SYNOPTIC SERIES OF OBJECTS IN THE UNITED STATES NATIONAL MUSEUM ILLUSTRATING THE HISTORY OF INVENTIONS.

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HISTORY.

Fifty years ago the United States National Museum was being rapidly and steadily enriched by a stream of ethnologic material poured in by explorations and expeditions carried on in the United States and in foreign lands. Among the first results of the classification of the collections was the recognition of similarities and differences in the material culture of races. This observation was to bear fruition in the exhibits of the Museum. There also arose at this period the germs of ideas as to the relative inventiveness of races, which is seen to have been a natural inquiry among a nation of inventors.

The study of certain common tools whose use extended among many different tribes was taken in due course. One of the early anthropological works published by the Smithsonian was Dr. Charles Rau's monograph on Prehistoric Fishing, which was a forerunner of numerous papers on the various industries of the American Indians. These publications form a large and important literature on aboriginal technology.

Such works also show that motivated by the earlier studies there arose in the analytic minds of Mason and Holmes conceptions of the distribution and sequence of inventions, and their relative grades, all of which gave an inkling of the progress of development by which series of objects could be arranged in order in historical categories from simple to complex.

While these studies were ripening almost unconsciously during the handling of the increasing materials coming into the Smithsonian no incentive to present these facts offered till, in preparing plans for the Trans-Mississippi Exposition held in Omaha, Nebraska, in 1898, it was suggested that a synoptic series illustrating the history of invention should be prepared for exhibit on that occasion.

The energies of the staff of anthropology were directed to this end and a series of extraordinary interest and value was prepared.

There is no evidence that this series attracted particular attention at the Omaha exposition or for some time thereafter. There began, however, an appreciation, slight at first, but rapidly increasing, concerning the educational value of this exhibit. The inconspicuous cases displaying the series came to be assiduously studied and were the object of special visits by classes from schools far and near. The cases taken to the Panama-Pacific Exposition at San Francisco in 1915 were placed on the curriculum of visits to the exposition by the schools of California, and it is estimated that 60,000 pupils inspected them.

The history of the various halting stages of development through which inventions have come to our hands from the past is of fascinating interest. It is only just that we who inherit should know our inheritance. This knowledge may not only prove an asset in expanding the mind but may be of economic usefulness in stimulating invention.

Every art that is used to minister to our comfort in this present vastly complex civilization has been brought forward step by step, beginning with the simple needs of cruder times. Some of these arts we may follow back into the oblivion in which they had their dawn, some branch off at later marks on the dial of progress, others arise in the full light of history, while myriads swarm within the memory of man.

The series deals with two classes of inventions—those whose ancestry is very ancient and which form the foundation stones of progress and those which begin with the present age of science and have part in its great material advancement.

Also some of the older inventions caught by the genius of the modern age have formed the starting points for new series, as the electric light, which has no genetic relationship with any of the lights which preceded it. The steam engine is also a similar example.

There are two arrangements of inventions practicable—the one followed in this paper, in which the order is by the grades of inventive results attained; the other is the distribution of inventions in area, demonstrating the effects of environment as shaping or modifying factors. Both are instructive and suggestive.

The specimens are arranged in the order of their grade of development irrespective of race, place, or time. The series therefore do not always represent a direct genesis of invention. They suggest rather the genesis and indicate how the mind of man has arrived at certain datum points which mark epochs in progress. No account has been taken of the fluctuations, the countercurrents, and eddies in the stream of invention, but only those specimens are selected which show a substantial improvement amounting to an advance.

In this paper 41 series are illustrated. The series are intended to lead the reader to the threshold of the inventive period which marks the present day. The modern inventions are thus beyond the scope of this paper and should be taken up in another publication.

The preparation of the series, with its accompanying literature, is the work of Prof. Otis T. Mason, Prof. W. H. Holmes, and the writer. Hastily gathered together in the press of exposition work, it was scarcely a finished product, and despite careful review and editing for publication no doubt inaccuracies will be found and, it is hoped, condoned.

It is confidently believed that the publication of this work will greatly extend its usefulness in the educational system of the United States through its stimulation of thought and especially by the simplicity of its teaching. The development of invention is like the unfolding of the human mind. It shows the connection of the present with the past and attains one of the chief objects of science, which is to reveal the structure of our civilization.

