forward hardly at all. The flake created by pressure runs ahead of it, like a ripple on a pond; but the tool stays where it was in the beginning.

The surprising thing about this ancient technique is the ease with which it works when it is done right. Some arrowmakers get short, stubby flakes because they have never understood that they should apply pressure in the direction in which they wish the flakes to run. If the stroke is correctly executed, it is no trick to make the flake run an inch or more. The farther it runs, though, the harder it is to control it.

A properly made pressure flake does not come off the bottom of the flint in a single piece, like a big flake knocked off with a hammer, even though that is the process ordinarily diagramed in textbooks. Usually, it breaks, perhaps into two or three pieces, perhaps into a hundred. If taken off skillfully, it will be from ten to a hundred times as long as it is thick and so delicate that it shatters in the instant of its creation. The byproduct will not be a series of slivers that the workman can fit back into the flake scars but will more nearly resemble a sort of sand with exaggeratedly wide, thin grains. And since a good pressure flake is thin and runs along the surface of the flint, it will even travel around a curve if the blank is curved.

The apprentice workman must not think that he has the Stone Age weapon-maker's art mastered as soon as he learns to press off a long, thin flake. For he must also learn to make serviceable blanks, as explained in Chapter IV. Furthermore, the ability to create parallel flake scars on a piece of flint does not by any means enable the workman to copy such masterpieces as some of the Solutrean points. It is fairly easy to make the flake scars run parallel, but it is extremely difficult to do the following three things simultaneously, with the same series of strokes: (1) Keep the flake scars parallel. (2) Shape the flint and sharpen the tip. (3) Sharpen the two edges.

The beginner in pressure flaking needs little instruction besides that already given. Anybody familiar with a file and a brace and a bit can make a tool like the one recommended, or anybody familiar with a saw can saw out a T-shaped piece of buckhorn. You will find it useful to keep tools of two or three different sizes handy. To notch projectile points, you need only to use less pressure on the stroke, sawing into the flint with shorter and stubbier flakes. To make a narrow notch, simply use a tool with a narrow tip.

Pressure flaking is a rapid process and a man can make an arrowhead or a dart point in five minutes or less. The common idea of the Palaeolithic artisan as one who succeeded only by vast perseverance and patience is wholly mistaken.

VI. The Hammer and the Chisel

SINCE A FLINT IMPLEMENT can be shaped with the hammer alone, with a hammer and chisel together, or with a pressure-flaking tool, all sorts of variations in technique can be managed by combining any two or all three of the fundamental methods.

The number of possible variations is further increased by the fact that any of the three principal methods can be used while the flint is simply held in the left hand, braced against the left knee or the left foot, or on top of a log, a boulder, the ground, or what not. Furthermore, the flint can be struck against the hammer (or the anvil) rather than the hammer against the flint. Or the flint can be pushed against some kind of pressure-flaking tool. And finally any or all of these variations can be employed by one man working alone or by two men working together. There are dozens of possible permutations and combinations.

How many of them were actually in use at one time or another during the million or half-million years of the Pleistocene, it would be hard to guess. When Europeans began moving into the Americas and Australia, they found the native workmen using a number of methods but by no means all the possible methods. From the time of Captain John Smith onward, a few such observers were thoughtful enough to take notes on what they saw. The fullest summary of their reports will be found in the *Handbook of Aboriginal American An-*

tiquities, written by W. H. Holmes, of the Bureau of American Ethnology, and published in 1919. But the reports are not so enlightening as might be expected. For one thing, they deal only with such processes as were in use very late in the Stone Age and give no information on Neanderthal techniques. Then, too, most of the observers were describing processes that they could not themselves perform, and, although flint-flaking is a simpler art than playing the fiddle, a manual for fiddlers written by a nonfiddler would necessarily be somewhat inexact. Most of them noted how the Indian or the blackfellow sat or squatted and how he held the flint rather than how he performed the stroke that did the work. And, finally, most of the observers failed to distinguish between commonplace work and expert work.

Whatever flint-working tools may have been used during the Lower Palaeolithic, most of them, except for the hammerstones, would necessarily have rotted long ago. And for some reason the scholars of the Old World seem to have little interest in collecting or studying hammerstones. The sites of later times, especially those in North America, have yielded fair numbers of bone and antler pressure-flaking tools, in addition to abundant hammerstones. But at most sites the evidence for flint-working techniques consists largely of finished implements and of waste flakes and cores. Now all you can tell by looking at the finished implement is whether the last series of flake scars—those that still show, for an earlier layer would have been wiped off—were made by percussion, by pressure, or by a combination of the two. Even this is not always wholly certain. In general, pressure-flaked scars are smaller, more even, and more precisely placed than percussion-flaked scars. But this distinction is by no means invariable. An expert can do small, delicate, and precise work with a hammerstone. A novice can do messy work with a pressure-flaker.

It is hard to distinguish work done with a hammer from that done with a hammer and chisel in combination. Extremely bold and large flake scars were probably made with the hammer alone; nevertheless, there is no way of being sure.

Some kinds of delicate work can be done more easily with a light hammer than with the hammer and chisel together. This is especially true for making burins. It is easier to strike that long, narrow strip-flake off the end or the edge of a burin with a light hammer than with a hammer and chisel together.

The terms *hammer* and *chisel* are, of course, somewhat imprecise. Although a modern cold chisel or woodworking chisel can be used to shape flint, it will not cut the flint as its cuts wood or soft metal but will only break it, much as the unaided hammer breaks it. As defined by function, the tool becomes a *punch* rather than a *chisel*. A bone or buckhorn punch, like the buckhorn pressure-flaker, will work as well as any other kind, owing to the fact that flint is extremely brittle. As for the hammer, it can be a striking tool of almost any sort: the primordial hammerstone, a stone hammer lashed to a wooden handle, a maul or billet of wood, a modern steel-headed hammer, or what not.

Most contemporary experimenters use the hammer and chisel rather than the unaided hammer, but a few become quite proficient with the simple hammerstone. When a hammerstone is used to trim flint into the finished or almost-finished implement, the process is not quite the same as that involved in striking blades or other suitable flat flakes off a core, as described in Chapter IV. A more delicate stroke is needed, and a twist can even be added to the stroke, more or less as is done in pressure flaking. The apprentice workman might as well study both techniques at the same time. During the preliminary thinning, he will probably strike off blanks that are too thick and lopsided to be properly finished by the pressure-flaker alone. Intermediate thinning with a hammer or hammerstone will be required.

It seems probable, though it is not certain, that most Stone Age peoples using the hammer and chisel would have preferred to steady the flint by simply putting a foot or a knee on top of it. Most modern experimenters, however, prefer to use some kind of vise. This is sometimes the ordinary iron vise, obtainable at the hardware store and operated by screws, with the flint protected from shattering by being wrapped in burlap or bits of old inner tubes. Or the vise can consist of two blocks of wood, held together or tightened with rope or with buckskin thongs. Or the vise can be a single block of wood with a groove cut in it, into which the flint is inserted. Whatever sort of vise is used, the workman shapes the flint by striking downward almost at 90 degrees, rather than by striking slantwise, as when the flint is held down by a foot or a knee. Also, when a vise is used, the workman can see the flake come off, instead of being compelled to labor blindly as when the flake is struck off the invisible bottom face of the flint.

There is no great advantage in being able to see the flake come off, and it seems doubtful that any considerable number of Stone Age men ever used any kind of vise. The method is rather cumbersome. The workman must continually be screwing or unscrewing, or tying or untying, his vise. He can do the job faster if he steadies the flint by putting his foot or his knee on it. But, anyhow, the modern experimenter might as well use a vise if he prefers to do so. He will not be giving himself any advantage over the Palaeolithic craftsmen. He will be merely slowing down the process.

Most men accustomed to using modern tools can do better work with a hammer and chisel than with the hammer alone. The chisel can be set in the exact spot where the workman wishes to strike off a flake. Nevertheless, it seems likely that most primitive craftsmen preferred to use the hammer alone Ordinarily, the hammer will produce the longer and neater flake. It takes a good deal of practice to learn to strike accurately with a hammer. But the Palaeolithic craftsmen had plenty of time for practice.

VII. Fire and Wet Straw

THERE IS A FINE OLD NORTH AMERICAN FOLK TALE—as charmingly ingenuous as the story of the Three Little Pigs—which explains that the Indians used to make arrowheads by heating a chip of flint in the campfire, then raking it out and touching the surface with a wet straw. As each little dab of moisture was applied, a tiny flake would pop off the surface of the flint. Of course, the flint soon cooled and had to be reheated. But time meant little to the patient, persevering Indian. He would keep on heating and reheating his flint, hour after hour, nibbling away at it with his wet straw until by the time the sun went down he had a perfect arrowhead.

Unhappily, this legend has disappeared from the serious literature. Franklin's story of the whale chasing the codfish up Niagara Falls is still reprinted from time to time. So is Davy Crockett's story of grinning so hard that he grinned the bark off a tree. But the tale of the persevering Indian and his piece of wet straw got its last scientific consideration when Holmes published his famous *Handbook of Aboriginal American Antiquities* in 1919. He quoted one report from an eyewitness, who told how he had actually stood by and watched while a genuine Indian plied the fire and straw. Holmes seemed a little hesitant about the story but was too open-minded to come right out and call that eyewitness a liar. Ignored nowadays by savants, the folk tale can still be heard on the street corners, and it is reprinted from time to time in lapidary journals or in the column devoted to letters in *Field and Stream*.

The skill of that straw-wielding Indian seems all the more remarkable when it is remembered that fire usually cracks flint and ruins it. A chip that has been in a fire may come apart at the cracks and break into jagged fragments, or it may stay all in one piece and crumble only when somebody tries to flake it. And investigators are utterly baffled by the fact that the straw-wielder left no identifiable handiwork behind him. That is to say, the ordinary flint artifact shows pretty clearly that it was made either by percussion or by pressure rather than with fire and water. Unless the piece is badly weathered or made of poor stone, the evidence will be in its flake scars. A flake scar not only has a certain shape, size, and position, it also has a definite direction. The tiny ripples, or arcs, mentioned in Chapter III show the direction in which the blow was struck or the pressure was applied—almost invariably from one or another edge toward the center. Presumably, the wet-straw method would leave the surface of the flint covered with tiny, shallow pits, or pockmarks. The ripples, if any were formed, would lie in closed circles rather than in arcs.

