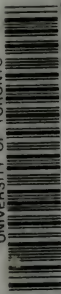


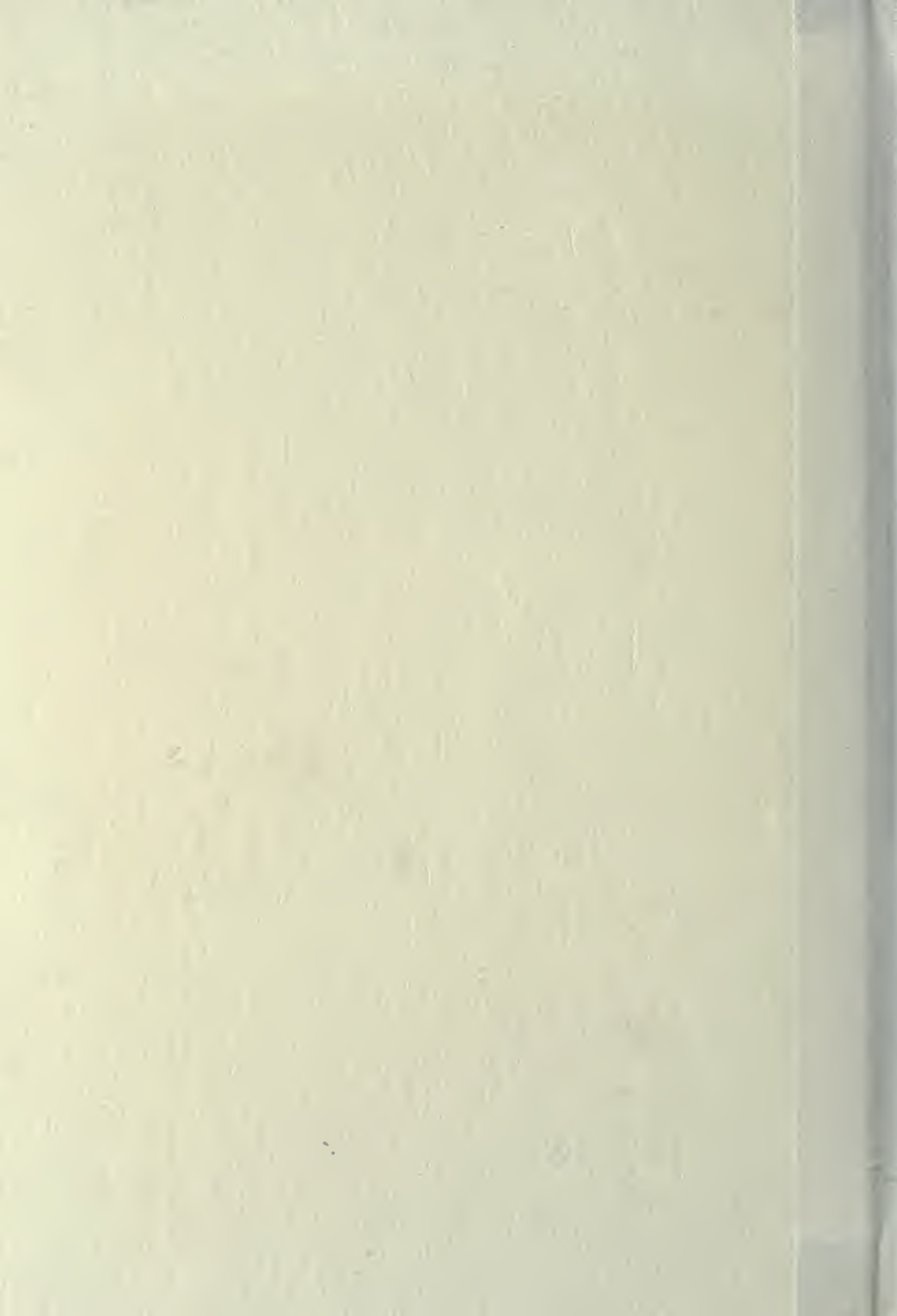
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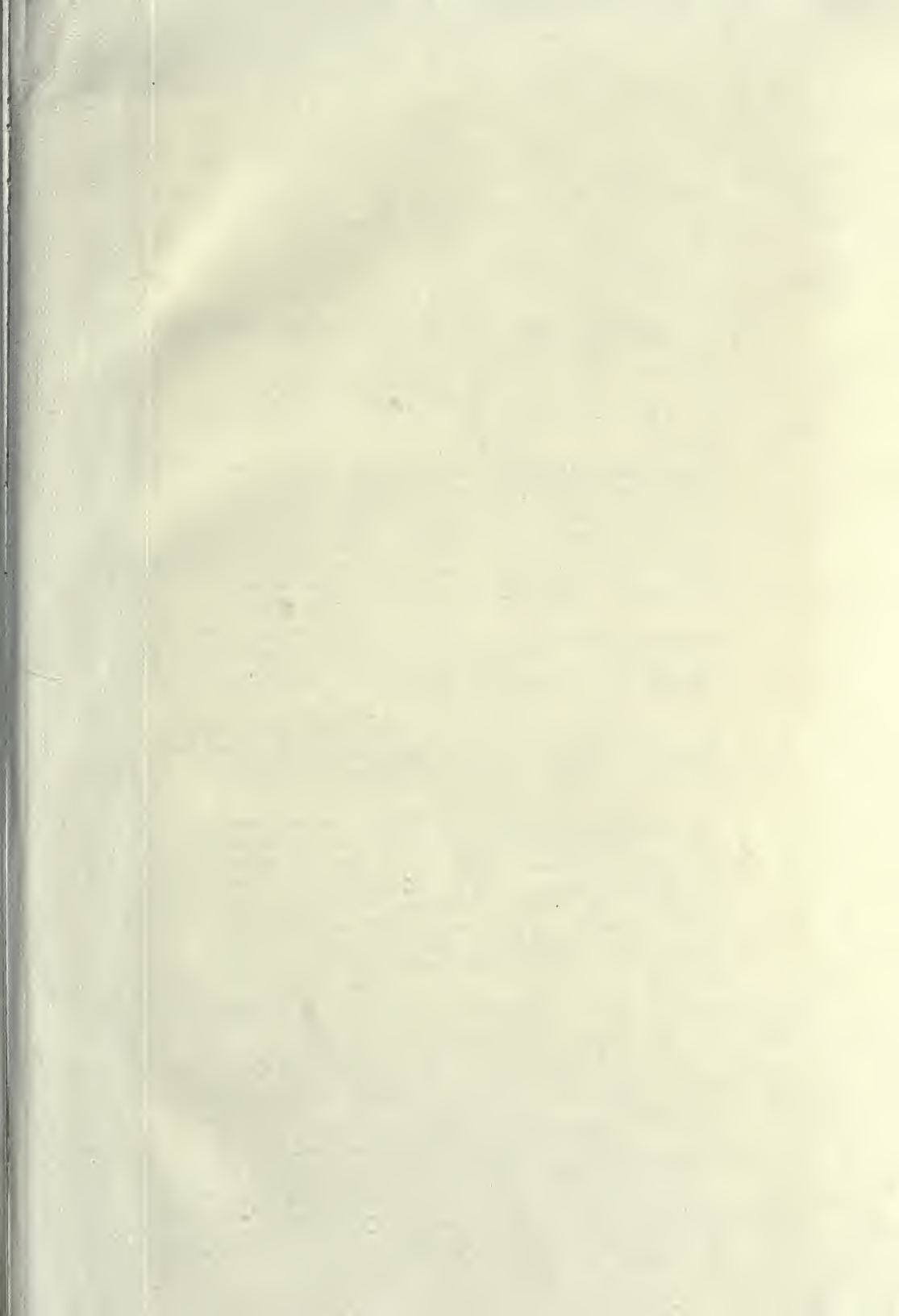


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Fire-making apparatus
in the U.S. National Museum

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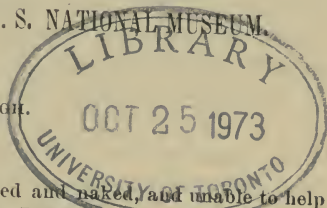
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FIRE-MAKING APPARATUS IN THE U. S. NATIONAL MUSEUM.

By WALTER HOUGH.



Man in his originals seems to be a thing unarmed and naked, and unable to help himself, as needing the aid of many things; therefore Prometheus makes haste to find out fire, which suppeditates and yields comfort and help in a manner to all human wants and necessities; so that if the soul be the form of forms, and the hand be the instrument of instruments, fire deserves well to be called the succor of succors, or the help of helps, that infinite ways afford aid and assistance to all labors and the mechanical arts, and to the sciences themselves.—BACON.—*Wisdom of the ancients*, Prometheus, Works, vol. iii. Lond., 1825, p. 72.

There is a prevalent belief that to make fire by rubbing two pieces of wood is very difficult. It is not so; the writer has repeatedly made fire in thirty seconds by the twirling sticks and in five seconds with the bow drill.

Many travelers relate that they have seen various peoples make fire with sticks of wood. The most common way, by twirling one stick upon another is well described by Pere Lafitau with reference to the Hurons and Iroquois.

They take two pieces of cedar wood, dry and light; they hold one piece firmly down with the knee and in a cavity which they have made with a beaver-tooth or with the point of a knife on the edge of one of these pieces of wood which is flat and a little larger, they insert the other piece which is round and pointed and turn and press down with so much rapidity and violence that the material of the wood agitated with vehemence falls off in a rain of fire by means of a crack or little canal which leaps from the cavity over a match [slow match]. This match receives the sparks which fall, and preserves them for a long time and from which they can make a large fire by touching it to other dry materials.*

All these descriptions omit details that are essential to the comprehension of the reader. There is a great knack in twirling the vertical stick. It is taken between the palms of the outstretched hands, which are drawn backwards and forwards past each other almost to the finger tips, thus giving the drill a reciprocating motion. At the same time a strong downward pressure, is given which may be called a rotating pressure. The hands move down the drill; when they nearly reach the lower end they are brought back to the top with a quick, deft motion. This is repeated as rapidly as possible. If the lower part of the drill is observed when the motion begins it will be seen that powder is ground

* Lafitau.—*Moeurs des Sauvages Ameriquains*, Paris, 1724. II, p. 242, 243.

off and is collecting in the canal cut into the cavity from the side of the lower piece of wood. Soon, as the motion progresses, the powder begins to increase and to get darker, the odor of burning wood is noticed and the smoke is seen. Probably when the next motion ceases there will be a little curl of peculiarly colored smoke, which shows that active combustion has begun. The pellet of ground-off wood may now be shaken out of the slot or canal. At first it is dark; a thin line of smoke comes from it; gradually the fire spreads through it until it glows. In this semi-charred dust the heat is held until it increases to about 450° , or higher. Everything depends on keeping the dust in a heap; it is impossible to make fire without doing this. This is true in all kinds of wooden fire-making tools.

By examination of many specimens of aboriginal fire apparatus it is found that both the drill and lower piece, which, for convenience, shall be called the hearth, must be of dry, inflammable wood. Wood that is soft from incipient decay is chosen; most often pieces riddled by worms. This is the *felicis materia* spoken of by Festus as used by the Vestals. Wood of this kind is not only easier of ignition, but it is ground off more easily and retains the heat generated until enough is accumulated to ignite the powder. In strong, skillful hands fire can be made from wood that does not wholly fulfill these conditions.

Woods vary in combustibility, depending on their density, coloring matter, and, perhaps, their chemical constitution. Sap wood of juniper and soft, white maple yield fire with the bow, but light mesquite is the best of all. The vascular, starchy flowering stems of plants have always been a favorite fire-generating material.

It will be seen that the Eskimo attachments to the simple drill enable him to use wood ordinarily of no account for making fire. Sand is used by Indians and other peoples to increase the friction.

From the material in the collection at the Museum, it is found that nearly every method that is or was used in the world is represented. The following classification, based upon the presumed order of development of the invention, is followed in this paper:

- I.—Fire-making by reciprocating motion.
 1. *Simple, two-stick apparatus*: Indians of the two Americas, Ainos, Somalis, Kaffirs, Veddahs, Australians, etc.
 2. *Four-part apparatus*: Eskimo, some Indians, Hindoos, and Dyaks.
 3. *Weighted drill*, with spindle whorl; Iroquois and Chukchis.
- II.—Fire-making by sawing.
 - Malays, Burmese, etc.
- III.—Fire-making by plowing.
 - Polynesians, Australians, and Papuans.
- IV.—Fire-making by percussion.
 1. *With pyrites, or stone containing iron, and flint*: Eskimo and northern Indians.
 2. *With flint and steel*: General.

I. FIRE-MAKING BY RECIPROCATING MOTION.

1. SIMPLE TWO-STICK APPARATUS.

This method may be said to have a world-wide distribution, and to have had no narrow range in time. It is a very interesting study to observe the many different practices that have been superadded to the simple task of twirling two sticks with the design of creating fire. It is also instructive to note how fixed have become tribal characters in so small a thing as the shaping of the elements of the fire drill. It has well been said by Dr. Schweinfurth, that—

A people, as long as they are on the lowest step of their development, are far better characterized by their industrial products than they are either by their habits, which may be purely local, or by their own representations, which (rendered in their rude and unformed language) are often incorrectly interpreted by ourselves. If we possessed more of these tokens we should be in a position to comprehend better than we do the primitive condition of many a nation that has now reached a high degree of culture.*

This fact holds good with reference to tribes in a higher plane than the learned writer included in this statement, in this way. There are many little things that have not been subject to the modification of time, intercourse, or environment, but co-exist with an art. To particularize: Prof. E. S. Morse has shown the value of the simple act of releasing an arrow from a bow-string as a classifier. Close attention to the minor acts and arts will reveal much more than the nice measurements of man's practically unmodified skeleton.

Differences that have become functional in the arts have come down from an early period; when they can be found they are of the greatest value as aids in ethnology.

The ethnography of the simple fire drill is studied geographically, beginning in North America with the most northerly tribes that use it, and ranging from north to south in the different sections of the country, among the tribes from which there are specimens in the Museum. Other countries are examined from west to east.

The Sitkan fire-drill spindle is unusually long and thick (fig. 1). Both hearth and drills are of the *Thuja gigantea*, a tree that enters so largely into the life of the Indians along this coast. The wood grinds off very well with much friction; at ordinary speed there is soon a small heap of powder at the bottom of the fire slot. The latter is deeply cut in from the side nearly to the center of the fire-hole. The whole hearth has been charred at the fire. This repels moisture, and also renders it easier to ignite the wood, charring being a process somewhat analogous to the decay of wood by rotting. If kept carefully in a dry place, this apparatus was perfectly adequate for the purpose of the Sitkan, and in his skillful hands would no doubt give the spark in a minute or so. The long drill would indicate that two worked at it consecutively

* Schweinfurth.—The Heart of Africa. New York, 1874. I, p. 257.

to keep up a continuous motion, as will be noted in the use of the Aino drill (p. 551).

For tinder, the bark of the arbor vitæ was used. It is finely frayed, and is much improved by being slightly charred. They also use, preferably, a tinder made from a fungus, because it is "quicker," *i. e.*, ignites more readily than the frayed bark.

The hearth is squared and measures 23 inches; the drill is of equal length.

Going southward from Sitka the next fire-making set in the series is from Bella-Bella, British Columbia. These Indians are of the Salishan stock, and are called Bilhulas. The horizontal is a piece of cedar wood dressed square on three faces. It is apparently a piece of an oar or spear handle. The fire-holes are shallow, and the fire slots are quite narrow (fig. 2). The drills have been scored longitudinally near the rubbing end; this may be a device to cause the wood to wear away more rapidly, and furnish fuel to the incipient fire. Fire has evidently been made with this set. Both parts are $1\frac{1}{2}$ feet long; the drill is much thinner than that of Sitka. The tinder is of frayed cedar bark.

From a southern family of the Salishan stock, called the Quinaiet Indians, of Washington Territory, the museum has a complete set collected by the late Charles Willoughby. It consists of a hearth, two drills, and a slow-match. The hearth is a rounded piece of cedar wood; opposite the fire-holes it is dressed flat, so as to rest firmly on the ground. There are three fire-holes with wide notches. The drills taper to each end, that is, are larger in the middle (fig. 3). The powder, a fine brown dust, collects at the junction of the slot and fire-hole, where they form a lip and there readily ignites. This side of the hearth is semi-decayed. No doubt the slots were cut in that side for the purpose of utilizing this quality. The drills are bulged toward the middle, thereby rendering it possible to give great pressure and at the same time rapid rotation without allowing the hands to slip down too rapidly, a fault in many fire-drills. The slow-match is of frayed cedar bark, about a yard long, folded squarely together, and used section by section. Mr. Willoughby says:

The stick with three cavities was placed upon the ground, the Indian kneeling and placing a knee upon each end. He placed one end of the smaller stick in one of the cavities, and, holding the other end between the palms of his hands, kept up a rapid half-rotary motion, causing an amount of friction sufficient to produce fire. With this he lighted the end of the braided slow-match of cedar bark. This was often carried for weeks thus ignited and held carefully beneath the blanket to protect it from wind and rain.

Fire is easily procured with this set. It takes but a slight effort to cause a wreath of aromatic smoke to curl up, and the friction easily grinds off a dark powder, which collects between the edges of the slot. When this ignites it drops down the slot in a little pellet, and falls upon the tinder placed below to receive it. Both drill and hearth are 18 inches long.

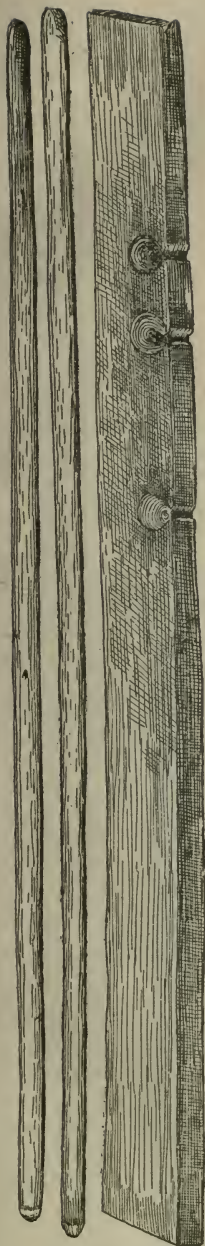


Fig. 1.

FIRE-MAKING SET.

(Cat. No 74,379, U S N M. Tlingit Indians, Sitka, Alaska. Collected by John J McLean.)



Fig. 2.

FIRE-MAKING SET.

(Cat. No 20,644, U S N M. Bella-Bella, B. C. Collected by James G Swan.)

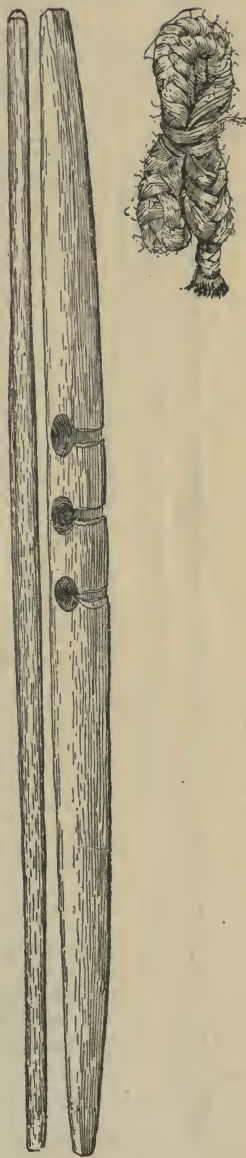


Fig 3.

FIRE-MAKING SET AND SLOW MATCH.

(Cat. No 127,866, U S N M. Quinault Indians, Quinault, Washington. Collected by Charles Willoughby.)

The Klamaths, of Oregon, of the Lutuamian stock, use a fire apparatus that looks very much like that of the Utes. The hearth is a rounded piece of soft wood thinned down at the ends (fig. 4). The drill is a long, round arrow-stick, with a hard-wood point set in with resin and served with sinew (see Ute drill, fig. 7). The holes in this hearth are very small, being less than three-eighths of an inch in diameter. They are in the center, and the fire slot being cut into the rounded edge widens out below, so that the coal can drop down and get draught. The wood is quite soft, apparently being sap-wood of yew or cedar, while the drill-point is of the hardest wood obtainable. It is probable that sand is used on the drill. The hearth is 13 inches long, and the drill 26.

The Chinooks, a tribe of Indians of a separate stock, called Chinookan, formerly lived about the mouth of the Columbia River, in Oregon, but are now nearly extinct. Hon. James G. Swan, the veteran explorer, investigator, and collector among the Northwest coast tribes, says that the Chinooks are the best wet-weather fire-makers he ever knew.*

To kindle a fire the Chinook twirls rapidly between the palms a cedar stick, the point of which is pressed into a small hollow in a flat piece of the same material, the sparks falling on finely frayed bark. Sticks are commonly carried for the purpose, improving with use.†

Mr. Paul Kane‡ describes the hearth as a "flat piece of dry cedar,



Fig. 4.