HISTORY OF FIRE MAKING AND ILLUMINATION.

At some early period man had a knowledge of fire in nature, derived from the volcano, from lightning, or from the friction of branches in the wind, but he made no more use of it than did the animals.

At a later period he began to use fire from some one of these sources, carefully preserving it. Later he discovered that by rubbing two sticks together fire could be produced at will, and by knocking together pieces of flint and pyrites sparks capable of igniting tinder could be had. In the iron age this became the familiar flint and steel, which gave way, after a number of chemical inventions, to matches. The use of fire also marks the beginning of artificial illumination, which has developed along the lines of the torch and the lamp. The beginnings of metallurgy, ceramics, and other arts that have reached a high degree of development in this century are found in this first use of fire.

SERIES 1.—FIRE MAKING.

Plates 1 and 2.

The illustrations of specimens in the United States National Museum show the implements used in making fire through friction of wood, percussion of minerals, compression of air, focusing of the sun's rays, through chemistry, and terminating with the electric lighter.

The series is preceded by three drawings, the first two illustrating presumptive sources in nature, namely, the volcano and lightning,

from which man may have obtained fire before he knew the manner of kindling it artificially. The third picture illustrates the primitive camp fire, where fire was preserved, and the conveying of fire from one camp to another.

The steps of man's acquaintance with fire are three—the knowledge of fire, the means of utilizing it, and the means of producing it. The last step, which is one of the most important in man's history, is illustrated fully in the series.

Improvements in the method of producing fire have followed the great steps of man's progress, and, besides, each method has been subject to various modifications by different peoples. To illustrate, the simple method of rubbing out fire from two sticks with the hands has been improved by adding the bow and socket and the weighted stick, as in the pump drill, and finally the machine with cog wheels and crank employed in the Soudan.

No. 1. Volcano in action; lava setting fire to forest (pl. 1, No. 1)------ 178,157

No. 2. Lightning setting a forest on fire (pl. 1, No. 2)------ 178,157

No. 3. Camp fire; man borrowing fire (pl. 1, No. 3)------ 178,159

No. 4. Fire saw. Strip of bamboo drawn across a section of bamboo. Dyaks of Borneo and other Malays------ 178,152

No. 5. Fire thong. Rattan thong drawn over a grooved piece of wood. Dyaks of Borneo------ 178,152

No. 6. Fire plow. Blunt stick worked along a groove in a lower stick. Polynesians------ 178,152

No. 7. Fire drill. Slender rod twirled between the hands upon a lower stick having a cavity with slot. Indians of the United States and widely diffused in the world------ 176,353

No. 8. Fire drill. Rod held in a socket and gyrated by means of a cord. The lower piece of wood has a cavity with slot, opening upon a shelf. Eskimos of Alaska------ 127,644

No. 9. Fire drill. Rod held in a socket and gyrated with a bow and cord. Lower piece with cavities on a central groove. Eskimos of Alaska------ 48,078

No. 10. Fire drill. Pump drill used specially for sacred fire. Iroquois Indians, Canada.

No. 11. Strike-a-light. Flint and iron pyrites struck together as the ordinary flint and steel. Eskimos of Alaska------ 178,154

No. 12. Strike-a-light. Flint and steel and box for holding flint, steel, and tinder. Sulphur-tipped splint ignited from the tinder. England, 130,436

No. 13. Strike-a-light. Bamboo tube and striker of pottery used as flint and steel. Two boxes for tinder. Malay.

No. 14. Tinder pistol. Gunlock adapted for throwing sparks into tinder. England------ 175,712

No. 15. Strike-a-light. Combination of flint, steel, tinder, and extinguisher, for carrying in the pocket. Spain------ 178,155

No. 16. Fire syringe. Cylinder with closely fitting piston bearing tinder. Driving the piston down smartly kindles the tinder. Siamese and Malays------ 176,091

No. 17. Lens. Used for prodncing fire by focusing sunlight upon tinder. Ancient Greeks------ 178,151

No. 18. Hydrogen lamp. Hydrogen gas is made to play upon spongy platinum, causing it to glow, Germany, 1824---------- 165,440
No. 19. Match light box. Bottle of sulphuric acid, into which splints tipped with chlorate of potash and sugar were dipped. Vienna, 1809-- 151,711
No. 20. Matches. Various kinds of phosphorus matches---------- 178,156
No. 21. Electric gas lighter. Cylinder containing a small dynamo run by pressure of the finger, producing sparks between the points at the upper end of the tube. United States, 1882---------- 200,512

PRIMITIVE FIRE MAKING.