No such pock-marked arrowhead has ever been found. But that persevering Indian is too picturesque a character to be lightly abandoned merely because nobody has ever found any traces of his handiwork. There is too much skepticism in the world anyway, and his method is entitled to a fair trial. Some of the most grotesquely implausible stories related by Herodotus, regarded for two thousand years as nothing but lies told to gullible travelers, turned out to be true when systematic research was performed. And research into the fire-and-wet-straw method is a simple project. All you need is a chip of flint, a fire, some water, and a straw. Only the most fanatically rigorous devotee of the primitive techniques would insist on building the fire out of doors and using a bow drill to start it, or maybe on waiting for a volcano to erupt. Just use the gas jet on the kitchen stove; it will get the edges of the flint red-hot if you want them that way.

Put your flint in the gas flame, or hold it there with a pair of pliers, and watch what happens. The first thing you discover is that fire really will crack flint—even without the water and the straw. A few jagged bits may pop off the edges while the flint is getting hot. As likely as not, the flint will also crack into two or three main pieces and fall apart. But do not be discouraged. Salvage the largest of the pieces, wet the end of the straw, and apply the moisture.

This is where the disappointment starts and a man begins to lose his faith in that patient Indian. It is hard to pick up much water on the end of a straw. Most of the time when you put that little dab of dampness on the surface of the flint, nothing whatever happens. There is not enough of the water to cool the flint.

The possibility remains that the Indian might have used a gourd with a hole in the bottom of it rather than a straw, even though Holmes's eyewitness said it was a straw. With a dripping gourd he certainly could have got more water on the flint. If you have no gourd handy, get an eye dropper, reheat the flint, and start all over. Now the eye dropper really will work—at least to the extent of cracking the flint. By applying a whole drop of water at a time (occasionally four or five drops are needed), you can crack a little chunk off. But there is no way of controlling the size or the shape of the chunk. It does not come loose from the upper surface of the flint in a paper-thin and narrow strip, like a well-made pressure flake. It does not even come off in the form of a tiny hemisphere, leaving a pock mark behind it. Usually, it comes loose as a small, irregular fragment, broken out of one edge. The only thing predictable about it is its thickness. Ordinarily, it will be as thick as your chip of flint, since all you have succeeded in doing is cracking the flint.

We must now bid farewell to our persistent but imaginary Indian. We shall leave him there, squatting by his little fire, with a piece of straw in his hand and a maniacal gleam in his eye. Stacked up on the ground beside him are half a ton of flint and a cord of firewood. He is fanatically determined to make an arrowhead with his piece of straw if it takes him all week. If he only had sense enough to get a piece of buckhorn, he could pressure-flake an arrowhead inside of five minutes.

VIII. A Reconsideration of Blades

WITH THE TECHNOLOGICAL HISTORY of the Stone Age in mind—and perhaps after some actual practice in working flint—it might be interesting to go back to the subject of blade-making, discussed in Chapter IV, and reconsider it, this time for its meaning within the large framework of that history and not merely for suggestions whereby a modern man can while away his time.

Blade-making in Europe was pretty much a continuity, both in place and in time, as soon as the Neanderthals were off the scene. There is a great abundance of middle-sized blades from the Upper Palaeolithic, of little ones from the Mesolithic, and of long, narrow, beautifully symmetrical ones from some stages of the Neolithic. The prevalence of those blades is easily recognizable because so many of them were hardly trimmed at all, whether used by the Aurignacians for knives and scrapers or by the Neolithic peoples for the cutting edges of sickles. But in North America there are big gaps in the record, at least as it is set forth in most of the technical literature. Blades turn up at a few of the fluted-point sites, small ones at sites of various ages in the Arctic. Elsewhere they are scarce and scattered except for Hopewell blades in the central part of the United States and the long, handsome, pressure-flaked obsidian blades that the Indians were still making when the Spaniards arrived in Mexico.

It seems likely that blades were more generally used on the

North American continent than some of the digging indicates. There are several reasons for thinking so: (1) To make a long, thin, and delicate flint implement it is almost a necessity to start by making either a blade or a neat flake. A nodule will hardly do. (2) Any workman who learns to strike off flat flakes has automatically learned how to make blades as well. (3) The presence of the blades may be masked. If an old-time mammoth hunter took six blades and trimmed all six into long, thin dart points, leaving no untrimmed blades behind, the eventual finder might not realize that he was looking at blades. (4) To make blades, it is by no means necessary to make a neatly conical core and leave it behind as the by-product or as a guide to some future researcher. Blades can be struck from a core of almost any shape.

All this, of course, is merely circumstantial evidence. The direct evidence is scarce. But the principles may be worth considering in some detail. The man who has never worked much flint may not realize how hard it is to make a long and delicate implement out of a nodule or even out of a flake with abruptly curved faces. A week's actual practice with a hammer would convince him of the futility of the process far more effectively than any explanation in print. But, anyhow, here is an endeavor to explain. It is easy to take a more or less spheroidal nodule of flint and use a hammer to trim it into a fist ax. The fist ax does not need to be thin. It is not especially hard to trim a nodule into a fat and clumsy spear point—something almost as thick as it is long. But to trim a nodule into a delicate implement is a different matter entirely. This means going at the job in the hardest possible way. It would require extreme skill, coupled with even more extreme stupidity, to take a roundish nodule of flint, more or less the size and shape of a squashed cantaloupe, say six inches by five inches by four inches, and hammer it down into a dart point still six inches long but only a quarter of an inch thick. You would have to alter the shape of the nodule by making it not so much absolutely thinner—which is easy—as very much relatively thinner, that is, by changing the proportions of its length and thickness from 6:4 to 96:4. And since the top and bottom faces of the nodule would not be parallel planes but curves bulging away from each other, you would have to start the thinning process by striking off flakes that were consistently thicker at their far ends than at the points of the hammer's impact—all this while swinging the hammer at an oblique angle against a curving surface. No doubt there are men who can do that; but I never saw one.

The extremely difficult process described above is the one illustrated with several drawings in Holmes's *Handbook of Aboriginal American Antiquities*. Thus it has come to be accepted, though chiefly among people who have flaked very little flint, as the orthodox way of thinning down a core. But it is the wrong way. There is no particular reason for learning to thin down a core, since it is much simpler to strike off a large flake and then use the flake, rather than a core, as the blank. However, if you insist on learning how to thin down a core, do this: Pretend you are a Levallois workman or one of those Neanderthals who still made Levallois flakes. Start out as if you actually intend to make a Levallois flake. Choose a rather flattened nodule of flint—the flatter, the better. Hold it with one of the flattened surfaces uppermost. Trim it along the edges with sharp blows struck downward at 90 degrees, much as the Levallois workman would have done. If you do this correctly, you will convert each edge into a long, narrow striking platform, and your nodule will now have almost the shape of a parallelepiped; that is, it will have thick and flat edges, like a domino. Turn your rough parallelepiped 90 degrees until one of the narrow striking platforms is uppermost. Now trim both faces of the nodule—not merely one, as the Levallois workman would have done. When you have finished, you will have thinned down your nodule by converting it into a double Levallois flake, without ever striking either flake loose from the other.

By comparison with either feat of craftsmanship described above, striking off a blade is easy, and the finishing work is easier still. The blade has almost the dimensions of a dart point as soon as it is struck off. All you need to do is to trim the edges and the faces and sharpen the tip.

The degree of skill needed for blade-making has been somewhat exaggerated. Undoubtedly, it would take a great deal of skill, and perhaps some years of practice, to match the best of the Neolithic work. But to match the Aurignacian average is no extraordinary feat. And it is somewhat unrealistic to regard blade-making as a distinct and separate art, not related to the ordinary processes of flint-chipping, and to suppose that it was perhaps invented only once by some Upper Palaeolithic genius and thereafter diffused clear across the world, from France through Asia to Mexico, by the slow and uncertain methods of intertribal marriage or intertribal commerce.

A blade is not something unique, *sui generis*. It is only a particular kind of flat flake, formed by blows that were all struck in the same direction but in different planes. Any man who learns to take a hammer and strike off flat flakes can also strike off blades. *Indeed, if he keeps on striking in the same direction, he will automatically and inevitably make blades, whether or not he wants to make them.*

Remember that the chief problem in making any kind of long and delicate flint implement is to start with a suitable blank, which is a long, flat flake. Begin with a good blank, and the rest of the work is easy. It seems a reasonable guess, then, that any man trying to make pretty implements would do his best to strike out long, flat blanks. Once he learned to do that, he would be a blade-maker—at least on an off-and-on basis—willy-nilly.

At any place where the hunters of the late Stone Age left their implements lying around, the number of recognizable blades (or recognizable flat flakes, for that matter) would seem to depend not merely on the number of blades originally struck but also on what was done with them. If the hunters prided themselves on making long, delicate dart points, they would convert their flattest and shapeliest blades into that form by trimming them on both faces and both edges, leaving only the culls lying around to be identified as blades or perhaps trimming them into end scrapers, still readily identifiable. If, on the other hand, the hunters preferred projectile points of bone or antler but fancied the sharpest obtainable cutting edges, they might use their best blades for knives, trimming them only on a single edge, again easily identifiable as blades.

Whatever these early men might have wanted with the blades and no matter how much or how little they trimmed them, they would not necessarily have left a collection of shapely conical cores behind, helpful as that would have been for future research. A conical core is evidence that the man who made it was trying to get as many blades as possible off the same chunk of flint and was going at the job in a systematic and efficient manner, rotating the core on its vertical axis as he struck off successive blades. Even so, the cores vary considerably in shape. If the hammer blows strike the upper surface of the flint at almost 90 degrees, the finished cone will be long and slender or will even resemble a narrow cylinder more than a cone. If the blows slant inward, sometimes as far as 45 degrees, the cone will be a broad-based, stubby one. If the workman finds a flaw in the flint or if one blade breaks off short, he may turn the core over on its side or even upside down and start using another surface for the striking platform. If he does that, the finished core may look somewhat like a cube or even vaguely like a double pyramid. Most commonly, however, it will have no definable or describable shape. But in any event, if the surface of the core is formed by flat, straight, and narrow flake scars, it may be assumed that flat, straight, and narrow flakes—or, in effect, blades—were struck from it.