FIRE-MAKING SET.

(Cat. No. 24096, U. S. N. M.,
Klamath Indians, Oregon,
Collected by L. S. Dyar.)

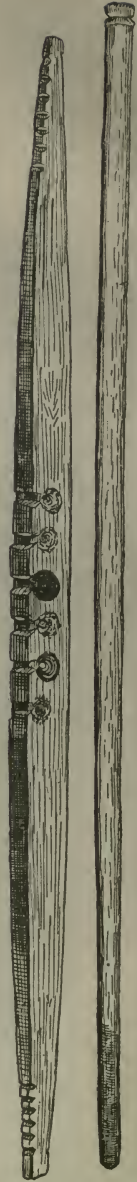


Fig. 5.

FIRE-MAKING SET.

* Swan.—Northwest Coast. p. 248.

† Bancroft.—Native Races. I., p. 237.

‡ Kane.—Wanderings of an Artist among the Indians. London, 1859.

(Cat. No. 77193, U. S. N. M., Hupa
Indians, California. Collected by
Lieut. P. H. Ray, U. S. A.)

in which a small hollow is cut with a channel for the ignited charcoal to run over. In a short time sparks begin to fall through the channel upon finely frayed cedar bark placed underneath, which they soon ignite." The Ahts and Haidas also use cedar fire-sticks of the usual Indian kind.

The Hupa Indians of California are of the Athapascan stock. Their fire-drill is a carefully made piece of apparatus (fig. 5). The hearth is of a reddish, punky piece, probably of mesquite, *Prosopis juliflora*, somewhat harder than the drill, which is charred slightly for some distance along the grinding end. Fire has been made in one of the holes; the others show the rough, frayed cavities which have been made to start the drill. The notches at each end of the hearth seem to be to facilitate the tying of the pieces together as a precaution to prevent their loss or separation. They are usually intrusted into the hands of the most skillful fire-maker, who wraps them up to keep them from becoming damp. The effectiveness of the sticks increases with use and age; a stick and hearth that have been charred by the former making of fire in most cases yields the spark in half the time required for new apparatus. Another advantage is that the drill is softer from incipient decay.

That this set in the highest degree efficient is shown by the fact that the writer repeatedly got a glowing coal, the size of a pea, from it in less than twenty seconds. The hearth is 18 and the drill 21 inches long.

The McCloud River Indians (Copehan stock) make the drill from the buckeye tree.

The Indians of Washoe, Nevada, from their language, have been classed by the Bureau of Ethnology as a separate stock, the Washoan. Stephen Powers, many years ago collected a rather remarkable hearth from these Indians. It has eight rather small holes, in every one of which fire has been made. The wood is soft, well-seasoned pine. Apparently sand has been made use of to get greater friction, as is the custom of the Zuñis and Apaches. This device, in a measure, obviates the necessity of having tinder-like wood, or wood in a state of partial decay. For the drill any hardwood cylindrical stick might be employed. A strip of buckskin about an inch wide is passed around the hearth over the fire holes to keep them dry (fig. 6).

At the end of the hearth is a mass of cement made of the resin of a pine mixed with sand, apparently; a kind of material used by the Indians over a large area in the Great Basin and southward to fix their arrowheads, pitch the water-bottles, and for other purposes. It is quite probable that this stick was the property of an arrow-maker, whose need of fire to melt the somewhat intractable cement, caused him to combine these functions in one tool.

It has a better finish, and displays greater skill in its manufacture than the fire-tools of the neighboring tribes of Shoshonian (Utes) and

Moquelumnian stocks. In fact, it has a close affinity in appearance to

those of the very near Athapasean (Hupa, etc.) stock. It is a matter of very great interest to compare with this a stick from the Mackenzie River. (See Fig. 28.) The resemblance is striking; it is as though one found a word of familiar sound and import in an unexpected place. The related tribes of the Indians dwelling on the Mackenzie have a wider range than the distance between the localities whence the respective sticks came; in fact, the Athapascans range about 50 degrees in latitude and the southern colonies of this great family are only about 250 miles southeast of the Washoans, while, as has been stated, the Hupas are quite near.

It would be presumptuous to say at present that this tool is a remnant of the influence of the Athapasean wave that swept along the Great Interior Basin, leaving groups here and there in California and other parts to mark its progress, but there is more to its credit than a coincidence of form and function.

The museum is in possession of a complete collection of fire-making material from the tribes of the Shoshonian stock. They were collected by Maj. J. W. Powell. The native name for the Ute fire set is *whu-tu ni-weap*. While the lower member of the set—the hearth—differs among the several tribes in point of material, shape, etc., the spliced drill is characteristic of the whole stock. It has never been noticed outside of the southern part of the Great Interior Basin but in one instance—among the

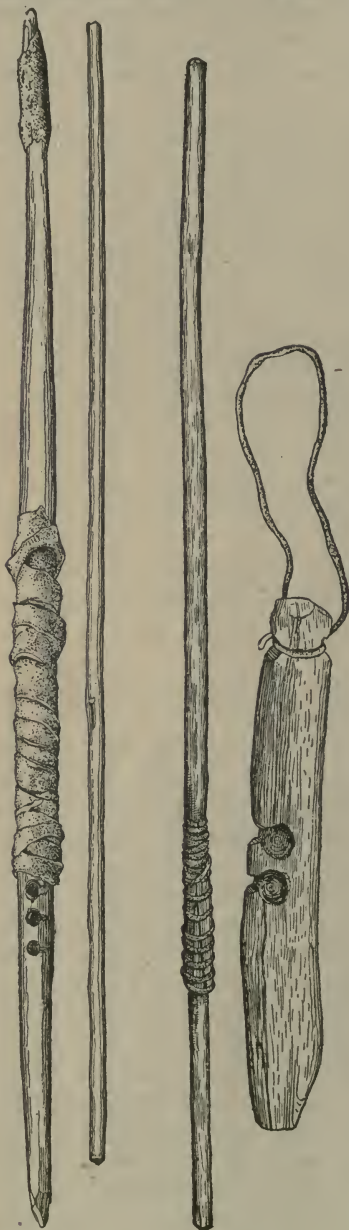


Fig. 6.

FIRE-MAKING SET.

(Cat. No. 19640, U. S. N. M.
Washoe Indians, Nevada.
Collected by Stephen Pow-
ers.)

Fig. 7.

FIRE-MAKING SET.

(Cat. No. 17230, U. S. N. M.
Pai-Ute Indians, Southern Utah.
Collected by Maj. J. W. Powell.)

Klamaths of Oregon. The main part of the drill is either a reed, or a straight sprout, usually the former. At one end a short piece of very hard wood—greasewood, *sarcobatus vermiculatus*—is set in and lashed with sinew. It resembles the Shoshonian arrows, which are foreshafted in this way. They also use sand in common with other neighboring tribes.

The Pai-Utes, of Southern Utah, make their hearths of a short, rounded piece usually of the sapwood of juniper. It is tied to the drill with a thong of buckskin when not in use (fig. 7). The drill is like the usual one, just described. This is the common form of the Pai-Ute apparatus. The small, two-holed hearth of rounded form, and the shortened, spliced drill are for convenience of carrying, this kind being used by hunters while away from the lodges. Mr. S. J. Hare says that the men do not usually make the fire, except when out on a hunting excursion. At the lodge it is the squaw's duty to make the fire when it is needed.

The Pai-Ute is rarely at a loss to get fire; he is master of various devices. Mr. Hare, who was among the Utes for some time, states that when the Indian is in need of a light he uses either the flint and steel, the drill, or, if these are not at hand, he takes two branches, and rubs one up and down on the other, soon getting fire. The Australians are said to have practiced fire-making by rubbing in the way mentioned. This is the only observation collected of its occurrence in America. It is, in all probability, a difficult, unusual way; only practiced under pressure of necessity among the Utes. They take great



Fig. 8.

FIRE-MAKING SET.

(Cat. No. 11976, U. S. N. M., Pai-Ute Indians, Southern Utah. Collected by Maj. J. W. Powell.)

Fig. 9.

FIRE-MAKING SET.

(Cat. No. 29022, U. S. N. M. Shoshone Indians, Wind River, Wyoming. Collected by Maj. J. W. Powell.)

pride in their skill; to be a quick fire-maker is to achieve fame in the tribe. They are fond of exhibiting their art to white travelers in the hope of gain.

Another form of hearth (fig. 8.) is made of yucca flower stalk, like those of the Apache and Navajos. The drill is of tule reed, set with a very hard wood head. It is suggested that the reason for splicing the drill is that the hard wood of the kind used for the head (grease-wood) can not be procured in pieces long enough to make the whole drill. This set is apparently one used as a fixture in the Ute domestic economy, the squaws having to light the fire. The duty is mainly relegated to the females in several other Indian tribes, and among the Eskimo. Mr. Catlin says that the Sioux objected to letting the squaws have their portraits painted, saying that their women had never taken scalps, nor done anything better than make fires and dress skins.* The hearth and drill last figured are respectively 20 and 23 inches long, while in the hunting set (fig. 8) the length is 7 and 18 inches.

The Wind River Shoshones are also represented (fig. 9). The hearth is of hard wood, rudely hacked out, and rounded. Upon the slanting edge are eight holes, or shallow depressions, prepared for the drill, with notches cut in to meet them from the sides. The drill is a willow branch, 25 inches long, with a hard wood head mortised in, and served with buckskin. It is most probable that sand was used with this set, because, if the parts are not models, it would be necessary to use it on sticks of equal hardness like these. I am inclined to believe that they are models, from their appearance, and from the difficulty of setting up a pyrogenic friction upon them even with sand. They were collected some fifteen years ago by Maj. J. W. Powell.

The Mokis are the most differentiated members of the Shoshonian stock. Mrs. T. E. Stevenson collected the two excellent fire-making sets in the Museum from the Moki Pueblos. The hearth is a branch of the very best quality of soft wood. In one hearth an end has been broken off, but there still remain eighteen fire-holes, showing that it was in use for a long time and highly prized (fig. 10). The drill is a roughly dressed branch of hard wood. It is comparatively easy to make fire on this apparatus. In the set numbered 126,694 these conditions are reversed; the hearth is tolerably hard wood and the drill soft wood.

The Moki fire-tools are used now principally in the estufas to light the sacred fire and the new fire as do the Zuñis, and the Aztecs of Mexico did hundreds of years ago. They use tinder of fungus or dried grass rubbed between the hands.

By their language the Zuñi people belong to a distinct stock of Indians. Their fire-sticks are of the agave stalk, a soft, pithy wood with harder longitudinal fibers, rendering it a good medium for the purpose of making fire.

*Smithsonian Report. 1885. Pt. ii, p. 723.

As to the plan pursued in grinding out fire, Col. James Stevenson informed the writer that they make a slightly concave place where the burnt holes are seen, cut the notch on the side, sprinkle a little fine sand on the concavity, set the end of the round stick on the sand and roll it rapidly between the palms of the hands, pressing down hard. The "sawdust," Colonel Stevenson called it, oozes out of the notch and forms a small mass, which on blowing slightly becomes a burning coal, and the application of a little tinder creates a blaze. For preserving the fire for any length of time they use a piece of decayed wood. (Figs. 11 and 12.)

Viewed in another aspect than as an implement of necessary or common use, this set is an important cult apparatus in the wonderfully complicated religious worship of the Zuñis. These people make the sacred fire that burns always in their estufas by friction of wood that has been wet. New fire is made at the beginning of their new year with great ceremony. The house is swept and everything is moved out of it until the fire is made. Their regard for fire and their customs with reference to it add

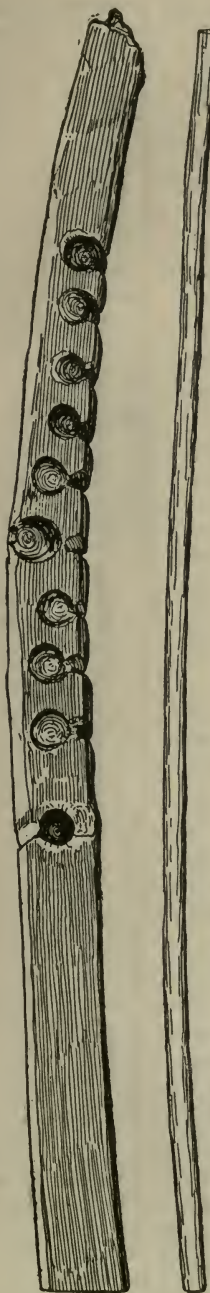


Fig. 10.

FIRE-MAKING SET.

(Cat. No. 126694, U. S. N. M., Moki Indians, Arizona. Collected by Mrs. T. E. Stevenson.)



Figs. 11 and 12.

FIRE-MAKING SET AND SLOW MATCH.

(Cat. Nos. 127708 and 69850, U. S. N. M., Zuñi Indians, New Mexico. Collected by James Stevenson.)

them to the list of peoples who have held it in similar reverence and have practiced similar customs all over the world, ranging widely in time. The wetting of the drill, increasing their labor, may be done to please their Gods.

This art must have been practiced for a long time in this region, for Mr. Henry Metcalf found a hearth (Fig. 13) with three fire-holes in a cave-dwelling at Silver City, New Mexico. It is apparently very ancient. The wood is much altered and has become heavy by impregnation with some salt, probably niter.

The Apaches and Navajos belong to the great Athapascan stock, that ranges so widely in North America. Capt. John G. Bourke, U. S. Army, collected the hearth of yucca wood shown (Fig. 14), and says:

With the stick you now see, the Apache Indians in my presence made fire in not quite eight seconds by the watch, and one asserted that he could make it in a number of motions, which, on the watch, occupied exactly two seconds, that is, under most favorable circumstances. The experiments, made under my own observation, ran all the way from eight to forty-seven seconds; sand is generally used, although not essential to success.

Captain Bourke's observation is very interesting, as it records the fact that the Apache is the most skillful fire-maker in the world. Many other tribes can make fire in less than a minute; I think by far the majority of them, but there is no eight-second record, while if he could prove his ability to do it in two seconds he would arrive at the facility of striking a match.

Mr. William F. Corbusier has noticed the fire-making of the Apache-Yumas of Arizona (Yuman stock).* They use a drill about 2 feet long and one-half inch thick, made of *o-oh-kad-je*, or "Fire-stick bush." Its end is dipped in sand and drilled on a soft piece of agave or yucca stalk held down by the feet. They carry a slow torch of dead wood (spunk)



Fig. 13.

LOWER STICK OF FIRE-
MAKING SET.

(Cat. No. 35268, U. S. N. M.
From a cave at Silver City,
New Mexico. Collected by
Henry Metcalf.)



Fig. 14.

LOWER PIECE OF FIRE-
MAKING SET.

(Cat. No. 130673, U. S. N. M.
Apache Indians, Arizona,
collected by Capt. John G.
Bourke, U. S. A.)

*American Antiquarian, Mendon, Ill.,
nois, September, 1886, VIII, p. 283.

and also use a flint and steel. For tinder they use dry grass or bark fiber. They use also a fungus, *polyporus* sp., for the same purpose.

Another reference to the fire making of this stock (Yuman) is found in the translation by the late Dr. Charles Rau of the writings of Father Baegert on the Californian Peninsula.* He says:

To light a fire, the Californian makes no use of steel and flint, but obtains it by the friction of two pieces of wood. One of them is cylindrical and pointed at one end, which fits into a round cavity in the other, and by turning the cylindrical piece with great rapidity between their hands, like a twirling-stick, they succeed in igniting the lower piece if they continue the process for a sufficient length of time.

The Navajo fire-set looks very much like a mere makeshift. The hearth is a piece of yucca stalk and the fire-holes have but a shallow side notch. The drill is a broken arrow shaft, to which has been rudely lashed with a cotton rag a smaller piece of yucca wood (fig. 15). This carelessness, which it is rather than lack of skill, is characteristic of the Navajos in their minor implements. They resemble the crude Apache in this. One thinks of the Navajos only with regard to their fine blanket weaving and silver working, so well presented by Dr. Washington Matthews in the reports of the Bureau of Ethnology, and does not consider their arts in other lines.†

Mr. Thomas C. Battey, a Friend, long missionary among the Indians, kindly gives a description of the Kiowan fire-making process, not now practiced among them, but shown to him as a relic of an abandoned art:

A piece of very hard and coarse, rough-grained wood, perhaps 8 inches in length, 2 in width, and three-fourths of an inch in thickness is procured. In one side of this and near one edge several holes are made, about one-half an inch in diameter by five-eighths of an inch in depth, rounded at the bottom, but left somewhat rough or very slightly corrugated. In the edge nearest these holes a corresponding number of smaller and tapering holes are made, opening by a small orifice into the bottom of each of the larger ones. These are made very smooth.

A straight stick, also of hard, rough-grained wood, about 8 or 10 inches in length, about the size they usually make their

*Smithsonian Report. 1865. p. 367.

†Dr. Matthews's mountain chaff of the Navajos, in the fifth annual report (1883-'84) of the Bureau of Ethnology, gives some very striking ceremonial uses of fire. No ethnologist should fail to read this important contribution to science,



Fig. 15.
FIRE-MAKING SET.

(Cat. No. 9555, U. S. N. M. Navajo Indians, New Mexico. Collected by Edward Palmer.)



Fig. 16.

FIRE-MAKING SET.

(Cat. No. 15396. U. S. N. M. Natives of Talamanca, Costa Rica. Collected by Prof. W. M. Gabb.)

arrows or larger, is provided. Both ends of this are rounded, but one end is made smooth, the other is left slightly rough. The dried pith of some kind of reed, or more probably of the yucca, some fibers of the same loosely prepared like hackled flax, some powdered charcoal, I think formed by charring the yucca, and a piece of hard thick leather similar to sole leather, completes the outfit, which is carried in a leather bag made for the purpose. The first described piece of wood is placed upon the knees of the operator with a quantity of the fibrous substance beneath it which has been powdered with charcoal dust; some of the latter is put into one of the holes and the rough end of the stick inserted, the other end is put into an indentation of the leather placed under the chin, so that a gentle pressure may be exerted. The spindle is then rapidly revolved by rolling it one way and the other between the hands. The friction thus produced by the rubbing of the roughened surfaces ignites the fine coal dust, which, dropping as sparks of fire through the orifice at the bottom of the hole, falls into the dry fibrous preparation, thus igniting that, then by the breath blowing upon it a flame is produced and communicated to some fine dry wood and a fire is soon obtained. The whole operation occupies but a few minutes.

One of the rudest fire-making appliances in the Museum was collected by Prof. W. M. Gabb, at Talamanca, Costa Rica. The hearth is a rude billet of charred, black wood, resembling mahogany. It has central holes, with no gutter usually, though sometimes a shallow notch is cut on both sides of the fire-hole. The drill is a light branch, rather crooked, but dressed down roughly with a knife. Another hearth is of partly decayed, worm-eaten wood; with this a hard wood drill can be used, the hearth wasting away instead of the drill (fig. 16.) The absence of any fire slot, that is, the use of the central fire-hole, is worthy of notice in this locality. I have only observed its use in various parts of the Eskimo area, from East Greenland to Kadiak; outside of this range I have not noticed it anywhere else among the present tribes of the world. From de-

scriptions given it seems to have been practiced by the Caranchua Indians, a recently extinct tribe in Texas and Mexico. (See below.)

These specimens from Costa Rica are the crudest fire tools, not to be mere make-shifts, that have come to my notice or have been described in the literature examined. The Costa Rican Indians are very interesting in their preservation of several other arts that may justly be classed among the most ancient. One may be mentioned, that of bark cloth making. Professor Gabb made quite a collection from Talamanca, but has not left any notes on these remarkable people, who are well worthy of the careful study of ethnologists.

A curious modification of this central hole plan is figured and described in Oviedo, folio 90, as occurring in Hispaniola; that is, the West Indies, Hayti, San Domingo, etc. He says that "two dry light sticks of brown wood were tied firmly together, and the point of the drill of a particular hard wood was inserted between the two and then worked." Mr. H. Ling Roth* thinks that if one can judge from the illustration (which is a miserable one) in Benzoni's work, the natives of Nicaragua also used three sticks in making fire. Benzoni, however, says: †

All over India they light fire with two pieces of wood; although they had a great deal of wax, they knew no use for it, and produced light from pieces of wild pine wood.

From Oviedo's description I am inclined to believe that the dust in which the fire starts was allowed to fall below on tinder placed beneath the hearth.

Through the kindness of Prof. F. W. Putnam, curator of the Peabody Museum, at Cambridge, Mass., I have received an extract from a manuscript written by Mrs. Alice W. Oliver, of Lynn, who, as a girl, in 1838 resided on Matagorda Bay, and learned the language and customs of the Caranchua Indians, a separate stock, now thought to be extinct.