Plate 3.

California Indian making fire by friction.—California Indian man, dressed in native costume, in the act of procuring fire by means of the fire drill. The heat generated by the friction of the wood is communicated to the dust ground off during the operation, causing it to ignite. This process is, perhaps, the earliest method of procuring fire by artificial means. Hupa, Athabascan stock, California.

SERIES 2.—TORCH AND CANDLE.

Plate 4.

This series epitomizes the development of the candle, beginning with rolled leaves, the burning of the fat bodies of fishes or birds, and of faggots of resinous wood. Continuing, the series shows torches consisting of rudely aggregated slivers of wood or sheets of bark, torches of more careful manufacture, torches made of wax or resin inclosed in palm leaf, forming an exterior wick, torches of rope or cords soaked in wax or resin, the crude beginning of the candle, and follows through formed candles, dipped candles, and molded candles, terminating with the elegant art candles of the present day.

While the line of development has proceeded from the rude torch to the candle the steps marked by the specimens in the series are suggestive, embracing devices employed by many different peoples and at divers times. Following the torch in the line of development comes the lamp, which separates from the stem of the torch at a period when oils and fats came to be used. This may have occurred after the domestication of animals whose fat was available, at the time of the discovery of mineral oils, or of the utilization of vegetable oils, such as that of the olive and coconut.

The history of the lamp is shown in series 3.

No. 1. Folded palm leaf used as a torch. East Indies.
No. 2. Stormy petrel, burned in the Orkney Islands for light---------- 178,160
No. 3. Candle fish in a split stick, burned for light. Alaska---------- 178,161
No. 4. Torch made of birch bark. Iroquois Indians---------- 178,162
No. 5. Torch made of splint fat-pine knots. Virginia---------- 129,997

No. 6. Torch made of a bundle of slivers of fat pine. Southern Indians_ 178,163
No. 7. Torch made of damar gum wrapped in palm leaves. Malays_____ 76,727
No. 8. Torch or "link" made by soaking rope in resin. Europe in the Middle Ages_____ 178,164
No. 9. Torch composed of cords soaked in fat or wax. Europe, sixteenth century_____ 178,165
Nos. 10 and 11. Cord soaked in fat or wax, coiled, for lighting. England. 178,166
No. 12. Rush soaked in grease, forming a primitive candle. England_ 178,167
No. 13. Stick smeared with grease for lighting. Mongolia_____ 178,168
No. 14. Mass of fat formed upon a stick, around which is wound a wick of fiber. Kashmir, India_____ 175,141
No. 15. Tallow dip with rush wick, later cotton. Northern Europe.
No. 16. Candles formed of wax; wick of fiber. Japan and North Africa. 128,246, 178,169
No. 17. Molded candles. Patent candles of stearine, paraffine, and wax, and decorated candles. Nineteenth century_____ 178,171

SERIES 3.—LAMP.

Plates 5 and 6.

The development of the lamp has been an extremely slow process. In the centuries before Argand efforts for the improvement of the lamp were confined to multiplying the number of wicks or to selecting wicks of greater capillarity and to a less extent to the improvement of illuminants. In respect to the amount of light furnished, the Eskimo, through stress of geographical conditions, had invented a lamp superior to any in use by civilized nations up to three centuries ago.

Usages which seem to antedate the actual lamp are the customs of throwing oil or bits of inflammable material on the fire for temporary light, the use of fireflies, and the employment of the bodies of fat birds and fish, as shown in the beginning of the torch series.

The history of the lamp begins with crude objects taken from natural surroundings, such as hollow beach stones, shells, or bones, furnishing reservoirs for fats or oils. The structure of the lamps reflects the stages of the world's progress as to materials, having been successively stone, pottery, bronze, iron, and glass. There were also minor improvements in the reservoir, wick tubes, wicks, and quality of oil, as shown in the specimens.