Indeed, the blade itself or a flake can be used as the core, and smaller blades can be struck off its ends or edges. This is no freakish experiment; it was a common practice during the Upper Palaeolithic in Europe and later in the Arctic areas of North America for making a burin or graver, almost as popular a tool in those days as the can opener is now. Burins, as mentioned earlier, were used to carve reindeer antler, ivory, and the like. Specialists in the subject distinguish at least twenty-three different kinds of them, though it is doubtful that the original manufacturers intended to offer the customer his choice of twenty-three models. Despite this diversity, all the various sorts of burins were made on a single basic plan. A burin is a little slablike piece of flint, about the size of a domino though much less regular in shape, made from a short blade, a section of a blade, or a flake. One corner is trimmed into a sort of thick chisel edge by knocking a strip off the end, off the side, off each in turn, or—to produce the twenty-three different models—by various elaborations on this fundamental method. Many of these little striplike flakes, or burin spalls, are perfectly regular miniature blades, though the burins may bear no resemblance whatever to conical cores.

IX. Barbing and Notching

FUNDAMENTALLY, MOST PROJECTILE POINTS have the same shape and this shape is an isosceles triangle. Or, to phrase the idea in another way, a projectile point is narrow and sharp at the tip and more or less broad and dull at the base. It is intended to penetrate the flesh of the game, or the man, that it strikes.

There is one exception. A few arrowheads are made upside down. The broad end goes foremost. The same sort of arrowhead, though made from steel, is still used by modern archers. It is meant for birds or other small game and is made so as to break the animal's bones or stun him rather than penetrate his flesh.

But most other projectile points—whether for spears, lances, javelins, atlatl darts, or arrows—are intended to pierce the animal, cut his flesh, and cause bleeding. Present-day archers say the bleeding is the main thing. The modern steel broadhead arrow brings the game down by making it bleed.

Although the presence of barbs is an inseparable part of the common idea of an arrowhead, the barbs do not seem to be of much use in killing most kinds of game. They are useful on fish spears or harpoons because the salmon or the seal may swim or float away unless it can be held back by the barbs and finally hauled out of the water. And there might be a good reason—though there is not much evidence that Stone Age men were conscious of it—for barbing a point to be used against a human enemy. The barbs would make it hard for him to pull out the dart or the arrow if he was only wounded rather than killed. But a buffalo, a buck, or a bear, having no hands, cannot pull out the weapon, anyhow. He can only wallow on the ground or rub against a tree and perhaps break off the shaft.

The barbing of projectile points seems to have been a rather late development in the Stone Age. And when barbs came into general use for flint points—as distinguished from the antler harpoon heads of Magdalenian times—they seem to have been only an incidental by-product of the notching process. The projectile point was notched, if it was notched at all, only so it could be lashed more snugly to the spear shaft or the arrow shaft.

Most of the early types—Clovis, Angostura, Eden, Plainview, and the like—have neither barbs nor notches. And most of them are so long in proportion to their width, so often broader midway or even farther toward the tip than at the base, that they do not seem obviously triangular, even though the base is necessarily much wider than the tip. The usual practice is to call such points "leaf-shaped" or "lanceolate," except that the Eden type is so narrow as to be almost dagger-like. Also, the usual practice is to distinguish between "barbs" and "shoulders." The projection is a barb only if it slants backward slightly toward the base. A shoulder is merely a sort of imperfect or unresolved barb.

The intimate connection between the notching process and the barbing is most easily understood by looking at the various kinds of dart points made during the so-called Archaic stage in North America or by actually making a few dozen in imitation of those styles. The man shaping a chip of flint into a dart point or arrow point can do so most easily and quickly by first shaping it into an isosceles triangle, meanwhile thinning the tip, the base, and the two edges with the same series of strokes. The edges can be straight, curved inward, curved outward, or doubly curved. With the more or less triangular projectile

The same point can be notched or left unnotched in any of these styles, as well as in a good many others. Parenthetically, the point at the upper right was made from a broken Archaic stage scraper, picked up in Bandera County, Texas. Presumably exposed to the weather for centuries, the flint was still readily flakable.

point almost finished, the workman can then prepare it for lashing (and at the same time give it the final form) in any of these ways:

1. Leave it as it is. Thousands of dart points and arrow points in the form of the simple, unnotched triangle have been found in all parts of the world. If the basal corners are sharp

and distinct, the piece will automatically have barbs, though it will have no stem. The wooden shaft itself becomes the stem as soon as the triangle of flint is lashed to its tip.

2. Chip out a notch in the base, not to hold the lashings but to seat the flint more firmly in the split end of the shaft. Once more, the shaft itself becomes the stem. If the basal notch is made in the form of a deep, inverted V, this method produces the most ferocious barbs of all. There is no evidence that the workmen were trying to make barbs, as such. They may have been only trying to show their skill.

3. Chip two small notches in the base. There would seem to have been no advantage in this method, but it was a fairly common one. It, too, left the basal corners in the form of barbs, and the shaft itself became the stem.

4. Notch the two sides. If the notches are small and the base of the triangle is broad, the basal corners are still in the form of barbs, and the shaft still becomes the stem. If the triangle is narrow and the notches are large, there will be no distinct barbs.

5. Notch both sides and the base also, leaving the basal corners as barbs.

6. Chip away both lower corners of the triangle. This method produces a stem and either two barbs or two more or less rounded shoulders.

7. Make narrow notches in the corners rather than chipping them away. As usually done, this produces distinct barbs and an expanding stem.

8. Chip away only one basal corner. If the triangle is short and broad, this results in a sort of feeble imitation of the famous single-shouldered Solutrean points.

9. Chip away the basal corners until a barbed and stemmed projectile point is produced. Then notch the bottom of the stem, creating a sort of ram's-horn effect. There seems to be no advantage in this method but at least it is easier than it looks.

This list includes only a few of the most obvious variations in notching. All of them are easy to execute if the flint is rea-

Random artifacts made from the famous Alibates agate, which is found along the Canadian River in the Texas Panhandle. A discoidal scraper, a T-shaped perforator, and a narrow unnotched point.

sonably thin. But if the piece is just about as thick as it is broad, the fancier styles are hard to execute.

No refinement in technique is needed to notch a point by pressure flaking. The notching is the easiest part of the job, since the flakes need no longer run all the way across, or half-way across, the surface of the piece. Quite short and stubby flakes will do. You simply keep flaking away until the notch is as deep as you like; if you choose, you can keep going until you cut the point in two, either from side to side or from base to tip. However, for an extremely narrow notch you must use a tool with a correspondingly narrow tip.

If a projectile point was made with notches or a stem for lashing it to the shaft, the finder can make a reasonable guess as to whether it was intended to tip an arrow or something bigger. That is to say, an arrow is a slight and slender thing. The thickness of the shaft will be something like three-eighths of an inch—maybe a little more, maybe a little less—but there will not be a great deal of variation. A shaft an inch thick is too heavy and too clumsy to be useful as an arrow. The man who shaped the flint would naturally shape it so it could be lashed firmly to the shaft. If the space between two side notches is something like three-eighths of an inch, or if the stem of a stemmed point is of that width, it is safe to assume that this piece of flint was intended to tip an arrow. If the space is very much greater, then the flint was intended for an atlatl dart or a javelin. If there is so much space that the flint cannot be snugly lashed to anything smaller than a hoe handle, then it was intended for a heavy spear, or else the maker chipped out a big one to show his skill or perhaps to present it as an offering to his gods.

But all over the world many far-separated tribes of men have made projectile points either in the form of the unnotched isosceles triangle or that of the triangle with an inverted V or U chipped in its base. Whether these were intended for arrows or for something larger can be guessed only by their size and weight. And, of course, if two projectile points are made in the same proportions but one is four times as long as the other, it will be sixty-four times as heavy.

The bow and the arrow seem to have been very late in North America. Naturally, the negative evidence is not wholly convincing. There could have been early Americans whose arrowheads have not been found yet. Or there could have been hunters who did not tip their arrows with flint, merely hardening the ends in the fire or using bits of antler, gar pike scales, or the like.

The boy or even the grown man who is fortunate enough to live on a farm where Indians once lived will often call nearly everything that he picks up an arrowhead, though the actual Indian may have used it to arm the tip of an arrow, an atlatl dart, a lance, or even a fish gig. There are also some tools that look like spearheads but were really hafted as knife blades.

For a long time, serious investigators made the same error as the boy, accepting as arrowheads all manner of flints that were too big to fit anything as slender as the ordinary arrow shaft. Nowadays the accepted term for both the big ones and the little ones is "projectile point," though even this is something of a misnomer. A projectile is something that is thrown or shot rather than merely thrust forward. An arrow or the dart for an atlatl is a projectile. A lance or a bayonet is not.

X. Hammerstone and Cutting Edge

THE BASIC AND INDISPENSABLE IMPLEMENTS for any Stone Age technology—from the rudest to the most complex and sophisticated—would seem to be the hammerstone and the cutting edge.

The cutting edge is, of course, the queen of implements. It is the thing that made man the lord of the earth. Without it he would have been little better off than his cousin the ape. He might have armed himself with whatever clubs he could have broken from trees and saplings with his bare hands, but these would have been too light and too clumsy to kill anything much bigger than a rat. Or, chancing upon the skeleton of a cow, he might have picked up a thighbone and used it for a club, as Samson did later with the jawbone of an ass. But except in the hands of a Samson such a weapon is none too formidable.

As soon as he discovered the uses of the cutting edge, early man could have equipped himself with the shapeliest clubs and spears his cunning might devise and gone on to make all manner of weapons, tools, clothing, and habitations out of wood, bone, horn, and hide. The only limit was his own ingenuity. A flint cutting edge can be used to make almost anything.

It is not certain that the peoples of the Lower Palaeolithic depended entirely on flint for their cutting tools. Much later

Two burins, not copied from any of the twenty-odd accepted models but each having the essential characteristic of a burin. That is, one corner is trimmed into a sort of chisel edge by striking off a strip flake from each of the two intersecting edges.

peoples have been found, dwelling along seacoasts or in river valleys where flint is scarce but clam shells are abundant, who made use of shell instead of flint and supplemented the cutting edge with some kind of grinding tool. How often that was done during the Lower Palaeolithic, or whether it was ever done at all, would be hard to guess now. The only thing certain is that some kind of cutting edge was indispensable.