Mrs. Oliver says:

After the hut is built a fire is made, the squaws usually begging fire or matches from the settlers, but, in case their fire is out and they have no other means of kindling it, they resort to the primitive method of producing it by friction of wood. They always carry their fire-sticks with them, keeping them carefully wrapped in several layers of skins tied up with thongs and made into a neat package; they are thus kept very dry, and as soon as the occasion for their use is over, they are immediately wrapped up again and laid away.

These sticks are two in number. One of them is held across the knees as they squat on the ground, and is about two feet long, made of a close-grained, brownish-yellow wood (perhaps pecan), half round in section; the flat face, which is held upward, is about an inch across. Three cylindrical holes about half an inch in diameter and of equal depth, the bottoms slightly concave, are made in it. The three holes are equally distant apart, about 2 inches, and the first one is the same distance from the end of the stick, which rests upon the right knee. In one of the holes is inserted the slightly-rounded end of a twirling stick made of a white, softer kind of wood, somewhat less than the diameter of the hole, so as to turn easily, and about 18 inches long.

* The Aborigines of Hispaniola. J. Authrop., *Inst. Gt. Britain and Ireland*, xvi, p. 282.

† G. Benzoni.—*History of the New World*. Hakluyt Society, xxi, p. 151.

Holding the twirler vertically between the palms of the hands, a gentle but rapid alternating rotary motion is imparted. After continuing this for about five minutes the abrasion of the softer wood causes a fine, impalpable dust to collect in the hole, from which soon issues a thin, blue line of smoke.

As soon as the Indian sees this he quickly withdraws his twirler with one hand, while with the other he catches up and crushes a few dry leaves previously placed on a dry cloth close by (having been produced from thin wrappings, in which they have been preserved for this very purpose, to serve as tinder), and quickly but lightly sprinkles them in and around the hole, over which both hands are now held protectingly, the head bent down, and the incipient fire fanned to a blaze with the breath. As soon as the blaze has fairly caught, the stick and tinder are deftly turned over upon a little pile of dry twigs and leaves, got ready beforehand, and the fire is started.

This operation of getting fire is always performed by the men, and not by the squaws. The fire is invariably built in the center of the hut, upon the ground, and, is usually kept burning, for the Indians never slept regularly, but whenever they pleased, often asleep in the day time and awake nights, or *vice versa*, as they felt inclined.

The Iroquois are unique in America, and perhaps in the world, in making fire with the pump-drill. Several other tribes in America use the pump drill to pierce stone and shell, for which purpose it is an excellent tool, but the mechanical difficulties lying in the way of making fire with it have only been overcome by the Iroquois. Pump-drills are intended for light, fine work, with uniform, light pressure; hence, with little friction. The Iroquois have added this element by increasing the size of the balance-wheel and stock. Mr. Morgan, in his "League of the Iroquois," p. 381, figures a fire drill with a wooden stock 4 feet long and 1 inch in diameter. This stock has at the upper end a string and bow, while near the lower end is a "small wheel." Mr. Morgan says this is "an Indian invention of great antiquity."

Mr. J. N. B. Hewitt, of the Bureau of Ethnology, has kindly given the writer a set of apparatus and valuable information with reference to fire-making among the Iroquois, especially the Onondagas and Tuscaroras. He states that at times when there is disease among the people they say it is because the fire is "old." They then determine to make "new fire," so all fires are put out and two slippery-elm logs are selected and one of these is laid on the ground and a V-shaped notch is cut on the upper side. In this notch some tinder of dry slippery-elm is put and three (mystic or sacred number) men at either end work the other log backward and forward until fire is generated, and from this the fires are lighted. He believes that the new fire is made at the winter feast of the Iroquois. They say that the drill with the weight is their own invention. They use elm for that also. In making the pump-drill they sometimes cut an elm sapling and work out the drill, leaving the tap root for the fore part, the knot for the weight, and part of the stem for the top part of the drill.

It is not improbable that the Iroquois — the most advanced Indians in some respects on the continent, invented this use of the widely diffused pump-drill. It scarcely seems to be a practical way to make fire,

and, despite the assurances and belief of the Iroquois, is not very ancient, but was perhaps suggested by the white man. Indeed, Pere Lafitau, that keen and careful observer, in his "Moeurs des Sauvages Ameriquains," written in 1724, on page 242, gives a description of Indian fire-making that includes the Iroquois. He says:

The Hurons, the Iroquois, and the other peoples of North America do not make fire from the veins of flint, but rub two pieces of wood one against the other.

Then follows a description of fire-making, taken probably from the Iroquois, that is as good an account of the Indian apparatus and the way of working it as exists in the literature of the subject.

The drill was sufficient for its time for the reason that there was at that period rarely necessity for generating fire; the art of fire preservation was at its height.

The Cherokees, the most southerly of the Iroquois, Mr. James Mooney states, kept fire buried in the mounds upon which the council houses were built, so that if the house was destroyed by enemies the fire would remain there for a year or so. The Cherokees use the simple rotation apparatus, and, as far as Mr. Mooney can ascertain, never used the pump-drill. They have a tradition that fire originally came out of an old hollow sycamore tree (*Platanus occidentalis*).

Capt. John Smith tells how the Indians of Virginia made fire. He says:

Their fire they kindled presently by chafing a dry pointed sticke in a hole of a little square piece of wood, that firing itself, will so fire mosse, leaves, or anie such like drie thing that will quickly burn.*

Writing in the first quarter of the next century, Beverley says:

They rubbed Fire out of particular sorts of Wood (as the Ancients did out of the Ivy and Bays) by turning the end of a Piece that is soft and dry, like a Spindle on its Inke, by which it heats and at length burns; to this they put sometimes also rotten Wood and dry leaves to hasten the Work. †

Loskiel says of the Delawares:

Formerly they kindled fire by turning or twirling a dry stick, with great swiftness on a dry board, using both hands. ‡

The Cherokees used for a drill the stalk of a composite plant (*senecio*), and twirled it on a piece of wood. The art has long been out of common use, but they employed the wooden drill to make fire for the Green Corn Dance into the present century, though flint and steel was then in vogue. Sometimes they passed the bow over drill. The tinder was of a fungus or dried moss. Mr. James Mooney collected this information from some of the older men of the tribe in North Carolina, who have retained the ancient customs and traditions, which the part of the tribe removed to the West has entirely lost.

The Creeks (Muskogean stock) had a regularly authorized fire-maker, who early in the morning made fire for the Green Corn Dance. The

* Smith.—The Natural Inhabitants of Virginia. English Scholars' Library. No. 16, p. 68.

† Beverley.—History of Virginia. 1722. 197, 198.

‡ Loskiel.—History of the Mission of the United Brethren. London, 1794. p. 54.

apparatus that he made use of was four sticks placed end to end to form a square cross. This was oriented, and at the junction of the sticks new fire was made by friction.*

The Choctaws (also Muskogean) of Mississippi, Mr. M. F. Berry writes, make fire in the following way: One stick of dry wood that has a hole in it, with a smaller hole at the bottom going through, is placed between the feet. Another piece made round and about 3 feet long is made to revolve rapidly back and forth between the hands in the hole, and the fire drops through the small hole below. When new fire was wanted for the Green Corn Dance, or other purposes, three men would place themselves so that each in turn could keep the stick revolving without a stop, until fire would drop down through the hole, which was nursed with dry material into a flame.

This form of the fire hearth is not represented in the collections of the Museum; the only other description of a process closely like it was given by Mr. Thomas C. Battey, who observed it among the Kiowas. It was shown him at that time as a revival of the ancient method (p. 543). The pierced fire hearth is somewhat impracticable, except in the Malay sawing method. In the rotary drill the small hole would come over the axis of least friction and heat. Unless provision was made for the dust to fall freely underneath by a double cone perforation worked from both sides the dust is likely to become obstructed and smother the fire. It will be seen, too, that it departs very much from the simplicity of the usual fire drill in the fact that a hole must be made through the piece of wood, a matter of some difficulty before the introduction of iron awls.

The Seminoles of Florida, the most Southern Muskoki, have neglected the art of fire making by simple friction, unless at the starting of the sacred fire for the Green Corn Dance, says Mr. Clay MacCauley.† A fire is now kindled either by the common matches, *ma-tei*, or by steel and flint.

Thus it is seen that wherever in the earlier period of the exploration in this country the observation has been made, the Indian, almost without exception, was found to be using the friction apparatus, consisting of two sticks of wood. Some tribes had improved on the working of the invention, while a very few others had perhaps arrived at the use of the higher invention of the flint and pyrites.

Returning to the tribes of the wide central plains of our country, we find that the flint and steel soon displaced the fire-sticks, except for religious purposes. The Mandans, of the great Sionan stock, were using flint and steel at the time of Mr. Catlin's visit in 1832.‡

There seems to be a great misapprehension among some of the writers

* Benj. Hawkins' Sketch of the Creek Country. 1798-'99. 68-72, cited in Pickett's History of Alabama. I, p. 108.

† Fifth Annual Report of the Bureau of Ethnology. 1883-'84, p. 518.

‡ The George Catlin Indian Gallery. Smithsonian Report. 1885. II, p. 456.

on ethnology, as to the general use of the bow-drill among the Indians. In mentioning that the Sioux use the bow-drill, Schoolcraft is quoted as authority. As a matter of fact the reference is to a "made-up" figure of a bow-drill set, marked "Dacota." On the same plate there is a representation of an Iroquois pump-drill that is obviously wrong. The lower part of the plate is taken up by a picture of an Indian woman (presumably Californian) pounding acorns in a mortar. To complete the absurdity the whole plate is entitled "Methods of obtaining fire by percussion," and is placed in the text of a *questionnaire* on the Californian Indians, opposite a description of the Californian way of making fire by twirling two sticks.*

Mr. Schoolcraft is not to blame for this state of affairs; in those days illustrations were not ethnological, they were "padding" gotten up by the artist. Nowhere in his great work does Mr. Schoolcraft describe either the Dacota or Iroquois drill. Among the northern Indians in central and northern Canada, however, the bow is used.

Sir Daniel Wilson, in his work on Prehistoric Man, notes that the Red Indians of Canada use the drill bow. In August, 1888, at the meeting of the American association, at Toronto, he gave an account of the facility with which these Indians make fire. He said that at Nipissing, on the north shore of Lake Superior, while he was traveling in a pouring rain, and not having the means wherewith to light a fire, an Indian volunteered to light one. He searched around for a pine knot and for tinder, rubbed up the soft inner bark of the birch between the hands, got a stick from a sheltered place, made a socket in the knot and another piece of wood for a rest for the drill, tied a thong to a piece of a branch for a bow. He put the tinder in the hole and rested his breast on the drill and revolved it with the bow and quickly made fire.

It is perhaps true that some of the Dacotas did use the bow at times, but it is not correct to place it as the customary tool of the whole stock. On the contrary, there is evidence that they used the simple means. Dr. J. Owen Dorsey writes:

I was told in 1879 by the late Joseph La Flèche, that the Omahas, prior to the advent of the white men, made fire by using pieces of the "du-à-du-à-hi," a grass (?) that grows in the Sand Hill region of Nebraska, near the sources of the Elkhorn River. One piece was placed horizontally on the ground, and a slight notch was cut at one end, wherein a few grains of sand were put. The other stick was held between the palms of the hands, with one end in the notch of the horizontal stick, and then rolled first in one direction then in the other till fire was produced. A fresh notch was made in the first stick whenever the old one became useless, and so on until it became necessary to procure a new stick.

In the Green Corn Dance of the Minitaries, another Siouan tribe, the "corn is boiled on the fire, which is then put out by removing it with the ashes and burying them. New fire is made by desperate and painful exertion, by three men seated on the ground facing each other and violently drilling the end of a stick into a hard block of wood by roll-

* Schoolcraft.—Indian Tribes. 1851-60. III, Pl. 28.

ing it between the hands, each one catching it in turn from the others without allowing the motion to stop until smoke, and at last a spark of fire is seen and caught in a piece of spunk, when there is great rejoicing in the crowd.* The desperate exertion was not necessary, except in imitation of the Zuñi fashion of wetting the drill to create sacred fire.

It will be seen from these references given that the Sioux used the customary Indian method. Later, they may have used the bow to expedite the drill when the wood was intractable. The bow may have been borrowed from more northern tribes, the Algonquians are said to use it;† Mr. Thomas C. Battey says that the Sac-Fox Indians (Algonquian stock) used a soft wood drill and a hard wood hearth. "The drill was worked by a bow and the fire caught on the end of the drill and touched to tinder."

Throughout South America the art of fire-making with two sticks of wood is found to be as thoroughly diffused as it is in North America. Many of the tribes still use it; we may say that in all tribes the use of flint and steel was preceded by that of the sticks of wood.

The Guanchos, a mixed tribe of herders on the Pampas of Venezuela, practice a peculiar way of fire-getting. They select a pliant rod, place one end against the breast and the other against the block forming the hearth, *held on a line with the breast*. By pressing against the rod it is bent and turned rapidly around like an auger. This impracticable and no doubt very local method is described by Prof. E. B. Tylor.‡

In Brazil, in the Province of Goyaz, the Chavantes, Cayapós, and Angaytés, use the simple fire drill.§ The Angaytés drill figured looks somewhat like that of the Mokis. It is usually 28^{cm.} long for the hearth, and for the drill 20^{cm.} They use the throat skin of the Nandu, *Rhea Americana*, for a tinder sack. The Lenguas of the same province use a strike-a-light consisting of a tinder horn, flint, and steel, which is also figured in the cited report. This set is very interesting, because from it we can say with certainty where the Lengua got it. The steel is the English "flourish," and the flint is the oval, old English shape, probably broken somewhat by blows. The Lenguas, being on the line of travel, have adopted the method from English traders. In Rio Janeiro the Indians had an angular recess at the back of their snuff mills for the purpose of making fire by friction.||

The Ainos of Japan formerly used fire-sticks, and are said even yet to resort to this method when they have no other means of getting fire. They use also flint and steel, adopted from the Japanese. A specimen (No. 22257) is figured and described on page 583 of this paper. The fire-

* Smithsonian Report. 1885. II, p. 315.

† Sir Daniel Wilson.—Prehistoric Man. II, p. 375.

‡ Darwin.—Narrative of the voyage of the Beagle. III, p. 458. Cited in Early History of Mankind. p. 241.

§ Dr. Emil Hassler.—In Jahrbuch Mittelschweiz. Commercial. Gesellsch. Arau, Zweiter Band. 1888. 114, 115.

|| Harper's Monthly Magazine. Nov. 1853. VII, p. 745.

sticks of the Ainos of Yezo (No. 129970, fig. 17) were loaned to the Museum by Prof. F. W. Putnam, who also secured the following letter of Mr. D. P. Penhallow, who collected the sticks:

At our request the chief brought several fire-sticks to my house, together with the necessary number of men to get fire in the approved style. Upon examination the sticks were found to be from 6 to 9 inches long, and very dry. Our informant stated that they were from the root of the elm *Ulmus campestris*, var. *lavis*, and that it was customary to keep a supply ahead, as the sticks require to be seasoned for about one year, by hanging them from the rafters of the house above the fire. To prepare them for the process of making fire, a shorter stick was cut flat on opposite sides, and about midway of one of the flattened sides a small hole was made with the point of the knife for the purpose of establishing the center of action. Another stick about 9 inches long was then well sharpened at one end. Three men now seated themselves in a circle, facing inward, with the flattened stick notched side uppermost in the center.

The point of the long stick was now placed in the notch, and with the stick in a vertical position and grasped between the extended palms of the hands, a steady and somewhat fast rotating pressure was brought to bear, exactly as in the use of the old-fashioned awl. As soon as the first man became weary, the second brought his hands to bear upon the upper end of the stick, and continued the motion without allowing it to cease. This was repeated as often as necessary until fire was obtained. Owing to the very dry character of the sticks used, the parts in contact rapidly wear away, so that the notch quickly becomes cup-shaped, and the pointed end is correspondingly rounded, while at the same time the powdery product is thrown out, forming a raised ring on all sides. Before long it is observed that the powder acquires a brownish tinge. This gradually deepens as the temperature rises until finally a delicate line of smoke warns the operator that the end is near.

The motion is now continued until the smoke is well established, when the vertical stick is raised, disclosing a spark on its end. The mouth is applied to the opposite extremity, and by means of a few vigorous pulls as if smoking a cigar, owing to the porous nature of the stick, the spark is drawn into a flame.

The actual operation as witnessed by us consumed about two hours, and the Ainos state that the process requires from one and one-half to two and one-half hours.

The sticks figured are the actual ones that were used in the operation above described.

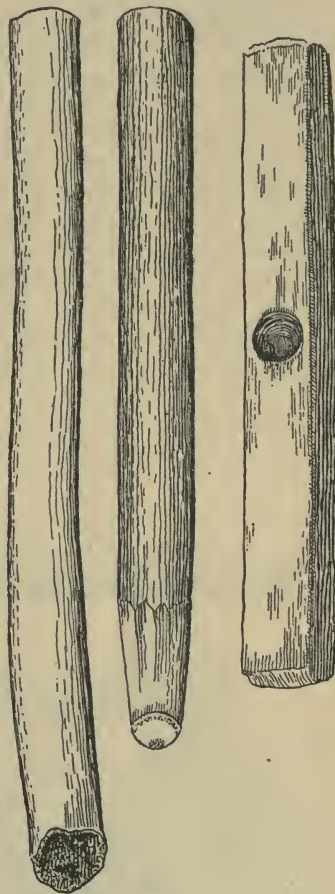


Fig. 17.

FIRE-MAKING SET WITH TOUCHWOOD.

(Cat. No. 129970, U. S. N. M. Ainos of Yezo, Japan. Collected by D. P. Penhallow. Lent by Peabody Museum, through Prof. F. W. Putnam.)

The Japanese formerly used the simple drill; a few are yet preserved in the temples. Under the name of "Sacred fire drill" it is described* as a board 1 foot wide, 1 foot 4 inches long, 1 inch thick, and with a step 1 inch wide or over on one edge. It has holes and grooves like the Eskimo hearth. The drill is a stick twirled between the hands. The parts are of the *hi-no-ki*, or fire tree, *Chamaecyparis obtusa*. The drill is called *hi-kiri-usu*, or fire drilling mortar. It was and perhaps is yet used for the purpose of drilling fire at the four corners of the temple inclosure to ward off the calamity of fire. They are said also to have used the *rokuro*, or pump-drill. It is interesting to note that the Japanese carpenter's drill with the iron point is rotated between the palms. They are still in use. The one figured is in the Tokio Museum.

Prof. Romyn Hitchcock has kindly allowed a drawing to be made of a photograph which he procured of a sacred fire drill preserved in the temple called Oyashiro, at Idzumo, Japan (fig. 18). The hearth of



Fig. 18.

SACRED FIRE DRILL.

From photograph of specimen in Tokio Museum. Lent by Romyn Hitchcock.

this set is made of *hi-no-ki* wood and the drill of the *Ut-su-gi*, *Deutzia scabra*.

Professor Hitchcock says:

The fire drill is used at the festivals of the Oyashiro to produce fire for use in cooking the food offered to the gods. Until the temple was examined officially in 1872, the head priest used it for preparing his private meals at all times. Since then it has been used only at festivals and in the head priest's house on the eve of festivals, when he purifies himself for their celebration in the *Imbidous*, or room for preparing holy fire, where he makes the fire and prepares the food.

The art of fire-making by sticks of wood by the method of rotation is, or has been, as far as we know, universal on the African continent as it was in the two Americas at the time of the discovery. There is not a clue as to how the ancient Egyptians generated fire.

The Somalis are a pastoral people of Arab extraction, inhabiting a large maritime country south of the Gulf of Aden. Their fire-sticks (fig. 19) are pieces of branches of brownish wood of equal texture, in fact the hearth has formerly been used as a drill, as may be seen by its regularly-formed and charred end. This is another proof that it is not necessary that the sticks should be of different degrees of hardness. The grain of the wood, that of the drill being against and the hearth

* Trans. Asiat. Soc. Japan. 1878, vi. Pt. II, p. 223.

with the grain, in effect accomplishes what the use of wood of different qualities results in. The hearth and drill are in the neighborhood of 12 inches long, the former with a diameter of three-eighths of an inch and the latter one-fourth of an inch. They were collected by Dr. Charles Pickering in 1843.

It is possible that the Somalis may have carried this method with them from Arabia. They conquered this coast, driving back the earlier tribes inhabiting the country in the early part of the fifteenth century. Long since that time, and even now, some Arab tribes practice the drilling of wooden sticks to produce fire.

In eastern equatorial Africa the Wataveita, says Mr. H. H. Johnston, generate fire in the common African way by rapidly drilling a hard-pointed stick into a small hole in a flat piece of wood. An interesting bit of custom comes out in connection with this art among the people. "It is the exclusive privilege of the men, and the secret is handed down from father to son, and never under any conditions (as they say) revealed to women." I asked



Fig. 19.