With Argand came that important invention, the regulation of the supply of air to the wick, coupled with the employment of a chimney to increase draft.

Following this came a multitude of inventions included in the past 125 years, most of them taking their rise after the discovery of gas and petroleum, which supplied cheap and suitable illuminants.

Within 40 years the electric light has been perfected to the standard of the incandescent lamp and the incandescent arc lamp.

Gas has also shared in the progress, as displayed in the Welsbach incandescent gas burner.

Far from being superseded by these inventions, coal-oil lamps have kept pace with them in brilliancy and usefulness.

No. 1. Firefly lamp. Perforated tree gourd in which fireflies are confined for light. West Indies.
No. 2. Lamp made from the skull of a sheep---------- 178,186
No. 3. Lamp. Pecten shell with oil and wick of rush pith mounted on a forked branch. Ainos, Japan---------- 178,187
No. 4. Lamp. Unworked beach stone, with concavity, supplied with fiber wick and oil. Aleuts, Alaska---------- 13,017
No. 5. Lamp. Hollowed beach stone with moss wick arranged along one edge. Eskimos, Alaska---------- 16,900
No. 6. Lamp. Fusus shell suspended. Orkney Islands---------- 178,188
No. 7. Saucer lamp with shallow grooves for wick. India.
No. 8. Lamp. Terra-cotta saucer. India---------- 164,920
No. 9. Saucer lamp with pinched-up spout for wick. Ancient Syria.
No. 10. Stone lamp with pointed spout. Cashmere, India.
No. 11. Lamp of terra cotta. Reservoir almost closed over; spout for wick. Roman---------- 74,561
No. 12. Lamp of terra cotta. Reservoir closed over; spout for wick. Roman. 175,583
No. 13. Lamp of brass. Reservoir mounted on rod and stand; several spouts. Italian---------- 129,400
No. 14. Lamp. Designed to furnish oil to the wick under pressure. Cape Cod, Massachusetts. Colonial period---------- 151,483
No. 15. Lamp of glass having two tubes, for burning lard or whale oil. United States. Eighteenth and early nineteenth centuries---------- 130,610
No. 16. Lamp, with chimney, draft around the wick, and oil under pressure. Argand's invention. United States---------- 130,667
No. 17. Lamp. "Fluid" or camphene, burned by means of wick and tubes and without chimney. United States---------- 178,189
No. 18. Lamp, with chimney and Argand burner, oil under forced pressure of a spring. France---------- 130,669
No. 19. Lamp, with chimney; burner ventilated; tubular wick, raising refined petroleum by capillarity. United States, 1876---------- 73,829
No. 20. Gas burner. United States---------- 178,190
No. 21. Electric arc lamp. (No cut.) The familiar arc lamp would appear here.
No. 22. Incandescent hood for gas burner. Welsbach's invention---------- 178,192
No. 23. Incandescent electric lamp---------- 178,191

SERIES 4.—COOKING UTENSILS.

Plate 7.

The history of cooking begins with the camp fire. At first the methods were confined to broiling and roasting by the direct application of heat, illustrated in the series by broiling sticks and the gridiron (Nos. 1 and 2). The next step is frying, illustrated by the two specimens embraced in No. 3.

Baking is illustrated by baking dishes and the primitive earth oven and the familiar form of portable oven (Nos. 4, 5, and 6).

Boiling, which is the third method, is illustrated by the basket and stones which were heated and used in "stone boiling" and pots for boiling and stewing and culminates in the double boiler and chafing dish (Nos. 7, 8, 9, 10, and 11).

Cooking by steam is illustrated by the double vessel called the steamer (No. 13).

The series is to be regarded only as an epitome of a subject capable of extensive elaboration and which it is expected to be taken up in extenso later.

No. 1. Broiling sticks. Stuck in the ashes of the fireplace. Fish are spitted on them for broiling. Ainos, Japan. Broiling fork of iron. Sioux Indians, Dakota ---------- 150,963, 126,802

No. 2. Gridiron. Set over coals for broiling meat. Colonial period, United States ---------- 127,284

No. 3. Frying pan of stone. Frying pan on small stove of earthenware. Korea and Portugal ---------- 151,634, 178,193

No. 4. Baking dishes, of soapstone, heated and filled with acorn mush, which is baked by the heat of the stone and before the fire. Hupas, California ---------- 77,170, 77,172

No. 5. Samoan pit oven. Alternate layers of food and hot stones are placed in pit, covered over, and allowed to bake.