It is not often that flint breaks naturally to form a truly serviceable edge. Man had to make the cutting edge before he could begin to equip himself with weapons and other things. To sharpen his piece of flint he needed a hammerstone. Thus the rude and simple hammerstone, ordinarily nothing but a pebble plucked from river gravels and shaped only by the battering it undergoes, is the first and original implement of them all. Civilization began with this simple pebble.

Flint cutting edges are of three principal kinds, to be distinquished rather by the stroke the artisan uses than by the shape of the implement itself. That is to say, there are tools for chopping, slicing, and scraping: fist axes, knives, and scrapers. A chopping tool is recognizable rather by its weight than by its shape, and some of the lighter and more handsome

Acheulean fist axes may have been intended for slicing instead of chopping. Knives and scrapers are often indistinguishable. The same tool may have been used for both purposes. But some of the knives and scrapers made in late times were highly specialized. Many varying types of scrapers have been found, described, and named. There is one fundamental distinction that does not depend upon the size, outline, or relative thickness of the scraper but only on the way the edge is trimmed: a scraper used for shaving down a piece of wood should be fairly sharp. If the edge is wavy or even jagged, no harm will be done. But a scraper used for dressing hides should not have a jagged edge or sharp corners, else it will tear the hide.

It is weapon points, rather than the far more useful hammerstone and cutting edge, that appeal to the modern imagination. They are picturesque, they are deadly, and some kinds are beautifully made. Nevertheless, men seem to have got along pretty well for several hundred thousand years before they made any weapon points of flint. What weapons and other equipment they might have made by trimming wood and bone with their flint cutting edges is little known as yet. Their way of life could have been poor and brutish or it could have been rather elaborate. The simple cutting edge would have been the basis for either kind.

For a woodsman the cutting edge, or the knife, is as indispensable now as it ever was. The next most indispensable thing is some means of making fire. For a man lost in a forest or a flyer forced down on a lonely isle, pure survival is likely to depend on possession of these two things. It is for that reason that the hunter makes sure, on setting out, that he has a knife and matches in his pockets, as well as spare cartridges for his rifle. The same reasoning is implicit, if not often explicitly stated, in the Boy Scouts' cult of the Scout knife and the bow drill.

The legends of recent peoples and the writings of such novelists of the primal as Jack London put more emphasis on the fire than on the knife. Prometheus bringing fire from the gods to man is a noble and heroic figure. No brother-Titan comes forth as the bearer of the cutting edge. But in retrospect the cutting edge seems even more needful than the fire.

To realize what the hunters of the Lower Palaeolithic could have done with the simplest kind of cutting edge—whether or not they actually learned all its uses—one may watch what a modern outdoor man does with a jackknife. The steel blade will stay sharp much longer than the brittle flint, but essentially the jackknife and the flaked cutting edge are only two forms of the same implement. More specialized kinds of cutting edges, scrapers, and perforators have long been in use. There are axes, adzes, chisels, saws, planes, drills, awls, and projectile points. But the versatile jackknife can be substituted for any of them. The farmer or the ranchman still uses it for a knife, a scraper, or a perforator. If thrown, it becomes a projectile point. It is a knife to castrate calves, cut wood or leather, prune peach trees, bud pecan trees, shell the fruit of the pecan, peel potatoes or peaches, skin animals, or slice bacon. It becomes a scraper to scrape the skin off new potatoes, scrape bark off a twig, scrape bits of fat and flesh off the inside of a coonskin, or scale fish. It is a perforator to cut a new hole in a saddle cinch or a belt. It can even be used as a screwdriver, a corkscrew, or a toothpick. Finally, it can be used as either a piercing or a slashing weapon to fight another man. Like the edged flint, the jackknife is an all-purpose implement.

The specialization of tools is, of course, not peculiar to the Iron Age. From the Upper Palaeolithic onward, distinctive tools were made for particular uses. Like the prettier kinds of projectile points, some were unnecessarily delicate and symmetrical. For instance, it seems doubtful that a T-shaped perforator would work any better than any other narrow and pointed sliver of flint, or that the handsomest discoidal scraper was more efficient than any clumsy-looking chunk of flint with the same sort of edge.

Many carefully made flint knives and axes are quite dull by Iron Age standards. They nibble away at wood rather than slicing it cleanly. To be sharp, a flint edge must be thin. If it is thin, it will break easily. The same brittleness that enabled our forerunners to trim flint with a piece of buckhorn made it easy for them to break an implement as soon as they had made it. Emerson's Law of Compensation may have already been deduced by many a Palaeolithic philosopher.

XI. The Absent-minded Beveler

SOME ARROWHEADS, some dart points, and some knives have beveled edges. Some of the Acheulean fist axes, which are very old, have a sort of propeller-like twist, as if the tool had been made of a viscous material and the two ends had been twisted in reverse directions on the longitudinal axis. An occasional thin and handsome Palaeo-American point will show a tiny propeller-like twist at the extreme tip.

Various theories have been offered to explain why the makers twisted or beveled those implements. It was once suggested that some Indians beveled their arrowheads to make the arrows spin in flight, as a rifle bullet or a forward-passed football spins. This theory was disproved by experiment, for a beveled arrowhead will not make the shaft spin on its axis. Archers say, however, that a slight spin can be imparted by the feathering if all three feathers come from the same wing of the bird.

Among the projectile points, some of the shorter and stubbier ones look as if they had acquired the bevels when they were resharpened after being broken. Others seem to have been beveled in the beginning. Experience in actually making projectile points will shed some light on the beveling process. For the most part, the bevel results from the nature of the flint itself. It is easier to make a point with a bevel than a point without a bevel, for a piece of flint is invariably undercut or undersloped when its edge is trimmed. If the trimming is done by taking off a series of short, stubby, thick flakes without moving the flint, the edge will be abruptly beveled.

It is in the nature of flint that it can be trimmed on only one edge and only one face at a time. The edge will be the one nearest the workman's hand; the face will be the bottom face, unless the man is holding the flint edge-uppermost in a vise or some similar nonprimitive gadget. With the flint in a vise, he can strike the flake off either face but still from only one edge at a time. But without the vise, it does not matter whether he is working with a hammerstone, with a hammer and chisel together, or with a pressure-flaking tool. At any given instant, he can work the flake off only one edge and only one face. To get at the other face or the other edge, he must either move the flint or change his own position.

We may assume that a reasonable man is not going to walk around the flint to get at the other edge or stand on his head to get at the other face. He will stay where he is and move the flint. Now the process of moving the flint is fundamentally the same, no matter what kind of chipping is being done. But it is easiest to visualize if we assume that the workman is pressure-flaking the flint, holding it either in his left hand or on top of something heavier. The man will press the flake off the edge nearest his right hand and off the bottom face of the flint. Since space consists of three dimensions, there will be three ways of changing the position of the flint in respect to its faces and edges. At some risk of belaboring the obvious, they can be listed thus:

1. The artisan can rotate the flint 180 degrees on its vertical axis. Then he will be working on the opposite edge but on the same face.

2. He can rotate the flint 180 degrees on its longitudinal axis. Then he will be working on the opposite edge and also on the opposite face.

3. He can rotate the flint 180 degrees on its lateral axis. Then he will be working on the same edge but on the opposite face.

The explanation may sound a little queer. If you have no

The reader must take part of this on faith. Only stereoscopic photography would have shown the detail. The triangular point has a grossly exaggerated bevel of about 80° along its left-hand edge. Although that edge looks almost as sharp as the opposite one, it is actually five-sixteenths of an inch thick. The forward and rear halves of the other point are twisted away from each other at about 30°.

flat chip of flint handy to test it with, you might substitute by laying a domino on top of a table. There will be only three ways of reversing its edges or its faces. (Of course, you could stand the domino on one of its flat edges, but that would be irrelevant to the problems of sharpening flint.)

To make a projectile point with steeply beveled edges, this is what you do—and it makes no difference whether you do it on purpose or from mere absent-mindedness or clumsiness: (1) You use a stroke that removes a short and thick flake rather than a long and thin one. (2) You leave the flint in the same position, without moving it, while you shape and sharpen one side of your isosceles triangle. Since the flakes are short and thick, you will automatically bevel that edge by abruptly undercutting it. (3) Then you turn the piece of flint upside down, rotating it 180 degrees on its longitudinal axis, and shape and sharpen the other side of the triangle, automatically undercutting and beveling that edge, too.

That is all there is to this business of the beveled projectile point. The beveling does not show that the maker wanted his shaft to spin in the air; it does not necessarily show that he was resharpening a broken point; in some instances it would seem to show that he simply didn't give a damn—he would just as soon have an abruptly beveled edge as a thin and delicate edge. It takes a deliberate effort to keep from putting more or less of a bevel on a projectile point.

The most interesting form of either the twist or the bevel is seen on some of the old-time Acheulean fist axes. As mentioned earlier, such an ax looks as if it had been made from tar rather than from flint and as if the maker had taken hold of the two ends and twisted them slightly in opposite directions. But the twist is not necessarily the result of any intention at all on the part of the maker; the nature of the flint itself can account for it. The big piece of flint shaped into a fist ax, like the little piece shaped into a projectile point, can be trimmed on only one edge and only one face at a time.

Suppose you are an Acheulean workman, chipping your fist ax into its final form with a hammerstone. With your left hand you pick up your long, rather flat, moderately thin piece of flint, holding it by one end. You start trimming one edge. But you do not trim its entire length. Trim only the half away from your left hand to keep from hitting your hand with the hammerstone. All the flakes come off the same face, the bottom face or the one that is more or less tilted toward the ground. When the edge is trimmed for half its length, you swap ends with the flint, that is, you rotate it 180 degrees on its lateral axis. Then trim the same edge for the other half of its length. Though still working on the same edge, you are now striking flakes off the opposite face of the flint. In effect, the two halves of the same edge have been undersloped in reverse directions. It is this technique that gives the finished fist ax the propeller-like twist.