FIRE-MAKING SET.
(Cat. No. 129971, U. S. N. M. Somalis, E. Africa. Collected by Dr. Charles Pickering. Lent by Peabody Museum through Prof. F. W. Putnam.)



Fig. 20.

TAVEITA AFRICANS MAKING FIRE.

After H. H. Johnston. (See Jour. Soc. Arts, June 24, 1887.)

one man why that was. "Oh," he said, "if women knew how to make fire they would become our masters."* The figure (fig. 20) shows how this people of the great Bantu stock make fire; this tribe visited by Mr Johnston lives on the slopes of the beautiful Kilimanjaro Mountain.

* J. Anthropol. Inst. Great Britain and Ireland. 1885. xv, p. 10.

Mr. R. W. Felkin*, in a study of the Maidu or Moru negroes of Central Africa, 5° north latitude, 30° 20' east longitude, describes the fire-making of that tribe. He says that one piece of wood about the size and shape of a large pencil is rotated in a hole in a flat piece of hard wood. One man holds the wood steady whilst two others take it in turn to rotate the stick. This article of Mr. Felkin's is commended to ethnologists as a model ethnologic study in method and research.

That veteran and renowned explorer, Dr. Schweinfurth, gives the following:

The method of obtaining fire, practiced alike by the natives of the Nile lands and of the adjacent country in the Welle system, consists simply in rubbing together two hard sticks at right-angles to one another till a spark is emitted. The hard twigs of the *Anona senegalensis* are usually selected for the purpose. Underneath them is placed either a stone or something upon which a little pile of embers has been laid; the friction of the upper piece of wood wears a hole in the lower, and soon a spark is caught by the ashes and is fanned into a flame with dry grass, which is swung to and fro to cause a draught, the whole proceeding being a marvel which might well-nigh eclipse the magic of my lucifer matches.†

Kaffir fire-making is described in some detail in the following :

The Kaffir blacksmith never need trouble himself about the means of obtaining a fire. Should he set up his forge in the vicinity of a Kraal, the simplest plan is to send his assistant for a fire-brand from one of the huts. But if he should prefer, as is often the case, to work at some distance from the huts, he can procure fire with perfect certainty, though not without some labor. He first procures two sticks, one of them taken from a soft-wood tree and the other from an acacia or some other tree that furnishes a hard wood. Of course both sticks must be thoroughly dry, a condition about which there is little difficulty in so hot a climate. His next care is to shape one end of the hard stick into a point and to bore a small hole in the middle of the soft stick. He now squats down * * * places the pointed tip of the hard stick in the hole of the soft stick, and, taking the former between his hands, twirls it backwards and forwards with extreme rapidity. As he goes on the hole becomes enlarged and a small quantity of very fine dust falls into it, being rubbed away by the friction. Presently the dust is seen to darken in color, then to become nearly black, and presently a very slight smoke is seen to rise. The Kaffir now redoubles his efforts; he aids the effect of the revolving stick by his breath, and in a few more seconds the dust bursts into a flame. The exertion required by this operation is very severe, and by the time the fire manifests itself the producer is bathed in perspiration.

Usually two men at least take part in fire-making, and by dividing the labor very much shorten the process. It is evident that if the perpendicular stick be thus worked, the hands must gradually slide down until they reach the point. The solitary Kaffir would then be obliged to stop the stick, shift his hands to the top, and begin again, thus losing much valuable time. But when two Kaffirs unite in fire-making, one sits opposite the other, and as soon as he sees that his comrade's hands have nearly worked themselves down to the bottom of the stick he places his own hands on the top, continues the movement, and relieves his friend. Thus the movement of the stick is never checked for a moment, and the operation is consequently hastened. Moreover, considerable assistance is given by the second Kaffir keeping the dust properly arranged round the point of the stick and by taking the part of the bellows, so as to allow his comrade to expend all his strength in twirling.‡

* Proc. Royal Soc. Edinburgh. Session of 1883-'84. p. 309.

† Schweinfurth.—The Heart of Africa. New York, 1874. 1, 531, 532.

‡ J. G. Wood.—The Natural History of Man. 1, p. 101.

It is an anomaly that the African, to light the fire to smelt the iron out of which he forges his remarkable weapons, should use sticks of wood.

2. ESKIMO FOUR-PART APPARATUS.

The arts of the Eskimo yield more satisfactory results to students of comparative ethnology than those of any other people.

In all their range the culture is uniform; one finds this fact forced upon his observation who has examined the series of specimens in the National Museum, where they are arranged in order by localities from Labrador to southern Alaska. Prof. Otis T. Mason's paper on Eskimo throwing-sticks* gave a new interpretation to this fact and powerfully forwarded the study of ethnology by showing the classificatory value of the distribution of an art.

Professor Mason points out that though the Eskimo culture is uniform in general, in particular the arts show the modification wrought by surroundings and isolation—tribal individuality, it may be called—and admit of the arrangement of this people into a number of groups that have been subjected to these influences.

The Eskimo fire-making tools in the Museum admit of an ethnographic arrangement, but in this paper it is not found necessary to make a close study of this kind. From every locality whence the Museum possesses a complete typical set, it has been figured and described.

The Eskimo are not singular in using a four-part apparatus, but are singular in the method of using it. The mouth-piece is the peculiar feature that is found nowhere else.

The drilling and fire-making set consists of four parts, viz:

The mouth-piece,—sometimes a mere block of wood, ivory, or even the simple concave vertebra of a fish, or the astragalus of a caribou. More often, they show great skill and care in their workmanship, being carved with truth to resemble bear, seals, whales, and walrus. The seal is the most common subject. The upper part is almost always worked out into a block, forming a grip for the teeth. The extent to which some of these are chewed attests the power of the Eskimo jaw. Frequently the piece is intended to be held in the hand, or in both hands, hence it has no teeth grip. In the under part is set a piece of stone, in which is hollowed out a cup-shaped cavity to hold the head of the drill. These stones seem to be selected as much for their appearance as for their anti-friction qualities. They use beautifully-mottled stone, marble, obsidian, and ringed concretions.

The drill is always a short spindle, thicker than any other drill in the world. It is frequently of the same kind of wood as the hearth.

The thong is the usual accompaniment of the fire drill. It is rawhide of seal or other animals. The handles have a primitive appearance; they are nearly always made of bears' teeth, hollow bones, or

* Mason.—Throwing-sticks in the National Museum. Smithsonian Report. 1884. II, p. 279.

bits of wood. Sometimes handles are dispensed with. Mr. Warren K. Moorhead found some perforated teeth in an Ohio mound that in every respect resemble the Eskimo cord handles. They have also been found in caves in Europe decorated with concentric circles like those on the Eskimo specimens.

The bows are among the most striking specimens from this people. They are pared down with great waste from the tusks of the walrus, taking the graceful curve of the tusk. The Museum possesses one 24½ inches long. It is on their decoration that the Eskimo lavishes his utmost art. The bow does not lend itself well to sculpture, as does the mouth-piece; so he covers the smooth ivory with the most graphic and truthful engravings of scenes in the active hunting life in the Arctic, or he tallies on it the pictures of the reindeer, whales, seals, and other animals that he has killed.

Professor Baird was interested more with these bows than with any other Eskimo products, and desired to have them figured and studied.

The distribution of the bow is remarkable. It is not found south of Norton Sound, but extends north and east as far as the Eskimo range. The Chukchis use it,* but the Ostyaks use the ancient breast drill.†

The bow is used by individuals in boring holes. It is presumed that its use as a fire-making tool is secondary, the cord and handles being the older. The difficulty of making fire is greatly increased when one man attempts to make it with the compound drill; at the critical moment the dust will fail to ignite; besides, there is no need of one man making fire; a thing that is for the common good will be shared by all. Hence the cord with handles, which usually requires that two men should work at the drill, is as a rule used by the Eskimo.

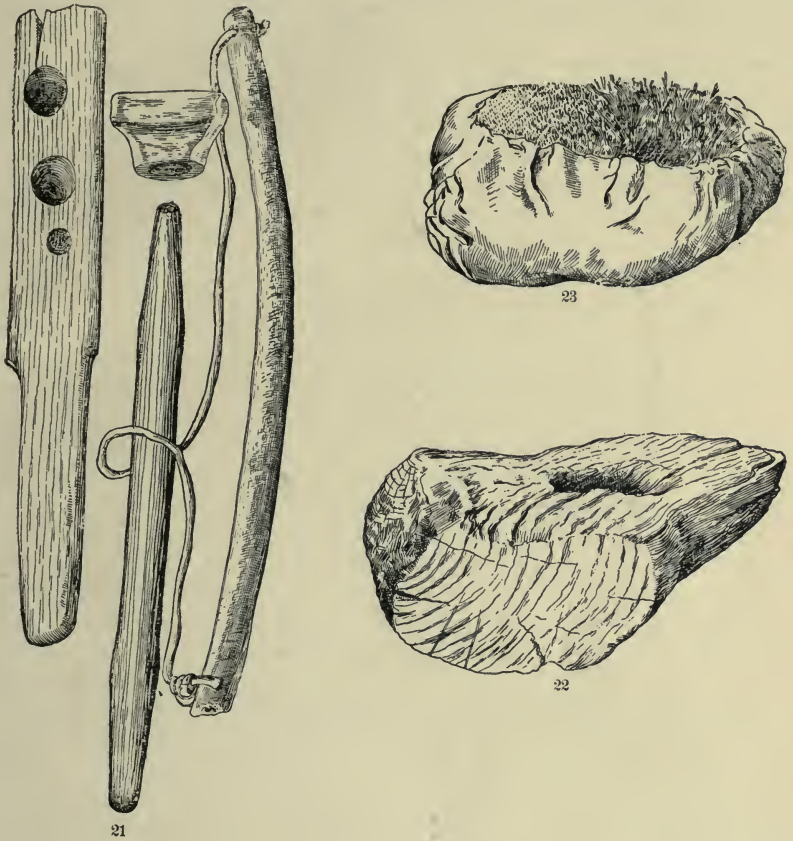
Though the Sioux, and some other North American tribes, made use of the bow to increase the speed of the drill, they did not use the thong with handles, nor was the bow common even in tribes of the Siouan stock that had attained to its use (see remarks p. 549). The bow may be termed a more advanced invention, allowing one man with ease to bore holes.

The hearth is made of any suitable wood. It is commonly stepped and has slots. The central hole with groove is also found. These hearths are preserved carefully, and fire has been made on some of them many times.

The distribution of the central-hole hearth (see fig. 21, pl. LXXIV), and the slot-and-step hearth (see fig. 36), is rather striking. The central holes are found in the specimens observed from the north coast of Alaska, Insular British America, and Greenland, exclusively. The stepped hearth with edge holes and slots is by far the more common in western Alaska, though the other method crops out occasionally; both ways are sometimes used in the same tribe. More often, the central holes are bored

* Nordenskiöld.—Voyage of the *Vega*. London, 1881. II, p. 121.

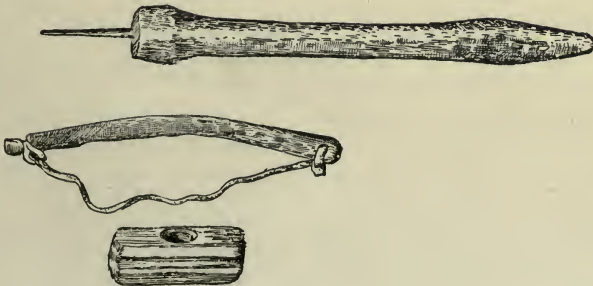
† Seebohm.—Siberia in Asia. p. 109.



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Figs. 21, 22. FIRE-MAKING SET AND EXTRA HEARTH. Cat. No. 10258, U. S. N. M. Frobisher Bay. Collected by Capt. C. F. Hall.

Fig. 23. MOSS IN A LEATHERN CASE. Cat. No. 10191, U. S. N. M. Collected by Capt. C. F. Hall.

Fig. 24. BORING-SET. Cat. No. 34114, U. S. N. M. Cumberland Gulf. Collected by L. Kumlein.

on a groove (fig. 34), which collects the ground-off particles and facilitates ignition. Rarely fire is made by working the drill on a plane surface, in single, non-connecting holes.

The difference between these features is, that it is found to be more difficult to get fire by a single hole without groove, or slot, than when the latter features are added. The powder forms a ring around the edge of the hole, is liable to be dispersed, and does not get together in sufficient amount to reach the requisite heat for ignition. Of course this is obviated when a second hole is bored connecting with the first, when the latter becomes a receptacle for the powder.

It is found that these different ways are due to environmental modification, showing itself as remarkably in fire-making, as in any other Eskimo art. Both the stepped and central-hole hearth are different devices for the same end. The step on the hearth is to keep the pellet of glowing powder from falling off into the snow, so universal in Eskimo-land; hence, the simple hearth of primitive times and peoples of warmer climates has received this addition. The same reason caused the Eskimo to bore the holes in the middle of the block.

By following the distribution of the center hole method, a clew may perhaps be gotten to the migrations of the Eskimo.

From Labrador to Norton Sound, by the collections in the Museum, the center hole is alone used; south of Norton Sound both methods prevail, with a preponderance of the stepped-hearth species. The step seems to be an addition to the Indian hearth; the center is an independent invention.

The operation of the drill is well told in the oft-quoted description by Sir. E. Belcher. The writer can attest to the additional statement, that the teeth of civilized man can scarcely stand the shock. He says:

The thong of the drill bow being passed twice around the drill, the upper end is steadied by a mouth-piece of wood, having a piece of the same stone imbedded, with a counter-sunk cavity. This, held firmly between the teeth, directs the tool. Any workman would be astonished at the performance of this tool on ivory; but having once tried it myself, I found the jar or vibration on the jaws, head, and brain, quite enough to prevent my repeating it."*

The ethnographical study of the Eskimo fire-drill begins with Labrador, including Greenland and following the distribution of the people among the islands and around the North American coast to Kadiak Island and the Aleutian chain. The following is an interesting account from Labrador, showing what a man would do in the exigency:

He cut a stout stick from a neighboring larch, and taking out the leather thong with which his moccasins were tied, made a short bow and strung it. He then searched for a piece of dry wood, and having found it, cut it into shape, sharpened both ends, and twisted it once around the bowstring; he then took a bit of fungus from his pocket and put it into a little hole which he made in another dry piece of wood with the point of the knife. A third piece of dry wood was fashioned into a handle for his drill.†

* Trans. Ethnol. Soc. London, 1861. p. 140.

† Hind.—Labrador. I, p. 149.

Eskimo in other localities often use such make-shifts. Cup cavities are often observed in the handles of knives and other bone and ivory tools where they have used them for heads or the fire-drill.

Cumberland Gulf is the next locality to the northward. There are several specimens in the collection from this part of Baffin Land, procured by the famous explorer, Captain Hall, and the less known, but equally indefatigable Kumlein. The fire-making implements from Cumberland Gulf have a markedly different appearance from those of any other locality in the Eskimo area. They have a crude look, and there is a paucity of ornamentation unusual among this people. The drill bow is one of the things which the Eskimo usually decorates, but these bows have not even a scratch.

It can be inferred that in Baffin Land, more unfavorable conditions prevail than in southern Alaska. It must be this cause coupled with poor food supply, that have conspired to make them the most wretched of the Eskimo.

The hearth (fig. 21, pl. LXXIV) is of drift oak. It was collected at Frobisher Bay by Capt. Charles F. Hall. It has central holes, and appears to be very unfavorable wood for fire-making. The block hearth is also from Frobisher Bay (fig. 22, pl. LXXIV). It is an old piece of hemlock, with two central communicating holes. The mouth-piece is a block of ivory. Another mouth-piece is a bit of hard wood soaked in oil; it was used with a bone drill having an iron point. A very small, rude bow goes with this set (fig. 24).

Our knowledge of eastern Greenland has been very much increased

by the explorations of Holm and Garde, who reached a village on the east coast never before visited by a white man. Extensive collections were made, both of information and specimens. In reference to fire-making, Mr. Holm reports :

"They make fire by turning a hard stick, of which the socket end is dipped in train oil, very rapidly around by means of a sealskin thong with handles. This stick is fixed at one end into a head set

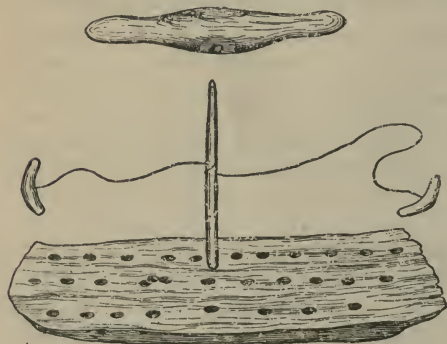


Fig 25.

FIRE-MAKING SET.

(Angmagsalik Eskimo, E. Greenland. Copied from G. Holm's *Ethnologisk af Angmagsalikerne*, 1887.)

with bone, and the other end is pressed down into a cavity on the lower piece of wood (fig. 25). Therefore there must be two persons in order to make a fire. One turns the drill with the cord, while the other presses it down on the hearth; both support the block with their feet. As soon as the dust begins to burn they fan it with the hand. When it is ignited, they take it and put it into dried moss (*sphagnum*), blow it, and soon get a blaze. In this way they make a fire in an incredibly short time."*

*Danish Umiak Expedition to Eastern Greenland, 1858. p. 28. Plate XIV contains the figure.

In the preliminary report, Mr. Holm gives the time at almost less than half a minute. It was made by the Eskimo, Illinguaki, and his wife, who, on being presented with a box of matches, gave up their drill, saying that they had no farther use for it.

In the same report Mr. Holm gives an interesting note. He says:

This fire apparatus is certainly better developed than that which has been described and drawn by Nordenskiöld from the Chukchis (Voy. of the *Vega*, II, p. 126). The principle is the same as the Greenlander's drill, which they employ for making holes in wood and bone, and which is furnished with a bow and mouth-piece.* (fig. 26.)

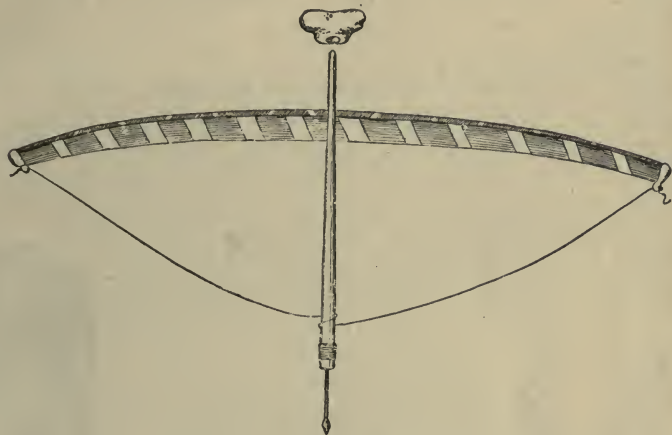


Fig. 26.
BORING SET.

(Aumagsalik Eskimo, E. Greenland. G. Holm's Ethnologisk of Anamagsalikkerne.)

The central holes of this hearth are worthy of note, occurring in the farthest eastern locality of the Eskimo, and in Labrador.

Western Greenland.—The material in the Museum from western Greenland is very scanty. The southern coast has been settled for so long a time that the Eskimo and many of their arts have almost become extinct. No view of fire-making in Greenland would be complete without Davis's quaint description of it, made three hundred years ago, but it was the upper end of the spindle that was wet in Trane. A Greenlander "begaune to kindle a fire in this manner: He tooke a piece of a boord wherein was a hole half thorow; into that hole he puts the end of a round sticke like unto a bedstaffe, wetting the end thereof in Trane, and in a fashion of a turner with a piece of lether, by his violent motion doeth very speedily produce fire."†

Eskimo graves and village sites yield evidence also that the fire-making tools were not different from those at present used higher north along the coast, and on the east coast.

* Danish Umiak Expedition. Preliminary Report, p. 208. This seems scarcely what would be inferred from the development of these inventions,

† Hakluyt Society. III, p. 104.

Dr. Bessels, speaking of Itah Eskimo of Foulke Fiord in Smith Sound, says: "The catkins of the arctic willow are used as tinder to catch the sparks produced by grinding two pieces of stone. Also the widely diffused 'fire-drill' is found here; the spindle is held between a piece of bone and a fragment of semi-decayed wood, and is set in motion by the well-known bow, and is turned until the wood begins to ignite."*

The "fire-bag" is an accompaniment to all sorts of fire-making apparatus. The fire bag shown (fig. 27, pl. LXXV) was collected by Captain Hall, at Holsteinberg, western Greenland in 1860. It is made of sealskin, and is a good specimen of the excellent needlework of these Eskimo. It was used to carry, more especially, the fire-drill and tinder which require to be kept very dry.