No. 6. Oven. Iron vessel with short legs, handle, and heavy lid, for baking by means of hot coals placed on top and underneath. United States, 130,315

No. 7. Boiling basket. Food to be cooked is placed in the basket and heated stones are dropped in. The method is known as "stone boiling." Clallams, Washington ---------- 23,512

No. 8. Coiled pot for boiling. Ancient vessel from the abandoned pueblos. Hopi, Arizona ---------- 69,874

No. 9. Tripod pot for boiling. Earthenware, with three legs, allowing the vessel to be set up in the fire. Zuñi, New Mexico. This form was acquired from the white man's cooking pots, but stands for the type ---------- 68,379

No. 10. Shoe-shaped pot. Earthenware, small handle. In use this vessel was thrust in the ashes at the side of the fire. Hopi, Arizona ---- 155,930

No. 11. Chafing dish. Combination stove for boiling and frying ------- 178,206

No. 12. Rice boiler. Double vessel, the lower containing hot water to prevent the food from scorching ---------- 178,208

No. 13. Steamer. Double vessel, the bottom of the upper portion perforated and set over the lower vessel containing hot water. Used for steaming food ---------- 178,207

HISTORY OF UTENSILS FOR PERSONAL USE.

SERIES 1.—KNIFE AND FORK.

Plate 8.

The knife and fork as eating utensils of personal use have developed together. This series shows the skewer-like fork and bamboo knife, combination knife and one-pronged fork, chopsticks and knife, combination of knife, fork, and spoon, and the modern table knives and forks.

Geographically, the ruder forks and knives are found in southeastern Asia and in the Pacific islands among peoples of a low state of culture. The Indians of the Americas are not known to have used forks of any kind, the fingers and spoons answering all purposes.

Among civilized nations the fork also developed from the skewer, and forks of two tines appeared very late, while forks of three or more tines are modern.

No. 1. Simple stick suggestive of the fork for eating marrow from a bone, South Dakota ---------- 151,494
No. 2. Bamboo knife and fork. (Model.) Andaman Islands.
No. 3. Combination knife and fork. (Model.) Andaman Islands.
No. 4. Chopsticks and knife. Japan and China---------- 175,299
No. 5. Knife and chopsticks in case. China---------- 169,151
No. 6. Combination fork and spoon, folding. Knife and spoon in one piece. Spain and Africa---------- 167,017, 167,464
No. 7. Fork and spoon in leather case. Switzerland---------- 175,246
No. 8. Knife and fork, old style. Germany---------- 175,244

SERIES 2.—SPOON.

Plate 9.

The history of the spoon begins with the introduction of methods of cooking food by boiling and stewing. The spoon has always been a utensil for conveying small portions of liquid food to the mouth, larger spoons for stirring being variations. The series suggesting the growth of the spoon begins with unmodified shells and rinds of gourds and passes through spoons showing the development of the handle to elaborately carved and ornamented specimens, closing with spoons of metal.

Although there has been a general development through successive steps of progress connecting the earliest and simplest forms of the spoon with the artistic productions of our higher civilization, the spoons employed at a given stage of culture have an extremely wide range of diversification, varying with environment. This series may serve, however, to show the full range of forms of this utensil and to suggest in a general way the course of development.

No. 1. Unmodified shells used for spoons. Mexico and California, 174,494, 131,163
No. 2. Modified shell and rind of gourd. New Guinea and British Guiana, 73,369, 45,669
No. 3. Spoons with projections designed for grasping. Tortoise shell and sea shell. Utah and Florida---------- 77,160, 14,475, 5,437
No. 4. Spoons with worked-out short handles. Shell and horn. Tennessee and Wyoming. Spoons with well-developed handles. Alaska, and Wyoming ---------- 165,912, 32,053, 56,011, 165,893
No. 5. Clamshell clamped in wooden handle. Alaska---------- 168, 368

No. 6. Spoon with elaborately carved handle of horn joined to bowl. Alaska, 88,907

No. 7. Spoon painted and decorated with geometric and conventional figures in black and red. Alaska 37,119

No. 8. Spoons of metal. Bronze spoon, Rome; pewter spoon, England. Modern pewter spoon, England 101, 164, 175, 296

SERIES 3.—CUP.