After so many thousands of years have gone by, there can be no way of knowing whether the Acheulean workman gave his ax a twist on purpose or by accident. In either case the mode of operation would have been the same. It would still have been the same if, instead of simply holding the flint in his left hand and letting its own inertia steady it, he had held it against a bone anvil or something of the sort.

The thicker, clumsier Abbevillian fist ax seldom or never has anything resembling a propeller twist, and the reason for that is obvious. When a man is working with a thick nodule, it is easier to strike off the second flake than the first one. The flake scar formed by the first blow can be used as the striking platform for the second one and so on down the line. If the Abbevillian workman had much concept of efficiency, he would have got his first flake off, turned the nodule upside down, and used the resulting flake scar as the striking platform for his second flake. He would have kept on working in that manner, turning the flint upside down after every successful stroke. For that reason his finished product had a coarsely wavy and irregular edge rather than an undersloped edge or a propeller twist.

Several theories about Stone Age weapons could stand reexamination in the light of these simple principles. The shape of flint implements depends very largely on the nature of the flint itself.

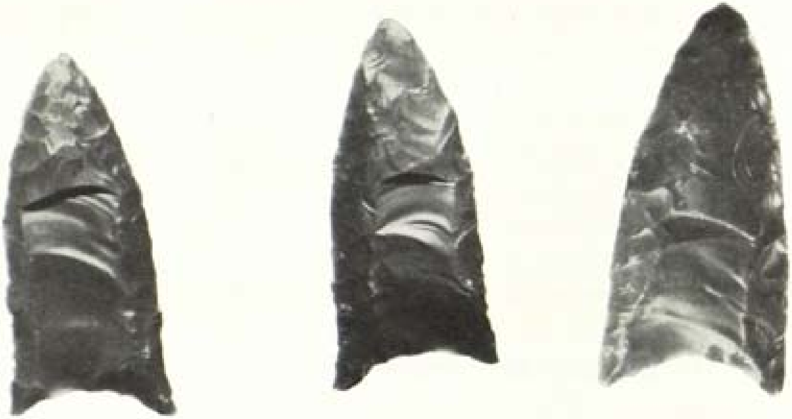
XII. Clovis and Folsom Craftsmanship

THE CLOVIS AND FOLSOM TECHNIQUE of fluting dart points is the most fascinating style of flintcraft ever practiced. It is spectacular, often beautiful, useless, and hard to execute. The wandering hunters who practiced it were artisans with an admirable skill. It is no wonder, then, that there is a copious literature on fluted points.

Fluting seems to have been a North American invention. At least, no fluted points have been found in Asia. Presumably, if any early Asians had known how to make fluted points before they crossed Bering Strait and became early Americans, somebody would have found one of the points by this time. Specimens of the Clovis type have been found from Alaska to Costa Rica and from California to the Atlantic and Gulf coasts. The later and more delicate Folsom type belongs mostly to the Great Plains. A third fluted type, much less skillfully made, is called San Patrice and is found mostly in Louisiana. It is not believed to be nearly so old as the others.

Wherever it may have begun and whether or not it actually began 37,000 years ago, the Clovis style of craftsmanship is obviously much older than the Folsom and it may have lasted for a good many thousand years. The two styles are much alike, the Folsom being only a late and delicate flowering of the Clovis.

The fluting may have been intended only as a decoration, a method whereby the workman showed his skill. Each face of



Two fluted points, with both faces of the smaller one shown. The edges have not been ground. Note that every flute ends in a hinge fracture.

the dart point was usually marked with a flute, or channel flake scar, where a long, thin flake was struck off, running from the base toward the tip. Or, sometimes, a less expert workman would need more than one blow to strike out a big enough flute. He might even succeed in fluting only one face of the piece. A good many Folsom points were made so thin that the workman would flute only one face, or neither face, for fear of breaking the point.

Some Clovis points, though by no means all of them, are rather thick. The fluting might have been done for the practical purpose of thinning the base, making it easier to seat the dart point in the split end of the wooden shaft. That was not true of Folsom points, many of which were so thin as to be fragile, even when left unfluted. As for the Clovis points, even the thickest of them could have been thinned down at the base by any one of half a dozen variations in technique, all of them simpler and easier to execute than the fluting process. Any workman expert enough to strike out flutes would have been well aware of that. Therefore, unless he fluted his weapon points to show his skill, there is no telling why he did it.

Flint has certain limitations. The artisan proud of his proficiency in flaking the stuff can give proof in very few ways.

He can make something spectacularly large, like some of the so-called ceremonial knives and spearheads. But it is no harder to make a big one than a little one, though it takes more time. What a large spearhead really shows is that its maker was able to find a big piece of flint without any cracks in it. On the other hand, the artisan may have chosen to make something exceedingly small and delicate. But this proves mostly that he used fine-pointed flaking tools and was careful not to break the piece. The workman may occupy himself, as many did during the latter part of the Stone Age, by decorating projectile points with fancy notches and serrations. This, also, is relatively easy to do. The only two techniques that are really hard to execute are those of making parallel-flaked implements and fluted ones. The former was practiced, off and on, in many parts of the world from Solutrean times until the end of the Neolithic and seems to have been invented and reinvented over and over. But apparently fluting was practiced only in North America and eventually fell into disuse.

The craftsmanship involved in striking out the flutes is sometimes admired for the wrong reason. It is no extraordinary feat to strike out the flute, as such. The feat consists in executing the flute without breaking the projectile point. That takes skill. The occasional thin Folsom point left unfluted shows that the Palaeo-Americans were fully cognizant of the difficulties. So do the numerous fluted points that were broken by hinge fracturing or shattering as they were being made. That is to say, the flute is only the scar of a long, straight flake. The man who takes a hammer and strikes thin blades off a polyhedral core or trims a burin by striking the strip-flake off the side or end is doing much the same thing that the flute-maker does. The difference is that he does not have to worry about shattering the core or the burin. The core is too thick, and the edge of the burin is reinforced by its total width. But the projectile point is thin and easy to shatter.

The man wishing to imitate the Clovis and Folsom artisans is confronted with two problems, which do not necessarily have the same answer: How did *they* do it? How can *I* do it?

The answer to the first problem is uncertain and may well remain so forever. But a good many men have solved the second problem, some of them, unfortunately, from motives of commerce. Imitation Folsom points, even broken ones, are common on the market.

All things considered, it seems most likely that the early American workman got the flute out by simply striking the flint with a light hammer or hammerstone. There may have been variations in technique from time to time or place to place, especially as thousands of years went by. But for anybody accustomed to striking blades or other thin flakes off cores, that would have been the natural way of proceeding.

For a modern workman, the method is a difficult one. Unless gifted with unusual dexterity, he is likely to break ten or even a hundred points for every one that he succeeds in finishing. It is quite disheartening to go to all the trouble of shaping and sharpening a point, and perhaps even fluting one face, only to break it when trying to strike the second flute. It is all the more disheartening the oftener it happens. Thus the modern workman commonly resorts to additional equipment. He takes to the mallet and chisel rather than the simple hammerstone, and he puts his flint in a vise so that he can look at it while he is trying to get that flute out, rather than working blindly by holding the flint down with his foot and striking the flake off the bottom face. All this can be done, of course, without resorting to iron tools. A bone or buckhorn chisel will work flint just as well. As for the vise, a most effective one can be assembled by lashing two blocks of wood together with rawhide thongs. All these materials were readily available in the dawning of the Pleistocene and the only real question becomes: Is that how the Clovis artisan did the work?

For that matter, the modern workman can use his knowledge of physics and add weight or leverage to a pressure-flaking tool to get the flute out. The Spaniards in Mexico and George Catlin on the Plains saw some of the inhabitants use a big T-shaped pressure-flaker, weighted with a heavy rock, to get blades off cores. A similar implement can be applied to the making of fluted points. Or a pressure-flaker can be lashed athwart a three-foot pole and the end of the pole tied to a tree or sapling—still with rawhide, of course. Mounted on this lever of the second class, as the physics textbooks call it, a pressure-flaker will punch out a sizable flute. But the question still remains: Is that what the Clovis men did?

All this familiarity with vises, weights, and levers seems appropriate to Neolithic rather than to Clovis times. It still seems most probable that the Clovis artisan struck the flute out with a hammer or hammerstone. Perhaps he was not necessarily more skillful than a modern workman but had only had the advantage of constant practice since his boyhood. Skill and practice are the principal requirements, even when the most elaborate paraphernalia are used. And practice is a matter of having sufficient doggedness and sufficient flint.

It is not yet known how early the Clovis style of shaping weapon points may have begun, how many other kinds of tools and weapons had been made still earlier and how many others were made during the same period, how long the Clovis style persisted in the eastern part of North America, or even how long the various species of mammoths survived. But other kinds of dart points besides the Clovis have been found with mammoth bones.

Something vaguely resembling a technological evolution is perceptible in the succession of Clovis, Folsom, and Plainview points. All three kinds are more or less leaf-shaped, or lanceolate, rather than obviously triangular. The Clovis and Folsom types are usually fluted. On some Plainview points there are small, narrow, multiple flutings, perhaps made by pressure instead of percussion, though this work is usually called "basal thinning" rather than fluting. All three types—as well as several others, mostly later ones—were usually ground smooth along the edges near the butt ends. Presumably, this was done so that a sharp edge would not cut the lashings, though most other projectile points in most parts of the world were not smoothed on the edges. Accordingly, it has been suggested that the early Americans may sometimes have used their darts as knives or scrapers.

Clovis points are rather variable in length, thickness, relative breadth, and degree of fluting. Among eight of them found with the bones of the same mammoth near Naco (Cochise County), Arizona, the longest is twice as long as the shortest. But this is not surprising. It is due to a simple principle: flint will not stretch. It is impossible to make a six-inch dart point out of a three-inch blank. The Clovis workman, apparently, was much too sensible to throw away a three-inch blank merely because he would rather have had a longer one.

The variability among Clovis points has persuaded some authorities to distinguish subtypes. For instance, there is one subtype, found mostly in Tennessee, that is called a Cumberland point. The Cumberland point is usually long and narrow, rather thick, with flaring basal ears. Some specimens have spectacularly long flutes and others have no flutes at all. So few have been found that it is at least theoretically possible—no matter how unlikely—that all could have been made by the same workman.