There is a wide gap in the collections of the Museum between the locality of the specimen just mentioned, and the fire hearth from the Mackenzie River (fig. 28). This specimen is from Fort Simpson presumably, where B. R. Ross collected. It is said to be difficult to discriminate the Eskimo from the Indian on the lower Mackenzie. This hearth may be Indian, as it has that appearance; besides, no Eskimo hearth yet observed has side holes and slots like this without the step. The Indians of this region are of the great Athapasean stock of the North. The close resemblance of this stick to the one from the Washoans of Nevada has been commented upon. (See fig. 6, p. 537.)

There is also a very fine old central-hole hearth from the Mackenzie River, collected also by Mr. Ross. It is a rough billet of branch wood, cut apparently with an axe, or hatchet (fig. 29). It is semi-decayed and worm-eaten. It has ten central holes where fire has been made; they are quite deep, forming a gutter in the middle of the hearth. There is, as can be seen, no need of a groove, as the dust falls over into the next hole, collects in a mass, and ignites.



Fig. 28.

LOWER PART OF
FIRE-MAKING SET
(on one end is gum
for cement).

(Cat. No. 1978, U. S. N. M.
Mackenzie River, B. C.
Collected by B. R. Ross.)



Fig. 29.

LOWER PART OF
FIRE-MAKING SET.

(Cat. No. 1963, U. S. N. M.
Eskimo of Mackenzie
River, B. C. Collected
by B. R. Ross.)

* Die amerikanische Nordpol-Expedition.
Leipzig. p. 358.

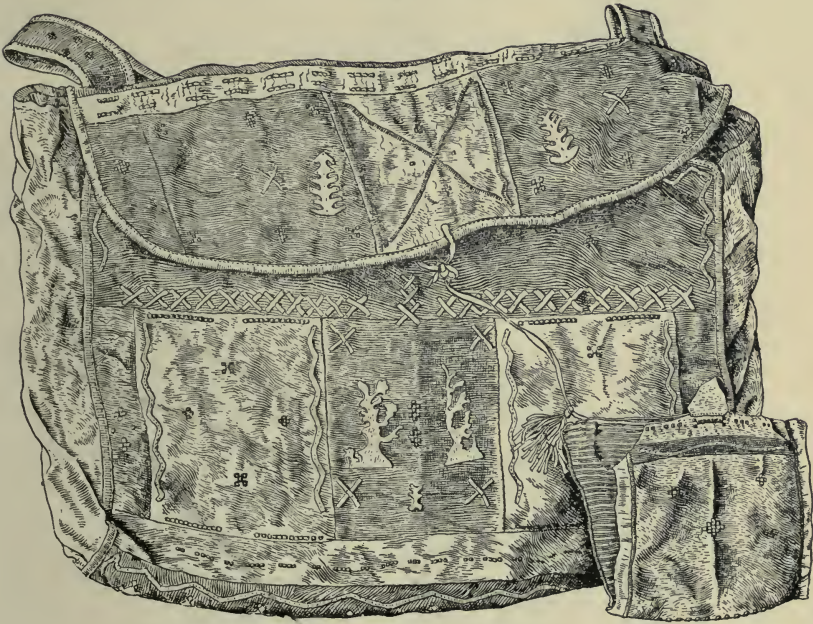


Fig. 27. FIRE-BAG. Cat. No. 10128, U. S. N. M. Eskimo of Holsteinberg, West Greenland. Collected by Capt. C. F. Hall.

The Anderson River set is a very complete and interesting outfit. It was collected many years ago by C. P. Gaudet. The parts are small for convenience of carrying. It is the custom of those who live in snow-covered regions to wrap the drill and hearth together very carefully to keep them dry, as these are the essential parts of the apparatus. It does not matter about the mouth-piece or bow. In this example there is a groove cut along the bottom of the hearth in order to facilitate tying the drill and hearth securely together. The hearth is a square block of soft wood with three central holes (fig. 30).

The other parts of this set are also worthy of consideration. The mouth-piece is set with a square piece of black stone. The part held in the mouth is very much chewed. One of the wings has a hole for tying, as has the hearth.

This is an usual Eskimo precaution to prevent small objects from being lost in the snow. The drill is short, being only 7 inches long. The bow is the fibula of a deer, pierced at each end for the frayed thong of sealskin. It has a primitive look, but it admirably serves its purpose.

The Point Barrow set was collected by the most successful expedition under charge of Lieut. P. H. Ray, U. S. Army. The knuckle-bone of a deer serves as a mouth-piece, the cup cavity and its general shape fitting it for the purpose admirably.

The drill is regularly made of light pine wood; it is slightly smaller in the middle. The hearth is a rudely rounded piece of pine. A fragment has been split off, and on this surface a groove has been cut and three fire-holes bored along it. The thong is without

H. Mis, 142, pt. 2—36

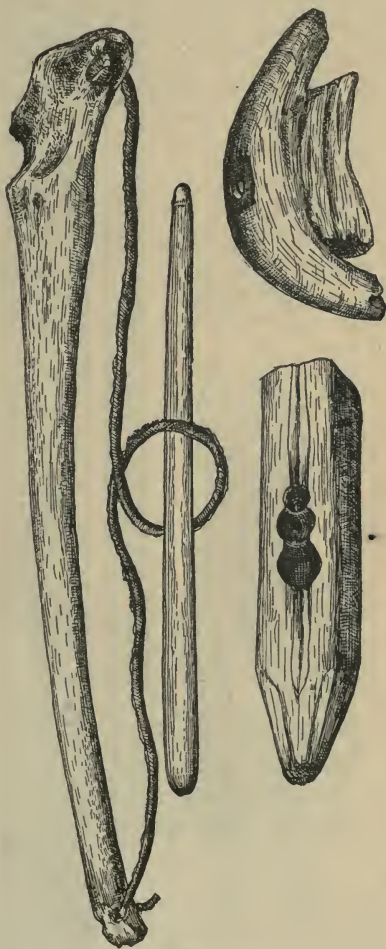


Fig 30.

FIRE-MAKING SET.

(Cat. No. 1327 U. S. N. M. Eskimo of Anderson River, B. C. Collected by C. P. Gaudet.)

use. A bunch of willow twigs, the down of which is used as tinder, is also shown (fig. 31).

This set is especially interesting, because it shows the degeneration of an art. The fire-drill is so rarely used at Point Barrow, Mr. John Murdoch says, that it was not possible to get a full set devoted to that purpose. Those here shown are a make-shift. The method only survives by the conservatism of a few old men of the tribe, who still cling to old usages. One of these made the drill for Lieutenant Ray, telling him that it was the kind used in old times. It seems primitive enough; the knuckle-bone might well have been the first mouth-piece. The Eskimo farther east sometimes use a fish vertebra for the same purpose; one from the Anderson River has this. The cord without handles is undoubtedly the earliest form also.

The small wooden and bone mouth-pieces of the Eskimo east of Point Barrow to Cumberland Gulf seem to be copies of the deer knuckle-bone. Another primitive adaptation is found in an Anderson River bow, which is made of the fibula of a deer (see fig. 30).

The fire-making drill collected from the Chukchis by the *Vega* expedition in the Cape Wankarem region, in northeastern Siberia, about the same latitude as Point Barrow, is figured in Nordenskiöld's Report.* It is worked by a bow, and the drill turns in a mouth-piece of a deer astragalus like the Point Barrow specimen. The block has central holes, with short grooves running into each one.

Nordenskiöld's description of the manner of making fire is very de-

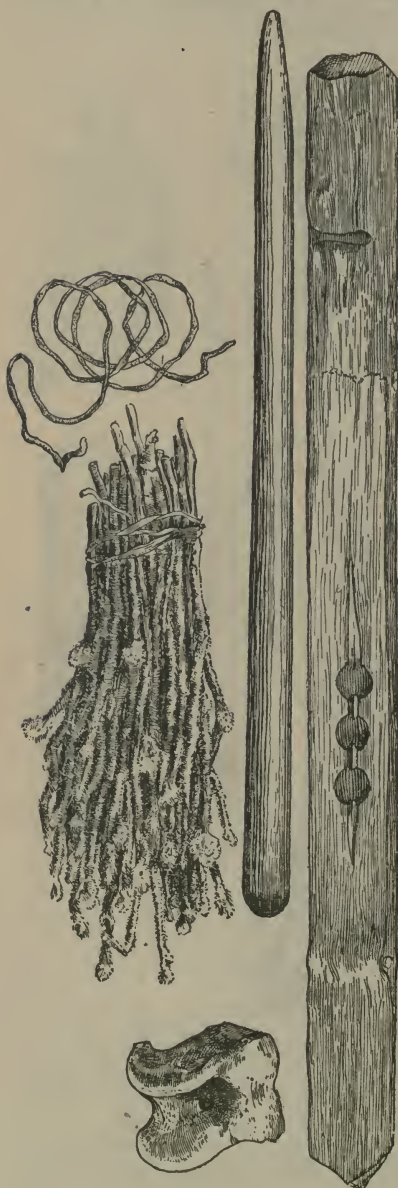


Fig. 31.

FIRE-MAKING SET (with mouthpiece of deer's knuckle-bone, thong, and tinder of willow catkins).

(Cat. No. 89822. U. S. N. M. Eskimo of Point Barrow, Alaska. Collected by Lieut. P. H. Ray, U. S. A.)

* Nordenskiöld.—Voyage of the *Vega*. London, 1881. II, 121, 122.

tailed. He records that the "women appear to be more accustomed than the men to the use of this implement."

He gives also a most interesting observation on the use of a weighted pump drill among the Chukchis. The Chukchis also use flint and steel.*

The drilling set from Point Barrow (pl. LXXVI, fig. 32), will show the appearance of the parts of the fire-drill if we substitute the round stick for the flint drill. Some of the old drill stocks are pointed with finely chipped flint heads. The length of these points varies from 2 to 4 inches; the transverse section of one would be a parabola. They are in general more finely wrought than any of the prehistoric drills found in various localities all over the world. Prehistoric man was an adept in the art of drilling stone, bone, and shell; the stone tubes, some of them 18 inches long, bored very truly, are triumphs of the American Indians. Without doubt the prehistoric drill points were mounted like the Eskimo specimen, and were, perhaps, twirled between the hands, the almost universal method of using the fire-drill. Japanese carpenters drill holes in this way.

The winged mouth-piece is also a good example of workmanship. It is set with a mottled, homogeneous stone that is tolerably soft, which gives a minimum friction. This stone is much affected by the tribes over quite an extent of coast for labrets, etc. It is probably an article of trade as are flints. The bow is of walrus tusk; accurately made, but poorly engraved in comparison with the life-like art work of the southern Eskimo.

Another drilling set is from Sledge Island (pl. LXXVII, fig. 33). The Museum has no fire-making specimen from this locality. The drill stock is set with a point of jadeite lashed in with sinew cord. The bow is of walrus ivory; it is rounded on the belly and flat on the back. All Eskimo bows of ivory have a like curve, no doubt determined by the shape of the walrus tusk. In another, the most common form of the bow, its section is nearly an isosceles triangle, one angle coming in the center of the belly of the bow. The head is intended to be held in one or both hands; it agrees in form with the rude St. Lawrence Island heads.

Mr. E. W. Nelson collected at Unalakleet, in Norton Sound, a fire-drill, and the native names of the parts. The name of the set is *öö-jöö-gū-tat*; the mouth-piece, *nā-ghöö-tuk*; the drill, *öö-jöö-ga-tuk*; the hearth of tinder-wood, *athl-uk*; the bow, *arshu-löw-shuk-pish-ik-sin-uk*.

This is a complete set (fig. 34) in first-rate order. The hearth has central holes along a deep median groove. Its bottom is flat, and it is rounded off on the sides and ends. All the parts are of pine wood, decorated in places with red paint. The drill is quite long, much longer than in any Eskimo set observed. It resembles more the Indian drill

* Nordenskiöld.—Voyage of the *Vega*. London, 1881. II, 120, 121.

for rubbing between the hands. The bow is of wood, which also is quite the exception in other Eskimo regions, where it is of ivory. There are many bows of antler from Norton Sound in the Museum, some of them skillfully and truthfully engraved. The mouth-piece is plain; not very well made. It is set with a square block of marble. It has the usual hole in one of the wings for the passage of a thong.

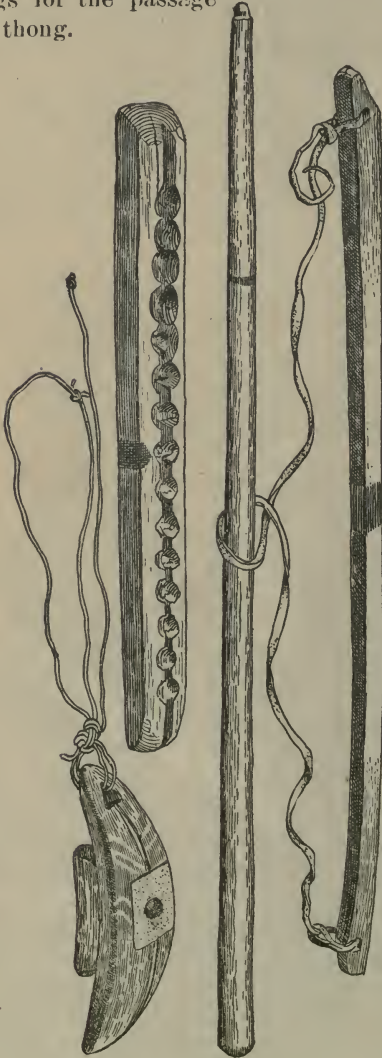


Fig. 34.

FIRE-MAKING SET (hearth showing median groove).

(Cat. No. 33166, U. S. N. M. Eskimo of Norton Sound, Alaska. Collected by E. W. Nelson.)



Fig. 35.

LOWER PIECE OF FIRE-MAKING SET (hearth).

(Cat. No. 39601, U. S. N. M. Eskimo of Cape Vancouver, Alaska. Collected by E. W. Nelson.)

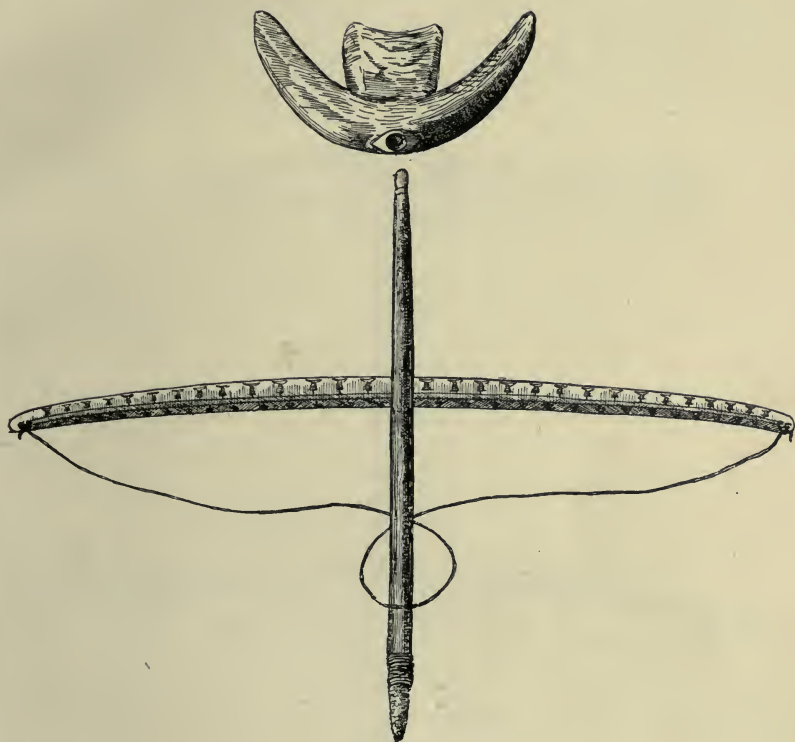


Fig. 32. BORING-SET. Cat. Nos. 89400, 89424, and 89630, U. S. N. M. Point Barrow, Alaska. Collected by Lieut. P. H. Ray, U. S. A.

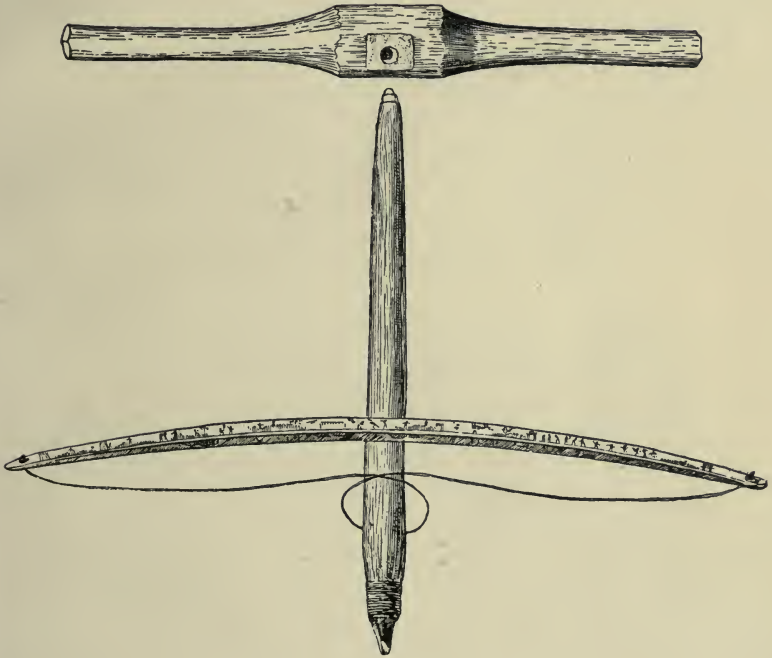


Fig. 33. DRILLING-SET. Cat. Nos. 25021, 44978, and 45108, U. S. N. M. Sledge Island, Alaska. Collected by E. W. Nelson.

Cape Vancouver is represented by a fine old hearth. This object has evidently been prized by its owner; it has had two rows of fire-holes (fig. 35), one row bored on the step in front of the first holes made; some of the holes are bored clear through. The reason why this was valued is, because the wood is so tindery that it is easy to make fire upon it.

Chalitmute, in the Kuskokwim region, on the northern side of the bay of that name, opposite Nunivak Island, is the next locality southward, to be considered. The parts of this set are exceptionally well-finished. The hearth is (pl. LXXVIII, fig. 36) stepped. It has four holes prepared for use; on one, fire has been made. The drill is unusually thick. The mouth-piece has no teeth-grip, and there is no evidence that it was ever held in the mouth. It is intended to be held in the hand. This mouth-piece is set with an oval socket-stone of black obsidian, ground down into facets and polished. The cord handles are fine, large teeth of the sea lion. The centers of the circles so characteristic of Eskimo art, are inlaid with wood. The holes for the drill cord are narrow; they must have been dug through with a sharp, narrow instrument. As before remarked, this is the region where the hand rest is more used than the mouth-piece, and the bow is not used at all.

The fire-making set from the Togiak River, was collected in 1886, by Sergt. I. Applegate, of the U. S. Signal Corps. Kassianamute, from which village it comes, is in the Bristol Bay region, but this set has a different appearance from the former outfits (pl. LXXIX., fig. 37). The hearth is a block of wood worked out at one end into a handle. It is remarkable in having central holes not connecting, and with no connecting grooves. In this it closely resembles the block from East Greenland (fig. 25). This hearth is of soft, tindery wood, and doubtless when the holes became too deep to allow the powder to mass around the edge, the upper part of hearth was scaped down. The mouth-piece is large, and is in the form of a seal. It has only a shallow, crescentic teeth-grip; from the size of the mouth-piece, its shape, and the absence of a block to fasten between the teeth, it must have been nearly always held in the hand of one of the operators. It is set with a round pebble, mottled with green. The cord is a thong of rawhide with handles of wood.

The next locality is Koggiung, on the southern shore of Bristol Bay, near its head. Two sets are shown from this locality. From the hearths it will be seen that both fire-slots on the side and center holes are used here. These sets are called *nũ-tshũn* (fig. 38). The apparatus shown in figure 38 has the stepped hearth. Both drill and hearth apparently have been made for sale. The mouth-piece is a good one, set with a large socket-piece of a black stone with green mottlings. This stone is tolerably soft. It is much used by the Bristol Bay Eskimo for making labrets, etc. The teeth-grip is very shallow. The hearth

(fig. 39) is of a very peculiar shape; only one other has been noticed like it. The wood is of the best kind, and fire has been made on it a number of times. In several places the holes have been bored clear through.