Plate 10.

The cup is older than the spoon and may well claim to be the most ancient utensil from its connection with water drinking. Theoretically, the partially closed hand and folded leaf are the most primitive cups. This series epitomizes the progress of drinking vessels and includes sea shells, cups made by bisecting hard rinds of fruit, and cups belonging to the class of tumblers. Cups with stable bases, cups with handles, cups of lacquer and metal, and cups of china complete the series.

The wide diffusion of cups in time and area renders it possible to select specimens which illustrate the effect of environment. Cups have been made of every conceivable material, and numerous natural forms have been adapted for the purpose.

The cup has also been made an expression of art and luxury from the most ancient times, and the most precious materials and cunning skill have been lavished on its manufacture.

No. 1. Shells used as drinking cups. Africa and Mexico 174,733, 174,494

No. 2. Cups made by bisecting the coconut and tree gourd. Fiji Islands and South America 164,775, 487

No. 3. Cups made of gourd and an imitative pottery form. South America and Arizona 128,324

No. 4. Cups without foot or base for support. Tree knot and horn. New Mexico and Wyoming 68,450, 165,895

No. 5. Basket cup. Apaches, Arizona.

No. 6. Cups having base or foot. Pottery and bamboo. China and India, 130,453, 130,341

No. 7. Cups and handles. Pottery and wood, decorated. New Mexico and Africa 40,643

No. 8. Cups of lacquer, metal, and elaborately carved coconut with cover. Burma and China 154,224, 176,651

SERIES 4.—TOBACCO PIPE.

Plate 11.

The pipe is a utensil for smoking tobacco or other plants and is later in point of invention than the cane cigarette or bundle of rolled leaves known as the cigar.

The first three numbers of the series show simple pipes, consisting of straight tubes of bone and wood, and curved pipes, in which

the stem and bowl are differentiated. The series proceeds through pipes with separate stems, ornamented and carved pipes, and terminates with the modern meerschaum.

It has been thought that the pipe was used for tobacco alone and that it was invented in the area where the tobacco originated. On the contrary, examples have been found in Europe which antedate those of America, and it must be concluded that the pipe was used in prehistoric times for smoking herbs other than tobacco, probably as a ceremony.

After the discovery of the New World the pipe, together with the use of tobacco, spread with wonderful rapidity over the whole earth.

No. 1. Pipes made of straight bone tubes, slightly worked. Comanche and Kiowa Indians_____ 6,901, 6,902
No. 2. Straight pipe of wood with stone bowl set in the end. California_ 77,182
No. 3. Curved pipes of clay and stone, with stem differentiated. Virginia, England, Oregon, and Washington_____ 165,458, 129,692, 720, 1,984
No. 4. Pipes of stone, with bowl and stem separate. Pipe of catlinite inlaid with metal (platform type); mound bird pipe. Mound builders, North Carolina, and Plains Indians_____ 130,497, 131,326, 18,813
No. 5. Pipes with stem and bowl separate. Alaska, Labrador, and Japan_ 89,289, 90,083, 4,035
No. 6. Pipe of pottery. Human figure, seated. Africa_____ 151,138
No. 7. Pipe of carved wood inlaid with abalone shell; mythological subjects. Alaska_____ 74,925, 74,924
No. 8. Meerschaum pipe, silver mounted, with cover. Germany_____ 130,652

HISTORY OF TOOLS.

This subject embraces the common hand tools which were used in the more primitive periods. They serve as extensions of the hand for definite purposes, and the motive power is the energy of human muscles. They consist of cutting tools, as the jackknife (series 1), the ax (series 2 and 3), the adz (series 4); pressure and abrading tools, as the hammer (series 1), the saw (series 2), the drill (series 3), and the scraper (series 4). These eight series represent tools which have had a profound effect on human history in its earlier phases. They have come down into this age and have been given vastly increased powers. They are still and will forever remain the indispensable agencies which articulate the hand of man with material nature.