The Folsom points, at least the prettiest ones, are a technological anomaly. The flute will be so long that it runs all the way from the base to the tip and so wide that it covers nearly all the face between the opposite edges. Such a Folsom point may also be exaggeratedly thin and exaggeratedly snub-nosed. There seems to be no practical reason for any of these qualities. The wide flutes would make it hard to lash the point securely on a narrow shaft. The thinness of the flint would make it excessively delicate and easy to break. And so snub-nosed a tip would not pierce flesh so easily as a sharp one. Thus, although the Folsom point looks like a later and improved model of the Clovis point, its only improvement is its increased beauty. In efficiency, it would seem to have lost ground.

A fair number of Folsom points are so thin that the workmen fluted only one face or sometimes neither face. Both the fluted and the unfluted kinds sometimes have a tiny nipple or tit in the center of the base. Some writers have argued that this nipple was intended as a striking platform for the blow that took the flute out. Alex Krieger has noted, with irrefutable logic, that there would be no sense in shaping a striking platform for a blow that was never meant to be struck. What is still more convincing is that on any point which actually has both flutes and a nipple, the nipple is outlined by tiny flake scars that overlap the flutes. In short, the nipple was shaped after the flutes were struck, rather than before.

The Plainview point looks as if some early American inventor, more intent on killing game than on displaying his skill in flintcraft, had recognized the deficiencies of the Folsom point and set about correcting them. A Plainview point is shaped very much like a Folsom point, though somewhat larger on the average, but the exaggerated flutes are dispensed with, and the tip is much sharper.

A few of the single-shouldered Sandia points are fluted. Whether or not this results from the Clovis influence, it would be useless to guess.

XIII. The Legend of Ishi

THERE ARE TWO STORIES to be told in this chapter. One of them is a true story, documented by trained observers, and the other is an odd sort of modern legend that grew out of the true story. The hero of both stories, one scientifically accurate and the other only symbolically true—like the story of Navius cutting the whetstone with the razor—is an Indian named Ishi.

The true story can be found in Bulletin 73 of the Bureau of American Ethnology, which is A. L. Kroeber's *Handbook of the Indians of California*, published in 1925. Ishi was a Yahi Indian and the Yahi were a small California tribe. When Ishi was a baby or a tiny boy or maybe not even born yet, his tribesmen fell afoul of some Anglo-American miners and were badly beaten in a miniature war. That was in 1864. The few remaining members of the tribe managed to hide out in the California hills and live in the Stone Age manner until 1911.

When all the others had died, Ishi gave up to the palefaces. He became, of course, something of a celebrity, for he was the last wild Indian left in the United States. He still knew the primitive crafts—and no others. He had not been contaminated or softened by reservation life or by the possession of trade goods such as firearms, firewater, brass kettles, or glass beads. In technical language, Ishi was wholly unacculturated. He was an experienced bow-maker and he even knew how to flake flints, an art largely forgotten by the more civilized Indians on the reservations.

Ishi was welcomed as a guest by some professors and students at the University of California. They studied him closely. They watched him flake flints. He made a good many projectile points, knives, and the like for the University. Besides admiring his flintwork, the white men admired his manners. They found him a pleasant, likable, well-adjusted fellow.

It was two simple photographs of Ishi that started the legend. They appeared in two famous books, Henry Fairfield Osborn's *Men of the Old Stone Age* and Holmes's *Handbook of Aboriginal American Antiquities*. The two pictures are almost identical. In each, Ishi's right hand is holding a pressure flaker, and his left hand is holding one of those long, handsome ceremonial knives of California obsidian, for which collectors will now pay fancy prices. This knife is not so long as the most spectacular specimens but it is fairly long, at that. From either picture it appears that Ishi has just finished making the knife and is about to give it a parting stroke or two with the flaker, much as a barber makes a few unnecessary passes with the scissors after he has finished cutting the customer's hair. Undoubted thousands of students have looked at those pictures; thousands of less serious readers have looked at them, too; they have been examined by goodly numbers of grave-faced scholars; and most beholders seem to have taken it for granted that Ishi really flaked out that handsome knife, starting from scratch.

But apparently he did not.

Sooner or later, a good many modern flakers of flint get around to looking at one or the other of those pictures. It makes them feel pretty envious. The biggest thing that most of them have learned how to make is a dinky little arrowhead. And here is old Ishi, that paragon of the aboriginal flint-flakers, nonchalantly knocking out one of those large and handsome knives as easily as a lesser man might trim his fingernails. I myself, in the bloody-fingered days of my first acquaintance with flint, used to take down my copy of Holmes every once in a while and gaze at that picture of Ishi with sadness and envy.

But finally I caught on. I began to suspect that Ishi had not made that knife. He might have only posed for his photograph while holding it.

For the picture showed the wrong thing. It represented the easier part of the process. If Ishi had really made that knife, starting from scratch, the proper pose for a photograph would have been—not Ishi with a pressure-flaker—but Ishi banging out his long, straight, original blank with a hammerstone, Ishi executing the blade-and-core technique. The woods are full of people who can pressure-flake flint if somebody will only furnish them with the blanks, either cut with a lapidary saw or stolen from dead Indians, but who are sadly devoid of skill in knocking out the blanks themselves.

Being a newspaper reporter by trade, I did not hesitate to expose either my skepticism or my ignorance. Learning that Dr. Kroeber had worked with Ishi before Ishi died in 1916, I wrote to him. But the letter of inquiry got buried under a stack of documents, like an artifact at the bottom of a kitchen midden, and it was not dug out until a year had passed. When Kroeber answered, he gave me permission to quote him:

> So far as I recall, Ishi did not make any long obsidian knives. He worked chiefly with plate glass which we furnished him. This he worked into points one to six inches long. The flakes were evenly parallel, but my recollection is that they did not extend clear across. They met in a sort of gable running midway between the two edges. He braced his material on a buckskin or similar pad in his left hand. Inasmuch as he was only pressure-flaking, he did not have to brace very hard. He pressured sometimes with a bone point, and sometimes with a hafted wire nail.
>
> Ishi did not like to work out blanks. I got him a good-sized chunk of obsidian and finally persuaded him to knock off some pieces which he could pressure-work down. When he finally struck it through his two-inch bone set-punch, I saw why he had been reluctant. He could not control what he got; the obsidian shattered and flew around, and he got a small cut on his forehead. Of course, with slivers of plate glass furnished him, or, for that matter, small blanks of obsidian, he did not run into this trouble.
>
> In return, may I belatedly ask where you got the idea that Ishi

worked any long blades at all? That may be an implication of the statement in some article, but I do not think it was intended, and to my knowledge it is not a fact, but an error. . . .

Well, there you have it and there goes Ishi. It would rather seem that he did not make that knife, unless perhaps he made it from a slab of black plate glass. He was a skilled artisan with a pressure-flaker but something less than a master of the blade-and-core technique. His admirers have not understood all the niceties of flintcraft.

XIV. Of Craftsmanship and Homicide

SCHOLARS ARE SOMETIMES TEMPTED to speculate that particular styles of weapon points must have been the best for particular uses, as for killing big game, small game, or a human enemy. But all such theories seem a little fanciful to the layman, especially to one familiar with the ordinary methods used for homicide nowadays. A few quotations will illustrate:

> The Solutreans broke into western Europe as a horde of invaders. Armed with the laurel and willow-leaf lance points, manufactured as a result of their new discovery of pressure flaking, they seem for a time to have completely dominated the scene. . . . (M. C. Burkitt, *The Old Stone Age*).

> Either it [the best Solutrean flaking] is the work of a people who rapidly spread from the East into Europe and who failed to reach Italy and Southern Spain, or it is the work of slaves who were forced to labor for an alien people. . . . (Herdman Fitzgerald Cleland, *Our Prehistoric Ancestors*).

> The projectile point developed by Folsom man, for instance, specially designed as it was for the bison hunt, is not likely to be found in abundance much beyond the range of the bison herds. . . . (E. H. Sellards, *Early Man in America*).

Of course, there is no way of disproving any of these theories. But let us examine them, if only for the intellectual exercise. Take the statement of the justly famous Professor Burkitt first. Research conducted in the years since he wrote his book has convinced a good many authorities that the Solutreans were not a separate people at all and that the Solutrean weapon points represent a style of flintcraft rather than the handiwork of a particular tribe.

But even if the Solutreans were a distinct people who invaded Europe, there is no reason to believe that the most beautifully flaked of willow-leaf points would kill either a man or a mammoth any deader than any other point with an equally sharp tip—a Font Robert flint point, for instance, or a point made from bone or antler. Man, indeed, is one of the easiest animals to kill, if you can only get at him before he kills you. This is something known to all homicide detectives and all police reporters. Men are killed every day with such unlikely-looking weapons as tack hammers, monkey wrenches, tire tools, and sticks of stovewood. For many years in the Southern states a favored instrument for homicide was the ordinary ice pick, now, alas, becoming obsolescent as more and more electric refrigerators are sold. The ice pick had not been intended by its manufacturers for the slaughter of *Homo sapiens*, but it has a sharp tip and it was handy in every home.

As for Professor Cleland's perhaps whimsically proffered hypothesis that the Solutreans might have been either intruders or slaves, it seems to rest on a misconception of the parallel-flaking technique. This is not a skill developed only under the taskmaster's lash or after long years of arduous practice, like the skill of the concert pianist or the Davis Cup player. It depends partly on individual dexterity and partly on a love of craftsmanship. If it entailed slavery for the workman, then slavery must have been widespread and recurrent in Stone Age times: Egyptian Neolithic, Danish Neolithic, Plainview, Eden, Scottsbluff, and what not. For some specimens of each of these types are parallel-flaked.

Finally, as to the statement of the distinguished Dr. Sellards, it should suffice to say that his own book pretty well confutes it. If the Folsom point was specially designed to kill bison, then by the same reasoning so were the Plainview point, the Scottsbluff point, and the Eden point, for all of them have been found with the bones of bison. The Folsom point and the Eden point are about as different as it is possible for projectile points to be, the former being decidedly snub-nosed and the latter being long, narrow, and dagger-like. A police reporter, familiar with the efficacy of the ice pick, would choose the Eden point as the deadlier of the two. But perhaps the Folsom artifacts, if they were chipped to fit any theory at all, are due to a different reasoning. We may never know exactly what their creators had in mind. And we may never know whether the Solutreans were a band of conquerors, whether they were downtrodden slaves, or whether they were craftsmen practicing a particular style.