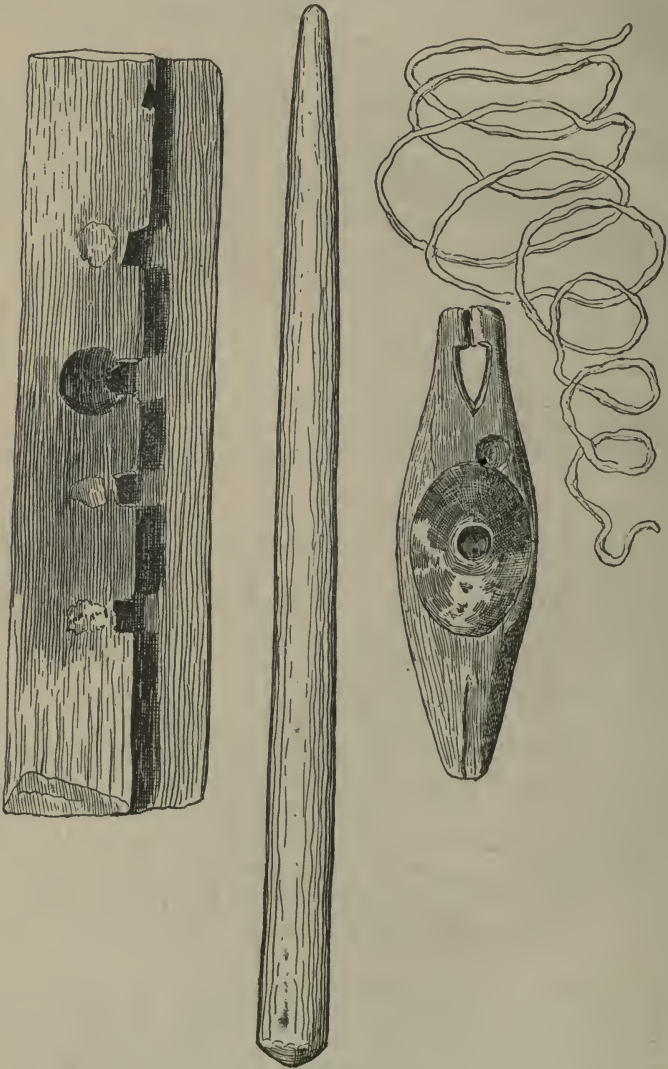


Fig. 38.

FIRE-MAKING SET (hearth with step and five slots).

(Cat. No. 127819a, U. S. N. M. Kogginug, Bristol Bay, Alaska. Collected by W. J. Fisher.)

The mouth-piece bears no evidence that it has been held between the teeth. It is highly probable that fire was made on these outfits more often by two persons, one holding the mouth-piece, or rest, and fanning

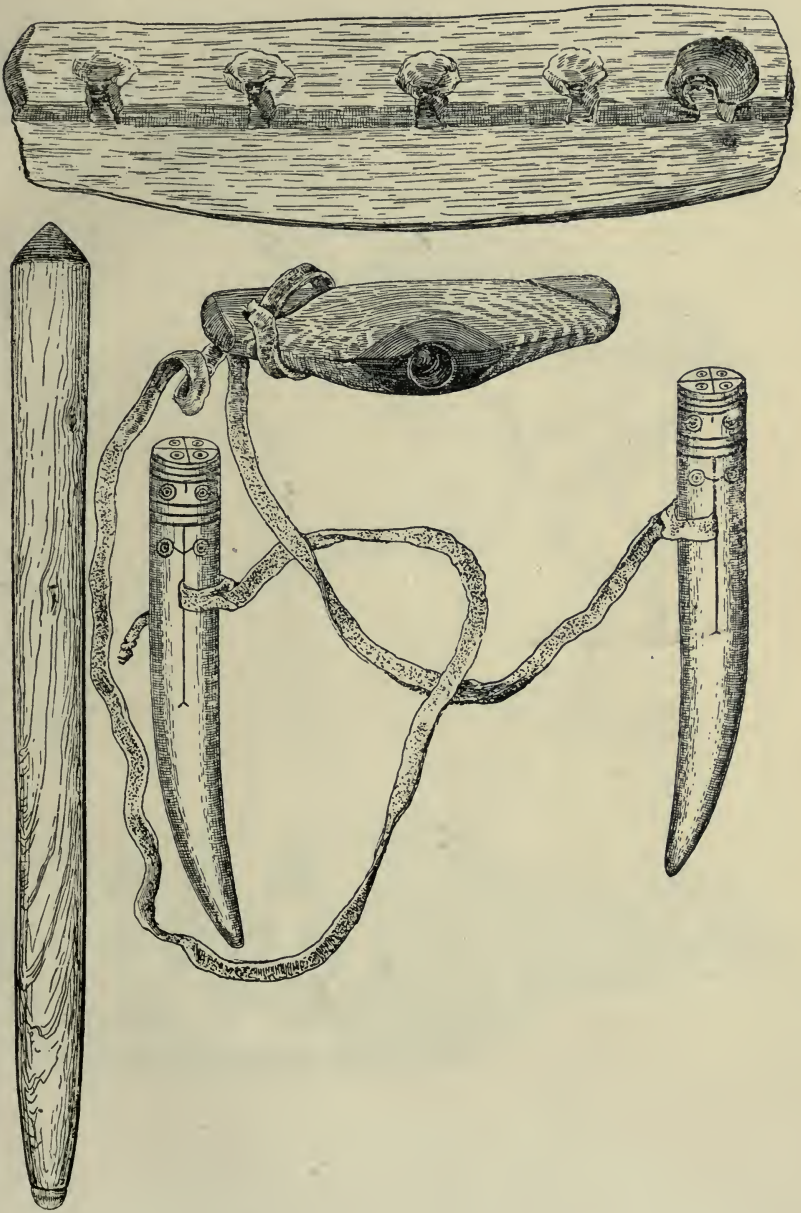


Fig. 36. FIRE-MAKING SET. Cat. Nos. 36325 and 37961. U. S. N. M. Eskimo of Chalitmute (Kuskokwim Region), Alaska. Collected by E. W. Nelson.

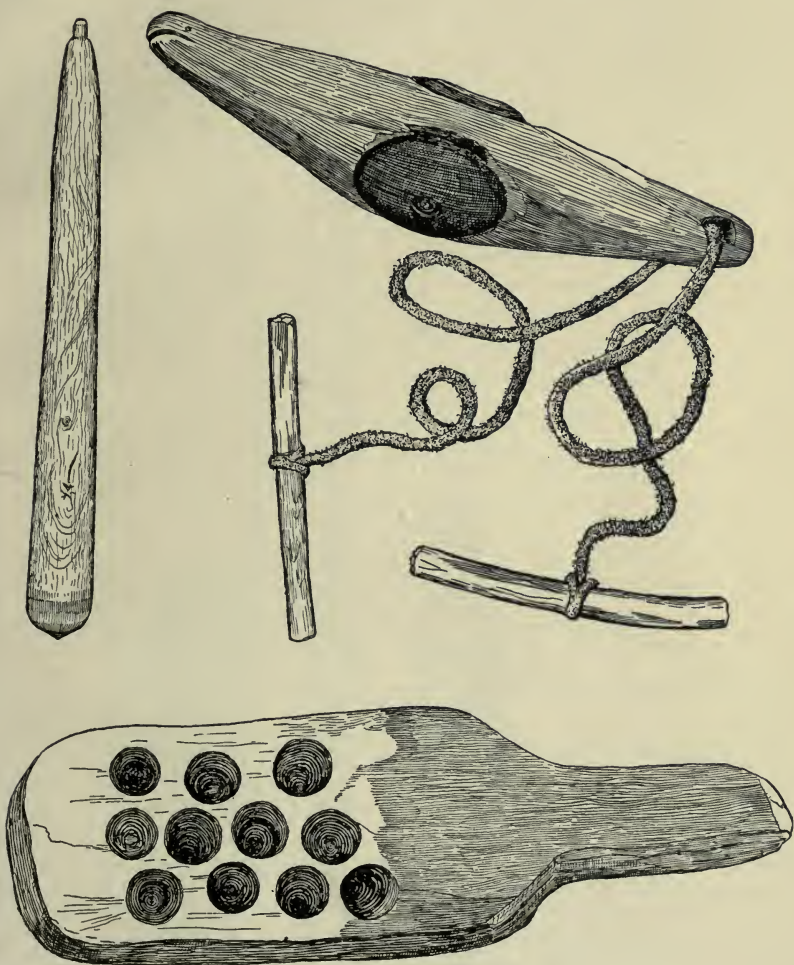


Fig. 37. FIRE-MAKING SET. Cat. No. 127520, U. S. N. M. Eskimo of Kassianamute (Togiak Region), Alaska. Collected by S. Applegate.

the flame, the other pulling the cord. This must be the method in Bristol Bay. Neither the true mouth-piece nor any bow has been procured by the Museum from this interesting region, from whence there are copious collections of ethnological objects. The cords without handles are worthy of notice.

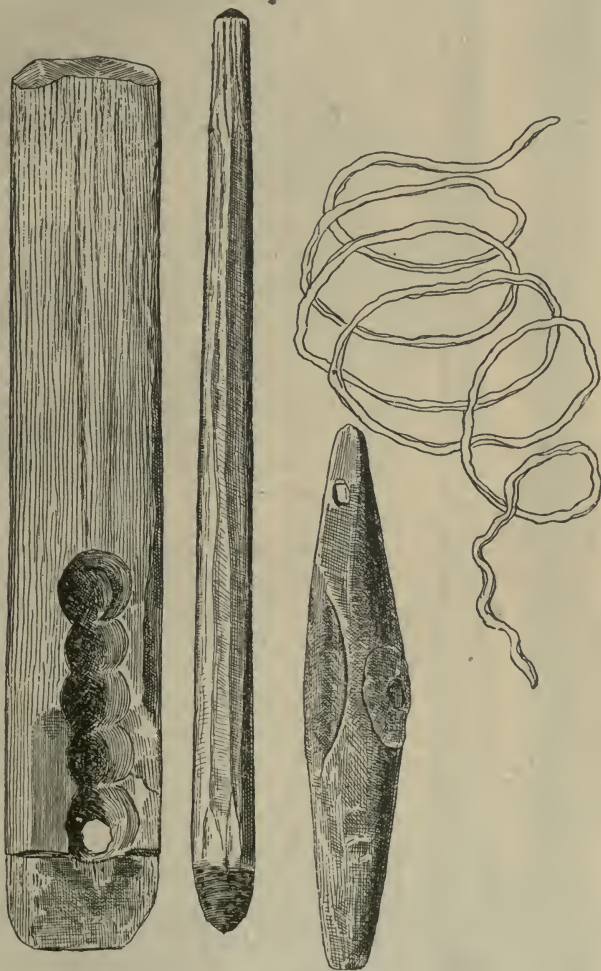


FIG. 39.

FIRE-MAKING SET (hearth with central holes and end step).

(Cat. No. 1278196. U. S. N. M. Koggiung, Bristol Bay, Alaska. Collected by W. J. Fisher.)

Another set from Bristol Bay is said by its collector, Charles McKay, to be used by both Eskimo and Indians. It is a very valuable outfit because of its completeness (pl. LXXX, fig. 40). The hearth is a rounded piece of wood with four large holes opening by slots onto the step. The



Fig. 41.

LOWER PIECE AND SPINDLE OF
FIRE-MAKING SET.(Cat. No. 72914, U. S. N. M. Eskimo of Kadiak
Island, Alaska. Collected by W. J. Fisher.)

drill is a thick, tolerably hard piece of close-grained wood like the hearth. The mouth-piece has no regular block for the teeth-grip, but has a crescentic gash on each side instead. It is set with a socket of a rock resembling marble. Nearly all the mouth-pieces south of Norton Sound are in the shape of seals, or other long animals. Cord handles are used attached to a thick thong of buckskin. Fungus is used for tinder and a blaze is started with cones of the larch. These are kept in the box, the lid of which is tied on with a thong.

Kadiak, the lowest limit of the western Eskimo, is as far south as the four part fire-drill extends by specimens in the Museum (fig. 41). The hearth is of cedar wood with three central holes with a connecting groove. It is neatly finished. The drill is also of cedar and bears the marks of the use of the thong; the top has also been used in the socket of a rest. The drill approaches in length those used for twirling between the hands by the Indians.

While the Aleutians use flint and steel, or a stone containing quartz and pyrites, struck against another stone, they still make use of the four-part drill at certain times. Hunting parties, says Mr. L. M. Turner, carry the drill to use when their matches run out. It takes two men to work it, one holding the hand rest and the other pulling the thong. The spindle is made of harder wood, so as to wear the light dust which ignites, from the hearth. A moment only is necessary to get fire; this is fed with tinder made of willow catkins and powdered charcoal. Sometimes, in order to get fire, they hold tinder at the mouth of a gun and ignite it by firing off a light charge of loose powder.

Possessed of four methods of getting fire, the Aleutian is superior to more fortunately situated people who depend wholly on matches.

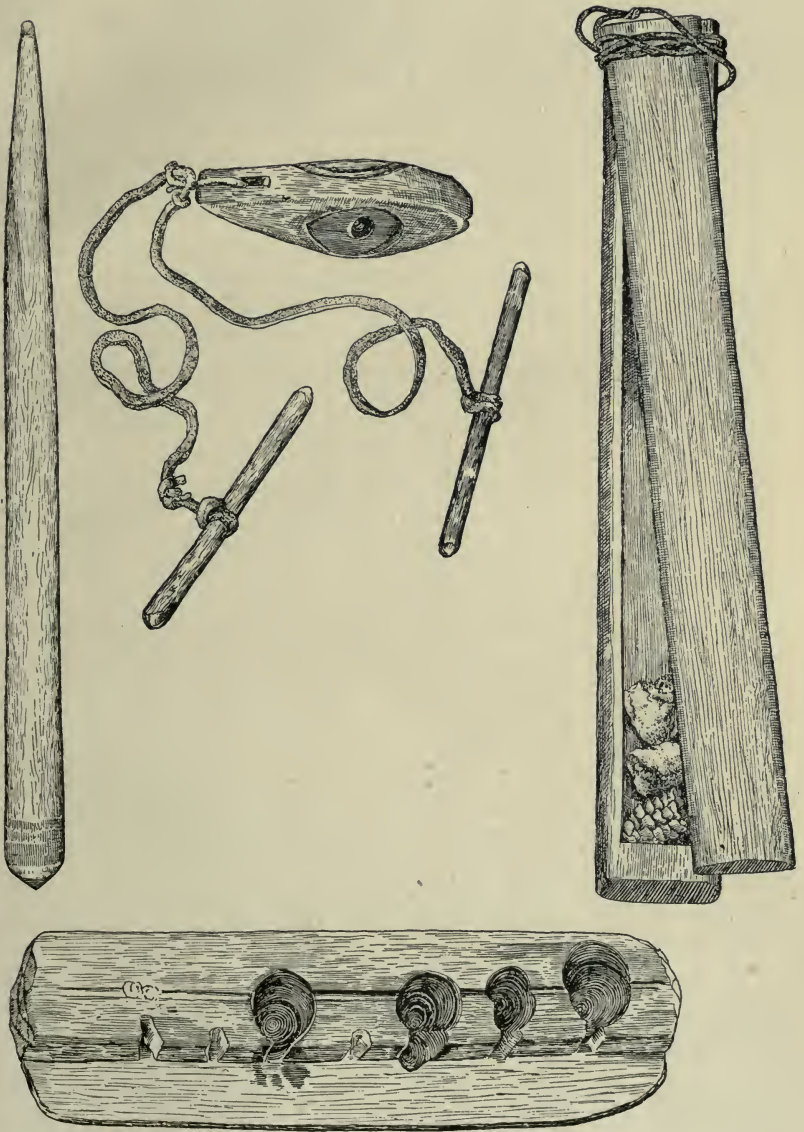


Fig. 40. FIRE-MAKING SET. Cat. No. 55938, U. S. N. M. Eskimo of Bristol Bay, Alaska. Collected by Charles McKay.

II.—FIRE-MAKING BY SAWING.

Prof. Alfred Russel Wallace has noted the method by sawing in his work entitled "The Malay Archipelago," p. 332: Two pieces of bamboo are used; a sharp edge piece like a knife is rubbed across a convex piece in which a notch is cut, nearly severing the bamboo (fig. 42); after sawing across for awhile the bamboo is pierced, and the heated particles fall below and ignite. The Ternate Malays and the Tungaras of British North Borneo* have improved upon this by striking a piece of china with tinder held with it against the outside of a piece of bamboo, the siliceous coating of the latter yielding a spark like flint. Both of the methods mentioned are in use at different points in the area affected by Malay influence.

The Chittagong hill tribes, on the eastern frontier of British India, use sand on the sawing knife to increase the friction.†

The Karens of Burma, Dr. R. M. Luther informs the writer, hollow out a branch of the *Dipterocarpus* tree like the lower piece of bamboo spoken of, cut a transverse notch, and saw across in it with a rubber of iron-wood. The wood fibers ground off form the tinder; the coal is wrapped up in a dry leaf and swung around the head till it blazes. It takes only two or three minutes to get a blaze this way.

Bearing upon the origin of this method of sawing in these localities, nature is alleged to suggest the way and to repeat the process that would give to fireless man the hint. Mr. W. T. Hornaday relates that many fires are started in the jungle by bamboo rubbing together in a high wind-storm. The creaking is indescribable; the noise of the rasping and grinding of the horny stems is almost unendurable.

In many tribes it is found that often there is more than one method of fire making practiced. For instance, in Borneo, as we have seen, the Tungaras use the sawing method, the Saribus Dyaks the *besiapi*, or fire syringe, a most interesting fact,‡ other Dyaks the rotary drill,§ while the Rev. Dr. Taylor says that the Dyaks are acquainted with the use of the bow and string and the upright stick and cord (pump drill). In connection with all these methods probably flint and steel were used.



Fig. 42.

MALAY FIRE STICKS.

(Cat. No. 129775, U. S. N. M. Models in bamboo made by Mr. Hough after Prof. A. R. Wallace's description. The Malay Archipelago, p. 332.)

* D. D. Daly.—Proc. Roy. Geog. Soc. 1888. p. 10.

† Capt. T. H. Lewis.—Hill tribes of Chittagong. Calcutta, 1869. p. 83.

‡ The American Anthropologist. Washington, 1888. 1, No. 3, p. 294.

§ J. G. Wood.—The Natural History of Man. 11, p. 502.

So in Australia, while the rotary drill is the usual way, some tribes have acquired the art of producing fire with knife or rubber, that is, the sawing method presumably under foreign influence.*

III.—FIRE-MAKING BY PLOWING.

One of the most marked of fire-making methods in its distribution is that pursued by the Pacific Islanders, confined almost entirely to the Polynesian cultural area. It has spread to other islands, however, being met with among the Negritos of New Britain:



Fig. 43.

FIRE-MAKING STICKS
(a SHOWING GROOVE).

(Cat. No. 130675, U. S. N. M.
Samoa. Deposited by Harold
M. Sewall.)

a They rub a sharpened piece of hard stick against the inside of a piece of dried split bamboo. This has a natural dust that soon ignites. They use soft wood when no bamboo can be procured, but it takes longer to ignite. The flame is fed with grass.†

There is a close connection between the Malay sawing method and this, as there is a decided Malay preponderance in the make-up of the population of the Islands.

The fire-sticks shown (fig. 43) were procured by Mr. Harold M. Sewall, at Samoa, and deposited in the museum by him.

The wood is a light corky variety, probably of the *Hibiscus tiliacus*, which is used for this purpose at Tahiti, or perhaps it is of the paper mulberry. The rubber may be of some hard wood, although fire may be made by means of a rubber of the same kind of wood as that of the hearth, though no doubt it requires a longer time to make fire if this is done. In the Sandwich Islands, Mr. Franklin Hale Austin, secretary of the King, states that the rubber is of *koh* or *ohia*, that is, hard wood and the hearth of *hon*, or soft wood, and the friction is always in soft woods; this is true, I believe, everywhere this method is practiced, in spite of the fact that a soft rubber on hard wood will answer as well.

Lieut. William I. Moore, U. S. Navy, gave the writer a complete description of the manipulation of the Samoan fire-getting apparatus.

The blunt pointed stick is taken between the clasped hands, somewhat as one takes a pen, and projected forward from the body along the groove at the greatest frictional angle consistent with the forward motion which has been found to be from 40 to 45 degrees. Kneeling on the stick the man forces the rubber forward, slowly at first, with a range of perhaps

* R. Brongh Smith.—The Aborigines of Victoria. London, 1878. 1, p. 393.

† W. Powell.—Wanderings in a Wild Country. p. 206.

6 inches, till the wood begins to be ground off and made to go into a little heap at the end of the groove; then he gradually accelerates the speed and moves with a shorter range until, when he pushes the stick with great velocity, the brown dust ignites. This is allowed to glow and if it is required to be transferred to dry leaves or chips of wood it is done by means of a tinder made of frayed or worn tapa cloth.

The groove (fig. 43a) is the most characteristic feature of this apparatus, there being apparently no definite form of implements for this purpose. Fire is made on any billet of dry wood that is available. It is not necessary to cut a slot, or even a groove, the hard wood rubber will form one, so that there is no more need of apparatus than among the Navajos, where two bits of yucca stalk collected near by form the fire tools.