XV. Some Beautiful Hypotheses

THOMAS HENRY HUXLEY ONCE SAID that the great tragedy of science is the slaying of a beautiful hypothesis by an ugly fact. This chapter is not intended for the slaying of any such hypotheses—not because of any squeamishness but only because insufficient ugly facts are thus far available. It is hereby suggested, nevertheless, that a few hypotheses evincing a certain frailty may now be found in many books about the Stone Age and that the ugly fact may in time arise and slay them. Let us meanwhile examine these below for evidences of frailty:

The controlled flaking, so called, on some of the Acheulean fist axes was achieved by using a billet of wood rather than a hammerstone.

Experiment will not bear this out. Neither will experiment disprove it. Success in percussion flaking depends mostly on the skill of the individual workman, no matter what kind of tools he uses: the rude and simple hammerstone, a stone hammer lashed to a handle, a hammer with a head of bone or buckhorn, a modern hammer with a steel head, a wooden mallet and a bone punch, or any or all of the foregoing, supplemented by that sophisticated instrument, a vise. As for the wooden billet, a modern workman may think at first that it is a better tool than a hammerstone merely because the hammerstone has no handle and the billet, in effect, does have one. But he can train himself to renounce the handle. Any experimenter who becomes proficient in a particular technique is in some danger of persuading himself that it is the precise technique used thousands of years ago. That conclusion does not follow.

The Upper Palaeolithic blade-and-core technique was executed by wrapping the core in buckskin or burying it in sand and by using a mallet and punch to direct the blow more precisely.

Very doubtful. For some men, at least, the sand and the buckskin merely get in the way, and it is easier to strike off the blade with a hammer or a hammerstone than with a mallet and punch.

Primitive flint-working tools were harder to use than modern tools.

Iron tools simplify the work because they last longer than bone, buckhorn, or even stone. They do the work no better, sometimes not so well. There is a queer inconsistency in arguing that iron is better than buckhorn but that the Acheuleans did their prettiest work with tools of wood. Wood is even softer than buckhorn.

Pressure flaking, in Europe, was introduced by the Solu treans, whoever they were.

Many Aurignacian implements seem to have been trimmed along the edges by pressure flaking. So do some Mousterian implements.

Pressure flaking can be consistently distinguished from percussion flaking.

Not so; or at least not certainly with the naked eye. On the average, percussion flakes are much bigger, but sometimes they are small and delicate. Or pressure flaking may be roughly executed. That is why the answer to the fourth theory remains in doubt.

Freehand pressure flaking allows better control than flaking with a rest.

Among modern workmen this seems to be a matter of individual preference.

It is almost impossible, in working flint, to execute flakes longer than half an inch by simple pressure.

Not quite true. Half an inch is perhaps the limit for a man of only average strength and skill who is working in the free-hand style and using run-of-the-mill flint. But such a workman can increase the length of the flake by getting better flint or by working with a rest. Choice flint being scarce, the second method is the easier. There seems to be no reason to doubt that a man of unusual strength and skill might press off flakes two or three inches long. The longer the flake, though, the harder it is to control it.

It was the finding of the strikeout flake from a fluted point which showed that the edges and faces of the point were trimmed before the long flake was struck.

No such proof was ever needed. If one flake scar overlaps another or erases the end of it, the one that does the overlapping is the later of the two. Most fluted points show clearly that the edges were trimmed before the flutes were struck. But some of them also show that the workman made a few finishing strokes along the edges after he struck the flutes. Also, the base was usually trimmed after the flutes were struck.

Neanderthal man ate his meat raw, as is attested to by the fact that he split the long bones to get the marrow out. If the meat had been cooked, the marrow would have been loosened and he could have simply sucked it out after breaking the ends off the bones.

This is getting outside the scope of a treatise on flint, but honor requires a defense of our eponymous hero. Maybe he did eat his meat raw. Nevertheless, consider: why would he have to cook the marrow while cooking the meat? Suppose his share of the kill was a mammoth thigh. Would he necessarily roast this ponderous cut of meat in a single piece? That would take a big fire and considerable time. It would be simpler to slice off cutlets and broil them over the coals, leaving the marrow in the femur uncooked. Or suppose our Neanderthal roasted smaller game all in one piece. He would not inevitably prefer his meat well done. If he cooked it rare, the marrow would not be loosened.

Suppose finally that he was merely ignorant of physics and had not yet discovered why and how a vacuum works. He broke one end off the bone and tried to suck the marrow out, unaware that to achieve his purpose he would have to break off both ends. So he abandoned the enterprise and simply split the bone.

Likely enough, the Neanderthal really ate raw meat. But the evidence is somewhat inconclusive.

XVI. A Few Thoughts on Fakes

THE FAKING OF ANTIQUES is itself an art of moderate antiquity and may have begun about as soon as the Renaissance merchants and nobles started collecting Classic coins and statuary. It has been applied to artifacts as diverse as Flemish paintings, Cremonese violins, and American Colonial furniture. Naturally, the handiwork of Stone Age craftsmen, whether early or late, has also been widely imitated. There are copies of pottery, sculpture, and beadwork, of birdstones, banner stones, and pipes, of things as recent as Navajo blankets and as old as Folsom projectile points.

Blankets, pipes, and pottery are outside the scope of this manual, but it might be permissible to offer a few comments on projectile points and other flaked implements. To begin, then, it must be understood that it would be bootless to copy the ordinary sorts of arrowheads or dart points. Most such workmanship is commonplace, and genuine examples already exist by the hundreds of thousands. Dealers often sell them for a nickel apiece, sometimes even less. If a faker could finish a dart point every five minutes and keep going at that speed throughout the course of an eight-hour day, never making a mislick and breaking a point, and if the dealer was so generous as to waive the middleman's commission, the faker would still wind up making $4.80 a day. There would be no profit in it. A man could make more money with a pick and shovel.

The demand among collectors, especially among unschooled collectors, is for something large, scarce, unusual, picturesque, or showy. Certain fakers have undertaken to supply this demand. Now a perfect fake, of course, cannot be recognized, even by the finest judges. The faker will have taken particular care to use primitive implements, such as quartzite hammerstones and buckhorn pressure-flakers, which are no harder to use now than they ever were. He will have chosen whatever sort of stone the original craftsmen preferred, such as Alibates agate for Folsom or Plainview points, eschewing glass, obsidian, semiprecious opal, and the like. He will have been careful to follow standard operating procedure, not forgetting to grind the edges of a Folsom point or to shape a little nipple on the base. Therefore, the remarks below are a guide for detecting only imperfect fakes, fakes on which the workman was a little careless or a little overconfident:

Is the material one available to primitive men?

Surprising numbers of large spearheads now in the hands of untrained collectors are actually made of rose-pink, green, or yellow plate glass. The seller will have described such material as obsidian of an unusual color, unusual enough to justify a rather high price. But it is much too unusual. Rose-pink obsidian would be a rarity indeed. Most commonly, obsidian is either black or reddish-orange or a mixture of the two. Occasional specimens are quite transparent and colorless. Nearly all obsidian of the black or reddish-orange sorts is banded, streaked, or clouded when viewed by transmitted light. The color may seem quite uniform when the piece is viewed by reflected light. Hold it up to a window and look through it, though, and the irregularities will appear. Perhaps the only way to distinguish certainly between obsidian and plate glass would be to have a physicist check the specific gravity and the index of refraction. But a man's suspicions should be aroused if his spearhead turns out to be entirely uniform in color from one end to the other when held up to the light.

Does the piece belong to one of the standard types of Stone Age craftsmanship?

That is to say, beware of animal effigies chipped from flint, of the so-called "eccentric" forms, and the like. Perfectly genuine examples do exist, but they are relatively scarce. A Stone Age man, making an image of something, would ordinarily choose to carve it from antler, ivory, or slate, or to shape it from clay and bake it like a piece of pottery. To make an image by flaking flint was an unusual, even freakish, practice. Suspiciously large numbers of such images are on the market now, especially flaked silhouettes of eagles and turtles.

Do the opposite faces of a spearhead, especially of a large one, show that they once consisted of precisely parallel planes?

If they do, beware again. An extreme regularity in the opposite faces means that the spearhead was chipped not from a blade or lamellar flake but from a blank cut with a lapidary saw. This test is hard to explain to somebody who has never chipped much flint. It needs no explaining to the experienced workman because curiosity will already have led him to make the same kind of experiments with sawed blanks, or perhaps only with plate glass, and he will have discovered the advantages and the disadvantages in the process. Roughly, what happens will be something like this: The man takes his sawed blank, sometimes of an unusual stone such as semiprecious opal. He proceeds to decorate both faces with large and parallel flake scars. But the flakes are so thin and shallow that in taking them off he omits to sharpen the edges of the piece. He now has to sharpen those thick edges. This he does by taking off two series of short, stubby flakes along each edge, that is, by creating a median or doubly beveled edge. These flakes and their corresponding scars have to be short, else they would overlap and mar the neat flake scars already made on the two faces. When the spearhead is finished, its opposite faces are still almost precisely parallel planes from one end to the other. The two edges are doubly beveled. In cross section, the piece is an extremely wide, flattened, and regular hexagon, whereas most spearheads are lenticular in cross section. The hoax is betrayed by its exaggerated and almost geometrical regularity.

Does the piece show some flake scars that are less weathered than the adjacent scars?

If so, somebody besides the original maker has been retouching it. The retouching, however, is not necessarily modern. In middle and late eras it sometimes happened that an Indian would find and resharpen a projectile point made a thousand or several thousand years earlier.

Has it been sandblasted to make it look older?

This test is hard to make with the naked eye unless the viewer is acquainted with the particular kind of flint used. Roughly, the idea is that sand blasting gives flint a sort of matte or dull finish without changing its color. Weathering usually changes the color, however.

Under the microscope, does the artifact show streaks of iron?