That making fire by this way is difficult to those inexperienced in it is not strange. Mr. Darwin found it quite so, but at last succeeded. The Samoan gets fire in forty seconds, and so great is the friction and the wood so well adapted that Mr. Austin, before quoted, says it sometimes actually bursts into flame.

The Australians in some parts use a method very much like the one described. They rub a knife of wood along a groove made in another stick previously filled with tinder.*

IV.—PERCUSSION.

1. FLINT AND PYRITES.

Ac primum silicii scintillam excudit Achates
 Suscepitque ignum foliis atque arida circum
 Nutrimenta dedit, rapuitque in fomite flammam.

(Æneid B. 1, 174-176.)

One of the oldest methods of fire-making that we know of is, that by the percussion of flint and pyrites. It is believed to have been the original discovery. If there is any difference in the difficulties of conception and execution in either of the inventions, it lies in favor of the sticks of wood.

The distribution of the flint and pyrites method, both in time and place, is very interesting. Mr. Evans, in his epoch-making work, "Ancient Stone Implements," page 14, remarks that the name of pyrites (*πυρ*, fire) is itself sufficient evidence of the purpose to which the mineral was applied in ancient times. Whatever the fact is in Roman history, the Eskimo calls pyrites firestone, some Indian tribes call flint firestone, the German name for flint is *feuerstein*, and it is a reasonable supposition that whatever people used flint or quartz, pyrites, or other forms of iron ore for making fire, would call the stone firestone. The statement of Pliny that fire was first struck out of flint by Pyrodé, the son of Cilix, Mr. Evans thinks, is a myth which points to the use of silix and pyrites, rather than to steel.

* R Brough Smith.—The Aborigines of Victoria. London, 1878. I, p. 394.

Mr. Thomas Wilson calls my attention to a discovery of a pyrites nodule by M. Gaillard, in a flint workshop on the island of Guiberon in Brittany. The piece bore traces of use. Mr. Wilson thinks that the curved flakes of flint like the one figured, found so numerous, were used with pyrites as strike-a-lights. The comparative rarity of pyrites is, perhaps, because it is easily decomposed and disintegrates in unfavorable situations in a short time, so that the absence of pyrites does not militate against the theory that it was used. A subcylindrical nodule of pyrites $2\frac{1}{2}$ inches long and bruised at one end was found in the cave of Les Eyzies, in the valley of Vézère, Perigord, mentioned in *Reliquæ Aquitanicæ*, page 248. This is supposed to have been a strike-a-light.

Prof. W. B. Dawkins thinks that—

In all probability the Cave-man obtained fire by the friction of one piece of hard wood upon another, as is now the custom among many savage tribes. Sometimes, however, as in the *Trou de Chaleux*, quoted by M. Dupont (*Le Temps Préhistorique en Belgique*, second edition, page 153), he may have obtained a light by the friction of a bit of flint against a piece of iron pyrites, as is usual with the Eskimos of the present day.*

Mr. Dawkins also says that fire was obtained in the Bronze Age by striking a flint flake against a piece of pyrites, sometimes found together in the tumuli. He figures a strike-a-light from Seven Barrows, Lambourne, Berks, England, an outline of which is reproduced here for comparison with the one from Fort Simpson, British Columbia (fig. 44*a* and *b*). Pyrites has been found in a kitchen-midden at Ventnor, in connection with Roman pottery † Chambers's *Encyclopædia*, article, Pyrites, ‡ is authority for the statement that pyrites was used in kindling powder in the pans of muskets before the gun flint was introduced.

It is thus seen that this art has a high antiquity, and that on its ancient areas its use comes down nearly to the present day, the flint and steel being its modern or allied form.

In North America this art is distributed among the more northerly ranging Indian tribes, and the Eskimo of some parts. Its use was and is yet quite prevalent among the Indians of the Athapasean (formerly Tinné) stock of the north. By specimens in the Museum, and notes of explorers, it is found to range from north of Dixon's Sound to Labrador, the following localities being represented, viz: Stikine River, Sitka, Aleutian Islands, Kotzebue Sound, Point Barrow, the Mackenzie River district, at Fort Simpson, and probably Hershel Island, Pelly Bay, Melville Peninsula, Smith Sound, and Labrador. The Canadian and Algonquins strike two pieces of pyrites (*pierres de mine*) together over an eagle's thigh, dried with its down, and serving instead of tinder. || From

* Dawkins.—*Early Man in Britain*. London. p. 210.

† *Loc. cit.*, p. 258.

‡ *J. Anthrop. Inst.* Great Britain and Ireland. VII, p. 83.

|| Lafitau.—*Mœurs des Sauvages Américains*. p. 272. An earlier account is found in *Le Jeune, Relation de 1634*, p. 24. Quebec, 1858.

other sources we know that the extinct Beothucs, of Newfoundland, did the same.*

As far as can be ascertained, the Eskimo and Indians both use the method, so that it is not characteristic of either, as the four-part drill is of the Eskimo, as contrasted with the simple rotation sticks of the Indians. A description of a flint and pyrites outfit, as at present used, will give a general idea of the status of the invention. In different localities the manipulation differs somewhat, as will be noted farther on.



Fig. 44.

a STRIKE-A-LIGHT.

(Seven Barrows, Berks County, England. From Lubbock's *Early Man in Britain*, p. 258.)

b STRIKE-A-LIGHT.

(Cat. No. 1961, U. S. N. M. Indians of Fort Simpson, Mackenzie River district, B. C. Collected by B. R. Ross.)

The strike-a-light (No. 128405) was collected by Capt. E. P. Herendeen from natives who told him that it came from Cape Bathurst, hence

* *J. Anthrop. Inst. Great Britain and Ireland*, v, p. 225.



Fig. 45.—1. TINDER POUCH. 2. FIRE BAG.
(Part of Strike-a-light set).

(Cat. No. 128405, U. S. N. M., Mackenzie River District, B. C. Collected by E. P. Herendeen.)

from the down from the stems and catkins of various species of dwarf arctic willows. At present the natives often soak the tinder in a strong solution of gunpowder and water to make it quick; an older way was to mix powdered charcoal with it. This plan is like the charring of the linen rags used in the old-fashioned tinder boxes of forty years ago. The Eskimo then puts the tinder into a little round, flat pouch, with a flap in the middle (fig. 45, 1).

The pyrites (fig. 46, 3) looks like a short pestle, too much of which appearance the repeated scraping has no doubt given rise. The upper end is concave, while the lower end has the original smooth surface of the concretion. Pyrite is found at Point Barrow in spherical masses of various sizes up to several pounds in weight. These spheres are nearly always cracked in two and scraped on the plane

he assigned the specimen to this locality on the evidence. Mr. John Murdoch has, with a great deal of probability, questioned this and thinks that it came from Herschel Island with the rest of Mr. Herendeen's collection and did not come from as far east as Cape Bathurst. While there is no improbability that this method is practiced at Cape Bathurst, yet the specimen has the appearance of the Mackenzie River strike-a-lights, hence it is deemed advisable to locate it in the Mackenzie River district at Herschel Island.

The essential parts of the apparatus are a piece of pyrites, a piece of flint and tinder. In the more northern parts of the Eskimo area, tinder is made

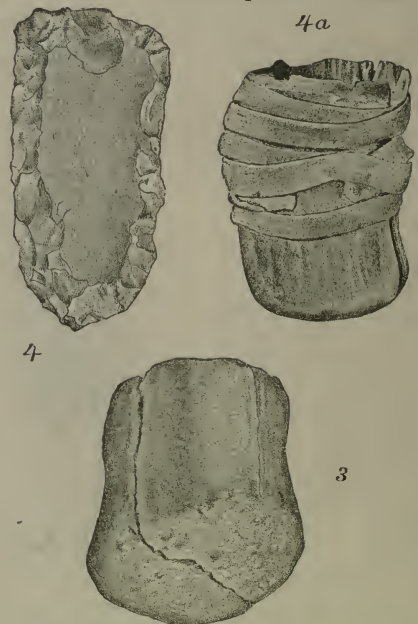


Fig. 46. 3. PYRITES. 4, 4a. FLINT STRIKER AND HANDLE.

(Part of Strike-a-light set.)

(Cat. No. 128405, U. S. N. M., Mackenzie River District, B. C. Collected by E. P. Herendeen.)

surface for very obvious reasons. This gives the shape seen in Fort Simpson and Long Barrows specimen. Mr. Murdoch says that the Eskimo think that pyrites comes down from above in meteors. They call it "firestone." A native related that in old times they did not use flint, but two pieces of pyrites, and got "big fire."

The flint (fig. 46, 4) is an oblong piece of chert, square at the base and rounded at the forward end. It is more elaborately made than the flakes so numerous in Europe, one of which was found with the piece of pyrites in the English Barrows. The Mackenzie River scraper is more like the curved ancient one (fig. 44*b*). In most cases the flints used are not mounted in a handle; this specimen, however, is fixed in a handle made of two pieces of wood held together by a thong of seal-skin (fig. 46, 4*a*).

The bag (fig. 45, 2) is made of reindeer skin. The little bag that hangs from the larger has a double use; it is a receptacle for reserve tinder, but its chief use is for a toggle; being passed under the belt it prevents the loss of the outfit, which is said to be carried by the women.

An oblong pad, stuffed with deer hair, is sewed to the mouth of the fire-bag to protect the hand from sparks and blows of the flint.

To get a spark, the Eskimo places (fig. 47) the piece of pyrites on the pad held in the left hand over the curved forefinger, the large end down and the thumb set in the cup shaped cavity in the top. The flap of the tinder pocket is turned back and held on the forefinger under the protecting pad. The flint is held in the right hand and by a scraping motion little pieces of pyrites at a dull red heat fall down into the tinder. The pellet that glows is transferred to the pipe or fire, and the flap of the tinder pocket is turned down, serving to keep the tinder dry and to extinguish it if necessary.*

There comes in here appropriately a note of B. R. Ross on the burial customs of the Kutchin Indians of the eastern Athapascan stock. He says:

They bury with the dead a flint fastened to a stick, a stone to strike it on (pyrites) to make fire, and a piece of the fungus that grows on the birch tree for tinder and some touch-wood also.†

There is no mention of this process of fire-making by the older writers



Fig 47.

METHOD OF USING THE STRIKE-A-LIGHT.
(Cat. No. 128405, U. S. N. M. Drawing by W. H. Burger.)

* Extracted from an article by the author in Proceedings U. S. National Museum, XI, 1888, 181-4.

† Smithsonian Report. 1866. p. 326.

on Greenland, Cranz and Egede, though they carefully note and describe the plan by wood-boring. Later explorers going higher north in western Greenland have found it. Dr. Emil Bessels, writing about the Itah Eskimo of Smith Sound, says:

The catkins of the arctic willow are used as tinder to catch the sparks which have been produced through the grinding of two pieces of stone.*

Dr. E. K. Kane gives a more complete account from nearly the same locality, the Arctic Highlands of northwest Greenland. He says that the Eskimo of Anatok struck fire from two stones, one a plain piece of angular milky quartz, held in the right hand, the other apparently an oxide of iron [pyrites or iron ore?] They were struck together after the true tinder-box fashion, throwing a scanty supply of sparks on a tinder composed of the silky down of the willow catkins (*Salix lanata*) which he held on a lump of dried moss.†

Very much farther west on Melville Peninsula Parry gives a complete and interesting description of the primitive way. This account gives us a link between the western and eastern Eskimo. He writes:

For the purpose of obtaining fire, the Eskimo use two lumps of common pyrites, from which sparks are struck into a little leathern case (see fig. 25, pl. LXXIV) containing moss well dried and rubbed between the hands. If this tinder does not readily catch, a small quantity of the white floss of the seed of the ground willow is laid above the moss. As soon as a spark has caught it is gently blown till the fire has spread an inch around, when the pointed end of a piece of wick being applied, it soon bursts into a flame, the whole process having occupied perhaps two or three minutes.‡

The Museum was in possession of a specimen catalogued, "Moss-bag and lumps of pyrites used by Innuits for getting fire," collected by Capt. C. F. Hall at Pelly Bay, in latitude 69°, longitude 90°, several degrees west of Melville Peninsula.

The only other record of the process under consideration among the Eskimo is found in the Aleutian Islands. There is absolutely no evidence had by the writer that the Eskimo south of Kotzebue Sound (Western Eskimo) use the pyrites and flint for making fire. The latest information about the Aleutian Islanders is given in a manuscript of the careful explorer, Mr. Lucien M. Turner. His observation will serve to explain the description of striking a light by earlier travelers.

They use the four part drill but they also use pyrites. A stone containing quartz and pyrites is struck against another similar one, or a beach pebble, into a mass of sea bird down sprinkled with powdered sulphur. This ignites and is quickly caught on finely shredded blades of grass or beaten stalks of wild parsnips. This method prevails to this day on the islands west of Unalashka.

The people told Mr. Turner that this was the ancient way. There is a doubt in the writer's mind that Sauer's (Billing's Expedition, page 59), and Campbell's (Voyage, page 59,) observations, brought together by Bancroft,§ were accurate with regard to the stones used. All the

* Die amerikanische Nordpol-Expedition. Leipzig, 1879. p. 358.

† Kane.—Arctic Explorations. I, p. 379.

‡ Parry.—Second Voyage. London, 1824. p. 504.

§ Bancroft.—Native Races of the Pacific States. I, p. 91.

other details are correct, but they say they took two pieces of quartz, rubbed them with sulphur, and struck them together. It is well known that pieces of quartz even when rubbed with sulphur will not strike a spark of sufficient heat to cause ignition. The pieces used must have been pyritiferous quartz as noticed by Mr. L. M. Turner.

To resume, the following facts arise out of the foregoing considerations of the flint and pyrites method:

- (1) It is very ancient, inferring from the few reliable finds of pyrites and flint in juxtaposition.
- (2) Its distribution is among high northern tribes, both Eskimo and Indian.
- (3) As far as known, its range is limited to this area, only one other instance coming to our notice, that of the Fuegians.

2. FLINT AND STEEL.

The flint and pyrites method is the ancestor of the flint and steel. The latter method came in with the Iron Age. It is found in the early settlements of that period. A steel for striking fire was found in the pile dwellings of the Ueberlinger See.* The Archæological Department of the Museum has a specimen of a strike-a-light of the early age of iron in Scandinavia. It is a flat, oval quartz stone with a groove around the edge; it is thought to be for holding a strap by which it could be held up and struck along the flat surface with the steel. It is scored on these surfaces. The specimen in the Smithsonian is from the national museum at Stockholm. In Egypt it is believed to have been used for a long period, though there is no data at hand to support the conclusion.† In China it has been in use for many centuries. Chinese history, however, goes back to the use of sticks of wood. The *briquet* must have been carried nearly everywhere by early commerce from the ancient countries around the Mediterranean, as it was into new lands by later commerce.

Many persons remember the tinder-box that was taken from its warm nook beside the fire-place whenever a light was wanted; the matches tipped with sulphur used to start a blaze from the glowing tinder are also familiar to the older generation. The tinder-boxes in use in this country were just like those in England from time immemorial down to fifty years ago (fig. 48). Mr. Edward Lovett, of Croydon, England, who has studied this matter thoroughly, calls attention to the resemblance of the old English tinder-flints to the neolithic scrapers. These scrapers, picked up at Brandon, can scarcely be discriminated from those made at the present time at that place, and there is a suspicion that the present tinder-flint has come down directly from neo-

* Keller.—Swiss Lake Dwellings. Pl. XXVIII, fig. 29.

† Sir J. W. Dawson gives an interesting account of the strike-a-light flints used in Egypt in 1844, in *Modern Science in Bible Lands*, p. 30.

lithic times. The old English steel, or "Flourish," (fig. 48) is the characteristic shape, and has been carried by English commerce into many places. A picture of a strike-a-light used by the Lenguas of Brazil, seen lately, shows the unmistakable old "flourish."

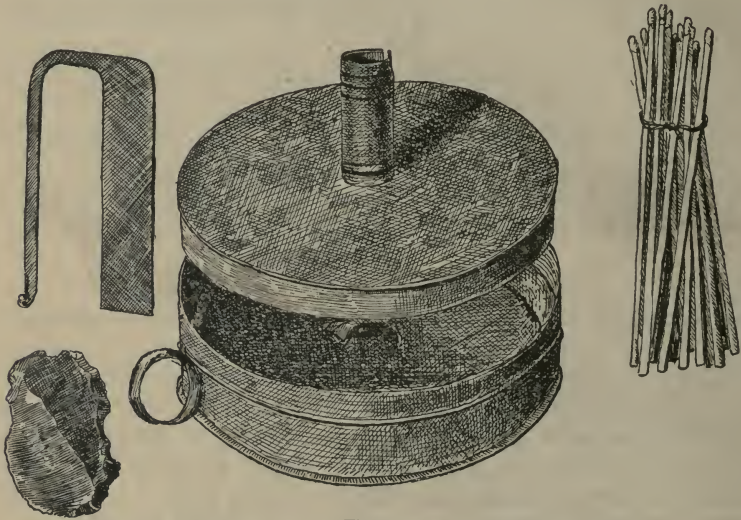


Fig. 48.

ENGLISH TINDER-BOX (with flint, "flourish," and bundle of spunks.
(Cat. No. 75516, U. S. N. M. England. Collected by Louis and Maurice Farmer.)

The tinder-boxes had also a damper to extinguish the tinder of burnt linen and to keep it dry. The lids were furnished often with a candle socket. This feature, says Mr. Lovett, has led to their preservation as candle-sticks long after they were superseded by matches.

Many devices were invented in order to improve on the crude way of holding the flint and steel in the hands to strike the spark into the tinder-box. One of these was the wheel tinder-box (fig. 49). The com-

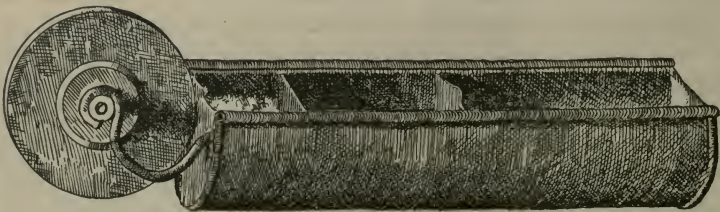


Fig. 49.

WHEEL TINDER-BOX.

(Cat. No. 130431, U. S. N. M. Broadalbin, N. Y. Presented by F. S. Hawley.)

partment near the wheel held the tinder. The flint was placed in a socket on the sliding lid, and the wheel was turned by unwinding a string from off its axle with a sharp pull as in spinning a top. The

flint was pressed against the rapidly revolving wheel and a shower of sparks fell into the tinder. The tinder pistol, whose name suggests its use, was another device.*

Other devices were intended to be carried in the pocket, and were probably brought out by the introduction of tobacco and the need of smokers for a convenient light.

The pocket strike-a-light is still used. The one shown (fig. 50) was bought in 1888 by Mr. E. Lovett, at Boulogne-sur-mer. They are still

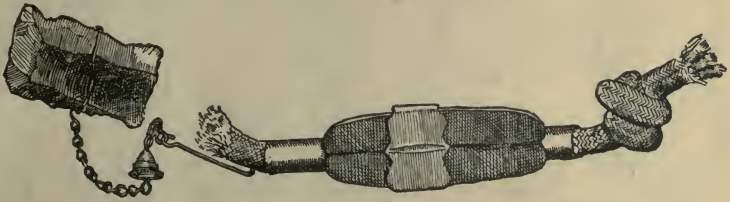


Fig. 50.

STRIKE-A-LIGHT (Briquet).

(Cat. No 120693, U. S. N. M. Boulogne-sur-mer. France. Collected by Edward Lovett.)

used by the peasants and work-people of France. An old specimen in the Museum of this character is from Lima. The roll of tinder, or "match," is made of the soft inner bark of a tree.

Among many of our North American tribes the flint and steel superseded the wooden drills as effectually as did the iron points the stone arrow-heads.

Some of these tribes were ripe for the introduction of many modern contrivances. Civilized methods of fire-lighting appealed to them at once. Among the Chukchis, Nordenskiöld says, matches had the honor of being the first of the inventions of the civilized races that have been recognized as superior to their own.† It was so among our Indian tribes; the Mandan chief "Four Bears" lighted his pipe by means of a flint and steel taken from his pouch when George Catlin visited him in 1832.‡

The Otoes (Siouan stock) made use of the flint and steel shown in fig. 51. The flint is a chipped piece of gray chert, probably an ancient implement picked up from the surface.

The steel is a very neatly made oval, resembling those of the Albanian strike-a-lights,§ or the Koordish pattern, (fig. 54). Here arises one of the perplexities of modern intercourse, perhaps both of these steels were derived from the same commercial center.

* See figure in D. Bruce Peebles's address on Illumination, in Trans. Roy. Scottish Society of Arts, Edinburgh, XII., part I, p. 96.