If so, it was made with an iron tool. However, this test is not dependable. The streaks will show only if the maker's hand slipped a time or two, so that the iron slid over a surface already flaked. Moreover, it is easy to get the streaks off by dipping the finished piece in hydrochloric acid. Another indication that iron tools were used is a tiny crushing or shattering of the edges on an otherwise well-made piece. But this does not necessarily occur, especially on choice flint. The maker can, of course, keep from leaving either sort of evidence behind by simply finishing everything with bone or buckhorn tools.

Do all the artifacts in a group deviate slightly but consistently from a recognized type?

Take a purely hypothetical instance. Suppose a collector has come into possession of a dozen Folsom points. All twelve are neatly fluted on both faces. All are made of Alibates agate from the Texas Panhandle, a material widely but by no means universally used during Folsom times. They are much alike in size and shape, say from thirty-five to forty millimeters long. But not a one of them has had its edges ground and not a one shows a tiny nipple protruding from the base. Now undoubtedly there are genuine Folsom points that show no grinding along the edges, and there are many of them that lack the basal nipple. The odd circumstance about these hypothetical twelve is that they resemble one another so closely, all deviating from the usual type consistently in two important respects. There is no proof that they were not made ten thousand years ago. But there is some slight cause for suspicion.

XVII. Remembering Boucher de Perthes

TO SCHOLARS, the story of Boucher de Perthes is an old and familiar one, but it is well worth retelling here as a sort of epilogue. In Dr. Johnson's phrase, it points a moral; it adorns a tale.

Jacques Boucher de Crèvecoeur de Perthes was a French customs collector, born in 1788. A little more nearly than anyone else, he can be regarded as the man who proved that there had been an Old Stone Age, who showed that our rude forerunners had been chipping fist axes in the valley of the Somme at the same time Pleistocene elephants and rhinoceroses were roaming thereabouts.

It was not so much that Boucher de Perthes made the discovery, for other men in other countries had made it before him but had been laughed down or ignored. It was that Boucher de Perthes was lucky enough to live at a time when opinion was changing, was sensible enough to believe the eyeball evidence, and was stubborn enough to challenge orthodox beliefs. Eratosthenes had measured the earth before 200 B.C. but most people thought it was flat for many centuries afterwards.

A fist ax had been found with the bones of a Pleistocene elephant near a lane in London as early as 1690. But the bones were explained away as those of a war elephant ridden by Roman legionaries and the fist ax as the tip of a patriot Briton's spear. After a century had gone by, more flints and more bones were dug up in Suffolk, and John Frere, F.R.S., was shrewd enough to see the meaning of the find. He so notified the Society of Antiquaries but nobody paid any attention. Finally, by the late 1830's, several men had found flints with the remains of Pleistocene mammals, the best work having been done by P. C. Schmerling in Belgium and Father John MacEnery in Devonshire.

But hardly anybody believed the evidence.

Boucher de Perthes himself became interested in flints through a friend who was studying the tools then believed to have been made by the Celtic peoples, now known to be Neolithic. But it was the ruder and earlier forms, found in the Somme gravels with the bones of elephants and rhinoceroses, that came to fascinate him more and more. He exhibited a collection of the old fist axes in Abbeville in 1838 and in Paris in 1839. In the former year he also began to publish a series of volumes explaining what he had found.

This Frenchman was a stubborn fellow, not to be put down or ignored. Best of all, he had the evidence. Two of his fellow-countrymen, Rigollot, of Amiens, and the palaeontologist Albert Gaudry, set out in the 1850's to disprove his theories with some digging of their own in the gravels around Saint-Acheul. But they, too, found fist axes with elephant bones; and they, too, were convinced by the visible evidence. In the meantime, Boucher de Perthes kept on collecting fist axes and writing books.

Other men had been working in other countries all this while. In Denmark and Sweden, especially, there was a brilliant group. As early as 1819, Christien Jurgensen Thomsen, curator of the National Museum in Copenhagen, had classified its exhibits into the periods of the Stone Age, the Bronze Age, and the Iron Age. As much as it has been altered by the later realization that other differences in the way of life mean more than the difference between flint tools and metal tools, that idea still prevails. But despite the great abilities of the Danes and Swedes, there was no such evidence available to them as to Boucher de Perthes that the early men had been contemporaries of the mammoth. Denmark had no Palaeolithic. It was too close to the centers of the glacial ice. Thus J. J. A. Worsaae put the beginning of the Stone Age only three thousand years before his own day—which actually would have been about the time that Agamemnon was sacking Troy.

In 1858 and 1859 Boucher de Perthes finally convinced a sizable audience that he had been right about those fist axes all the time. It was also in 1858 that William Pengelly, a schoolmaster who had continued Father MacEnery's digging in Devonshire, began new excavations in Brixham Cave, sponsored by the Royal Society and the Geological Society, which confirmed the earlier but disregarded findings. In that same year the palaeontologist-botanist Hugh Falconer visited Boucher de Perthes on his way to Sicily, looked at the fist axes, and decided that the Frenchman had the evidence. When Falconer returned to England, he asked the archaeologist John Evans and the geologist Joseph Prestwich to visit the Somme themselves and look at the flints from the gravel pits. In 1859 they did. Evans himself found a fist ax seventeen feet down in the gravel. The two went back to England, made reports to the learned societies of the kingdom, and got the evidence generally accepted. Now this was nearly thirty years after Boucher de Perthes had first started collecting fist axes. He was a man not easily discouraged, not to be laughed down, not daunted by the authoritative frown. The Société d'Émulation d'Abbeville, whose members had so often laughed in earlier years, put up a monument to him in 1908.

Nor is the value of stubbornness the only thing to be learned from this story. The study of the Stone Age is an art, a science, a discipline—call it what you will—that was founded by novices. There was nobody to tell Boucher de Perthes that the fist axes were man-made implements; he had to recognize them by common sense alone. There was no literature that he could consult, no training that he could undergo to qualify himself.

Working at a lower intellectual level—working, to be literal about it, at the same intellectual level as *Homo neanderthal-*

ensis, with a chunk of flint in my fist—I take some comfort in the memory of Boucher de Perthes. He stands forth as an example to all men in his willingness to look at the evidence with the naked eye and to trust in nothing but the evidence, doubting all traditional opinion. I hope that my fellow-Neanderthals, be they few or many, who chance to read this book will refuse to believe anything I have told them about the nature of flint. Take my word for nothing. Try it yourself. Go get a chunk of flint and see how it works. If you are going to accept without question whatever I tell you about flint, you are really not much better off than if you asked your neighbor across the street. He will tell you, with utter conviction, that the Indians used to make arrowheads with fire and a piece of wet straw.

Reading List

THIS LIST is purely for laymen and especially for laymen who have read little about the Stone Age but would like to get started. To a professional student the list may seem banal. There have been so many discoveries of new evidence and so many changes in interpretation since the First World War—or even since last year, for that matter—that some of the finest books are now somewhat out of date. Detailed bibliographies will be found in some of the books and papers listed below, and everyone can decide for himself how much more he wishes to read.

Burkitt, M. C.: *The Old Stone Age.* London: Cambridge University Press, 1933.

Written clearly and gracefully, with no disposition to theorize beyond what the actual evidence will support. Rather dated. At the time of the original publication, there was little evidence that men had been in North America during the Pleistocene. A second edition in 1949 did not add much to the story.

Coon, Carleton S.: *The Story of Man.* New York: Alfred A. Knopf, Inc., 1954.

A spirited and slightly opinionated account of the entire history of the species. The author has little interest in flint artifacts, as such.

Daniel, Glyn E.: *A Hundred Years of Archaeology.* London: Gerald Duckworth & Co., Ltd., 1950.

A splendid history of the science or the discipline itself and of the men who made the chief discoveries. From Australopithecus to Agamemnon.

Haury, E. W., Ernst Antevs, and J. F. Lance: "Artifacts with Mammoth Remains, Naco, Arizona," *American Antiquity*. Vol. 19, No. 1 (1953).

A report on an important discovery, especially interesting because it shows an extreme variability among the Clovis points used to kill a single animal.

Holmes, W. H.: *Handbook of Aboriginal American Antiquities, Part I, Introductory: The Lithic Industries*. Bulletin 60. Washington: Bureau of American Ethnology, 1919.

Badly outdated now as an account of stone artifacts in the two Americas, but contains a fine anthology of reports from people who saw the aboriginal craftsmen at work.

Howells, William: *Back of History*. Garden City, New York: Doubleday & Company, Inc., 1954.

Another account of the species from its beginnings or of the genus from its beginnings. Somewhat more restrained than Coon's.

Krieger, Alex D.: "A Comment on 'Fluted Point Relationships' by John Witthoft," *American Antiquity*, Vol. 19, No. 3 (1954).

This paper constitutes half of a fascinating debate between two typologists as to whether or not the Enterline point is a type distinct from Clovis. See Witthoft, below. For Krieger on typology in general, see Suhm, below.

Oakley, Kenneth P.: *Man the Tool-Maker*. 2d rev. ed., London: British Museum of Natural History, 1949.

The best of all books about the Stone Age. But lamentably brief and scantily illustrated.

Osborn, Henry Fairfield: *Men of the Old Stone Age*. New York: Charles Scribner's Sons, 1915 (3d ed., 1918).

Badly outdated but written with great spirit and learning. Profusely illustrated, it gives the layman an idea of what the people, the implements, and the animals actually looked like.

Sellards, E. H.: *Early Man in America*. Austin: University of Texas Press, 1952.

A clear and comprehensive account but written more for the professional student than the benighted layman who would rather know more about what was found and less about the details of digging it up. Well illustrated. Exhaustive bibliography.

Suhm, Dee Ann, Alex D. Krieger, and Edward B. Jelks, *An Introductory Handbook of Texas Archaeology*. Bulletin of the Texas Archaeological Society, Vol. 25.

The only book ever yet published with enough pictures in it to enable the befuddled novice to understand how the experts distinguish one kind of projectile point or one kind of pottery from another. Illustrates the full range of variation.

Witthoft, John: "A Palaeo-Indian Site in Eastern Pennsylvania; an Early Hunting Culture," *Proceedings of the American Philosophical Society*, Vol. 96, No. 4 (1952).

Witthoft's study of the Enterline points.

———"A Note on Fluted Point Relationships," *American Antiquity*, Vol. 19, No. 3 (1954).

Witthoft's half of the Witthoft-Krieger debate. Both papers listed are fascinating but abstruse.

Index