† Nordenskiöld.—Voyage of the *Vega*. II, p. 122.

‡ The George Catlin Indian Gallery. Smithsonian Report. 1885. II, p. 456,

§ See figure in Jour. Anthropol. Inst., Great Britain, XVI, 1886, p. 67.

The flint, steel, and tinder were always carried in a pouch, usually suspended from a belt as in specimen No. 8481 from the Assiniboins (Siouan stock) of Dakota. This is a buckskin waist-belt, beaded and fringed, ornamented with bells of tin. It supports a flapped pouch for the flint, etc. The tinder used was fungus.

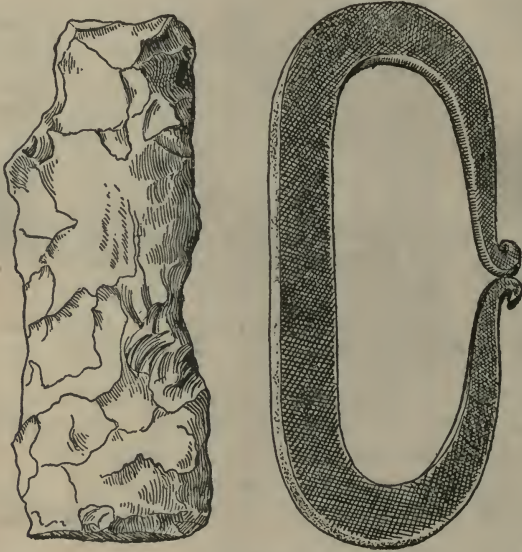


Fig. 51.

FLINT AND STEEL.

(Cat. No. 22431, U. S. N. M. Otoe Indians, Kansas and Nebraska. Collected by J. W. Griest.)

The pouch of the Cheyennes (Algonquian stock) is compact, and neatly made of leather (fig. 52). The equipment is complete and of a superior order. The bone cup is used to hold the tinder while striking a spark into it. It is the tinder horn of early days, a cow's horn which was used to hold tinder before sheet-iron boxes came into use. The Lenguas of Brazil use a horn for the same purpose.* In the Aino set, (fig. 57), and the Eskimo strike-a-light, (fig. 45), can be seen this feature. The tinder with this set is rotten wood. Nearly all Indians know the value of fungus tinder.

The Comanche Indian strike-a-light is a similar pouch to the one described, but much poorer in equipment (fig. 53.) A broken rasp, a piece of chert, and a piece of spunk, is enough for the purpose, and a bag made from a saddle skirt to hold them, completes the outfit.

The flint and steel is still used nearly all over Mexico, Dr. Palmer informs me. There is at present a manufacture of gun and strike-a-light flints at Brandon, England, whence they are shipped to Spain,

* See figure in Jahrbuch Mittelschweiz. Commercial. Gesellsch, Arau, Zweiter Band, 1888, pp. 114-115.

Mexico, Italy, and other civilized countries. Doubtless this flint from Guadalajara (fig. 54) came from Brandon. It is real calcareous flint, such as does not exist in this country. The flint is the "swallow-tail" pattern. The tinder is of prepared fungus sold in little packets.



Fig. 52.

STRIKE-A-LIGHT (flint, steel, tinder-horn, spunk, and pouch).

(Cat. No. 22104, U. S. N. M. Cheyenne Indians, Arkansas. Collected by Dr. J. H. Barry.)

The Koords of Bhotan, Eastern Turkey, carry a pipe pouch containing besides flint, steel, and tinder, a pipe pick and a pair of pincers,

to transfer the lighted tinder to the pipe (fig. 55). The tinder is prepared from a fungus, probably *polyporus* species. The steel, shaped like an old-fashioned bell pull, is a very good form for holding in the hand.

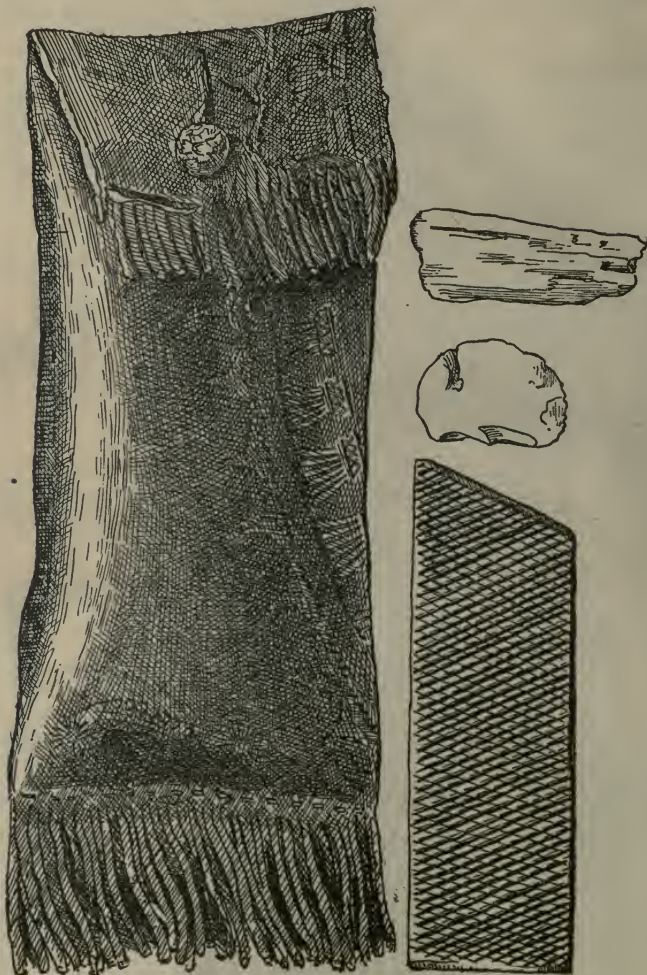


Fig. 53.

STRIKE-A-LIGHT. (Pouch for holding flint and steel.)

(Cat. No. 6972, U. S. N. M. Comanche Indians, Texas. Collected by Edward Palmer.)

The Chinese strike-a-light is the customary appendage to the pipe pouch. It is a very ingenious way of combining the steel with a pouch in which to keep the flint and tinder (fig. 56). In Thibet they are made very large and are finely decorated. One owned by Mr. W. W. Rockhill has a curving steel between 5 and 6 inches long, finely carved. The pouch was trimmed with encrusted silver set with jewels.

The Ainos of Japan use flint and steel for striking-a-light, this method having supplanted the generation of fire by sticks (p. 551.) This outfit shown (fig. 57, pl. LXXXI) is complete. The shoe-shaped steel is attached by a piece of sinew to the cork of a small wooden bottle containing the soft charcoal used as tinder. The flint is a small piece of ferruginous silex. With this set is a piece of stick which retains

fire for a long time. It is the root of the *Ulmus campestris*, or *lavis*, formerly used for the fire-drill (see fig. 17), but has come into a secondary place since the introduction of the flint and steel.

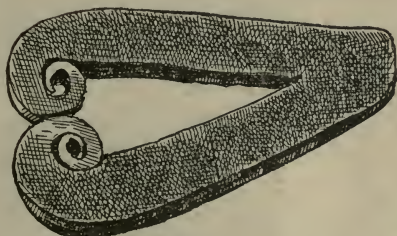
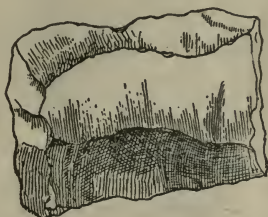


Fig. 54.

FLINT AND STEEL.

(Cat. No. 126576, U. S. N. M. Guadalajara Indians, Mexico. Collected by Edward Palmer.)

Fig. 56.

STRIKE-A-LIGHT.

(Cat. No. 130311, U. S. N. M. China. Gift of George G. Fryer.)

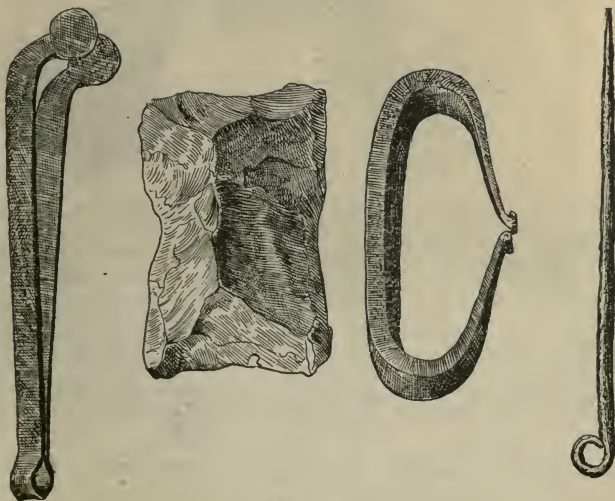


Fig. 55.

SMOKERS' PIPE-LIGHTING OUTFIT (showing flint, steel, pipe-pick, and pincers).

(Cat. No. 130607, U. S. N. M. Koords of Bhotan, eastern Turkey. Collected by Rev. A. N. Andrus.)

To strike a light the Aino takes out the cork with the steel attached and stirs up the tinder with the sharp point. He then holds up the

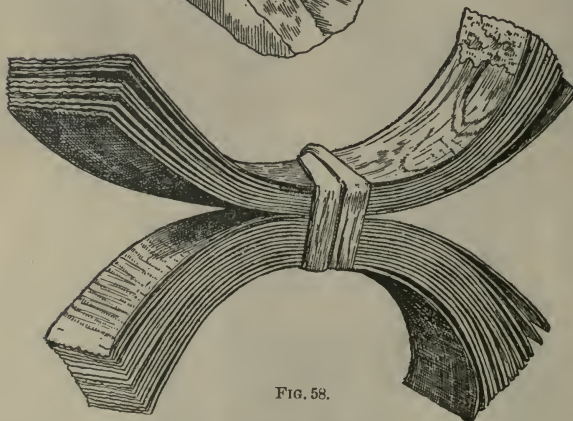
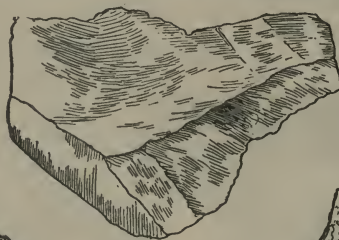
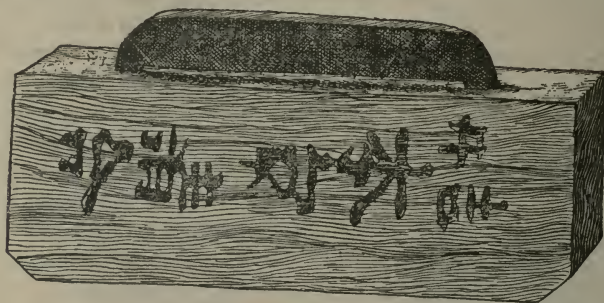


FIG. 58.



Fig. 58.

TINDER-BOX (showing mounted steel, flint, and bundle of shaving matches; box one-third natural size).

(Cat. No. 127137, U. S. N. M. Japan. Gift of the Japanese Department of Education, Tokio.)

flint in his hand over the box and strikes a spark down into it. He then transfers the coal to his pipe, or material for fire, or fire-stick, with

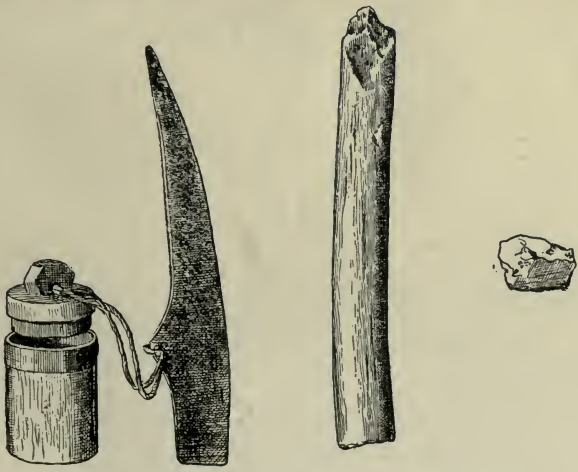
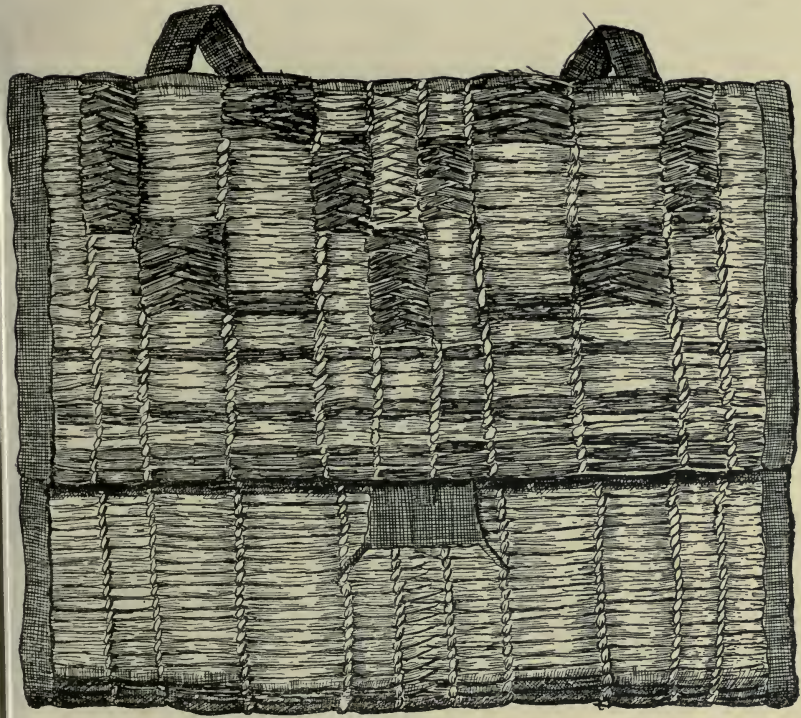


Fig. 57. STRIKE-A-LIGHT. Flint, steel, tinder-box, and rush-pouch. Cat. No. 22257, U. S. N. M. Ainos of Yezo, Japan. Collected by B. S. Lyman.

the point of the steel. These articles are kept in a rush pouch of twined weaving. A much ruder pouch of fishskin is in the Museum.

The Japanese tinder-box has two compartments, one with a damper for the tinder, and the other larger one for the flint and steel. This box is a familiar object in Japanese kitchens yet. The mounting of the steel in wood is an improvement on holding it between the fingers (fig. 58 and 59). No one it seems ever thought of so mounting the steel in Western countries. The matches are broad shavings tipped at both ends with sulphur, and are the Japanese rendering of the "spunks" used with our tinder-box.

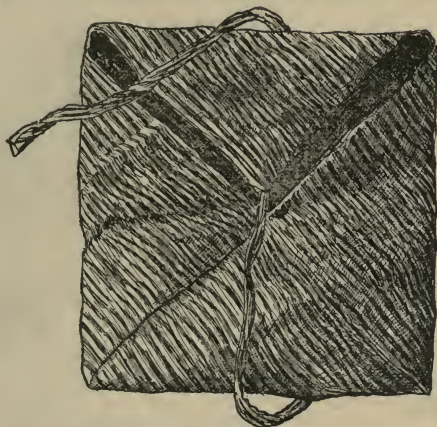


Fig. 60.

SMOKERS' STRIKE-A-LIGHT.

(Cat. No. 123133. U. S. N. M. Tokio, Japan. Gift of the Japanese Department of Education.)

Smokers in Japan carry a very small strike-a-light (fig. 60). The cloth pouch with a long flap that can be rolled around several times and tied, contains the three essentials, flint, steel, and tinder, the latter of burnt cotton.

List of specimens described and figured.

	Catalogue No.	Name.	Localities and Tribes.	Collector.
Text fig. 1	74379	Fire-making set	Sitkans, Alaska	John J. McLean.
2	20644	.....do	Bella Bellas, British Columbia.	James G. Swan.
3	127866	.....do	Quinaliets, Washington..	Charles Willoughby.
4	24096	.....do	Klamaths, Oregon	L. S. Dyar.
5	77193	.....do	Hupas, California	Lieut. P. H. Ray, U. S. Army.
6	19640	Hearth	Washoes, Nevada	Stephen Powers.
7	17230	Fire-making set	Pai-Utes, Southern Utah..	Maj. J. W. Powell.
8	11976	.....do . . . . .	.....do	Do.
9	22022	.....do	Wind River Shoshones	Do.
10	128694	.....do	Mokis, Arizona	Mrs. Tilly E. Stevenson.
11	127708	.....do	Zuñi, New Mexico	Col. James Stevenson.
12	69850	Slow match, punk . . . . .	.....do	Do.
13	25268	Hearth from cave	Silver City, New Mexico..	Henry Metcalf.
14	130672	Hearth	Apaches, Arizona	Capt. Jno. G. Bourke, U. S. Army.
15	9555	Fire-making set	Navajos, New Mexico	Dr. E. Palmer.
16	15396	.....do	Costa Rica	W. M. Gabb.
17	129970	.....do	Ainos, Japan	Peabody Museum, D. P. Penhallow.
18	(*)	Sacred fire-drill	Idzumo, Japan	R. Hitchcock.
19	129971	Fire-making set	Somalis, East Africa	Peabody Museum, Dr. Chas. Pickering.
20		Taveita men making fire.		
Pl. LXXIV	10258	} Fire tools	} Frobisher Bay and Cumberland Gulf.	} L. Kumlein.
21	9833			
22	10295			
23	14252			
24	34114	Boring set	East Greenland	From Holm and Garde.
Text fig. 25		Fire drill . . . . .	.....do	Do.
Text fig. 26		Boring set . . . . .	.....do	Do.
Pl. LXXV	} 10128	Fire Bag	Holsteinberg, West Greenland.	Capt. C. F. Hall.
27				
Text fig. 28	1978	Hearth with cement	Mackenzie River	B. R. Ross.
Text fig. 29	1963	Hearth . . . . .	.....do	Do.
Text fig. 30	1327	Fire drill	Anderson River	C. P. Gaudet.
Text fig. 31	89822	Fire-making set	Point Barrow, Alaska	Lieut. P. H. Ray, U. S. Army.
Pl. LXXVI	} 89500 89630 89424	Boring set . . . . .	.....do	Do.
32				
Pl. LXXVII	} 25021 44978 45108	.....do	Sledge Island, Alaska	E. W. Nelson.
33				
Text fig. 34	33166	Fire-making set	Norton Sound, Alaska	Do.
Text fig. 35	38601	Hearth	Cape Vancouver, Alaska	Do.
Pl. LXXVIII	} 37961 36325	Fire-making set	Chalitmute, Alaska	Do.
36				
Pl. LXXIX	} 127520	.....do	Kassianamute, Alaska	I. Applegate.
37				
Text fig. 38	127819a	.....do	Koggiung, Bristol Bay, Alaska.	W. J. Fisher.
Text fig. 39	127819b	.....do . . . . .	.....do	Do.

* From photograph.

List of specimens described and figured—Continued.

	Catalogue No.	Name.	Localities and Tribes.	Collector.
Pl. LXXX 40	55938	Fire-making set . . .	Bristol Bay, Alaska	Charles L. McKay.
Text fig. 41	72514	Hearth and drill . . .	Kadiak Island, Alaska . . .	W. J. Fisher.
Text fig. 42	129775	Fire sticks (model)	Malays	After Wallace.
Text fig. 43	130675	.....do	Samoa	Harold M. Sewall.
Text fig. 44	1861	Strike-a-light.....	Fort Simpson, British Columbia.	B. R. Ross.
Text fig. 45	128405	.....do	Mackenzie River District.	E. P. Herendeen.
Text fig. 46				
Text fig. 47				
Text fig. 48	75516	Tinder-box	England	L. and M. Farmer.
Text fig. 49	130431	Wheel tinder-box . . .	Broadalbin, New York . . .	F. S. Hawley.
Text fig. 50	129693	Strike-a-light	Boulogne-sur-mer, France	Edward Lovett.
Text fig. 51	22431	Flint and steel	Otoes, Kansas	J. W. Griest.
	8481	Belt with flint, steel, etc.	Assiniboines, Dakota	Dr. J. P. Kimball.
Text fig. 52	22104	Strike-a-light	Cheyennes, Arkansas	Dr. W. H. Barry.
Text fig. 53	6972	.....do	Comanches, Texas	Dr. E. Palmer.
Text fig. 54	126576	Flint and steel	Guadalajara Indians, Mexico.	Do.
Text fig. 55	130607	Pipe-lighting outfit	Koords, East Turkey	Rev. A. N. Andrus.
Text fig. 56	130311	Strike-a-light	China	George G. Fryer.
Pl. LXXXI 57	22257	.....do	Ainos, Japan	B. S. Lyman.
Text fig. 58	128137	Tinder-box	Japan	Japanese Department of Education.
Text fig. 59				
Text fig. 60	128138	Strike-a-light.....do	Do.

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Fire-making apparatus in th
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