SERIES 1.—JACKKNIFE.

Plate 12.

Among industrial tools of general use there is a class for cutting, commonly called "edge tools." These vary in structure, manner of working, and results, and have received different names, such as knives, chisels, axes, and so on.

The jackknife is a tool for whittling, for making chips or shavings in wood and like substances, and always works by pressure, never by a blow. The first jackknives were spalls of siliceous stone, little modified from natural forms, having one portion, the working part, sharp, the other portion, or manual part, after a fashion fitting the hand. The elaboration of the jackknife consists in the development of the blade, the handle, and the connective devices between them. The series ends with complicated forms for general use and differentiated forms in endless variety for special crafts. In the mechanical stage of industry the functions of the jackknife are performed with great celerity in planing mills. The plane itself is a jackknife working with a gauge. The objects exhibited in this series are suggestive of steps in the elaboration of the jackknife.

No. 1. Knife consisting of spall of stone---------- 173,563
No. 2. Knives consisting of spalls slightly modified---------- 30,504, 146,131
No. 3. Knife consisting of long flakes specially selected---------- 99,918
No. 4. Knife from long flake, chipped on the edge---------- 173,566
No. 5. Symmetrically chipped blades, the grip formed by wrapping one end with fur---------- 98,813, 26,230
No. 6. Chipped blades, with tang for attaching to the end of the handle-- 17,319, 14,329, 63,769
No. 7. Chipped or ground blades of stone, with tang for side hafting---- 48,826, 136,991
No. 8. Knives of bamboo, the hard exterior forming the cutting edge. West Borneo and Gaboon River, Africa---------- 249,048, 164,484
No. 9. Knife of ivory with slightly shaped handle. Knife of scapular bone with wrapped handle. Eskimos, Alaska---------- 26,040
No. 10. Clam shell with sharpened edge. Beaver tooth set in handle. Eskimos and Indians, Alaska---------- 36,366, 168,352
No. 11. Copper and bronze blades; handle and blade in one piece- 101,223, 101,405
No. 12. Metal blades, with tangs to be driven into the ends of handles.
No. 13. Metal blades, with sockets for handles---------- 147,420, 14,722
No. 14. Metal blades, with flat tangs for rivets---------- 101,338, 45,948
No. 15. Hinged blades, closing in the handle. Morocco-------- 130,324, 168,804
No. 16. Hinged blade, closing in the handle with a spring. American Frontier. 54,340
No. 17. Farrier's knife, with hinges and springs, showing a variety of blades.

SERIES 2.—EUROPEAN AX.

Plate 13.

The lowest form of the ax is a fragment of stone so sharp that, held in the hand, it can be used as a chopping tool. An important first step in human progress was the discovery of means for increasing the efficiency of this natural tool by sharpening its edge. For a long period this was accomplished by striking off flakes with another stone; later pecking and grinding were employed for this purpose, and handles were attached in various ways to give greater power to the stroke. It was a long time before metal came into use, and it is

only very recently that the invention of steel has furnished humanity with a satisfactory chopping tool. The most important function of the modern ax is the cutting of wood. The bronze ax took many forms in Europe, and in the series here presented these are followed by two stone axes which, on account of their method of hafting, are placed next the iron and steel tools.

In early days the ax was a weapon as well as an implement, and with simple peoples it still serves as a weapon. The machine ax, of which a model is presented in No. 16, is a comparatively simple contrivance when placed alongside of the marvelous machines that stand at the head of some of the other lines of mechanical progress.

No. 1. Stone ax or hatchet, earliest and simplest form of cutting implement known to have been made by man. Nodule of flint roughly flaked. France. Thennes ---------- 99,440
No. 2. Stone ax or hatchet of flint, shaped by chipping. Sweden ---------- 137,521
No. 3. Stone ax or hatchet of flint, shaped by chipping and finished by grinding. Sweden ---------- 136,743
No. 4. Stone ax or hatchet of nonchippable material, pecked into form and then ground ---------- 15,868
No. 5. Stone ax or hatchet; nonchippable material, pecked into form; ground and polished; poll roughened for insertion in wooden handle. Switzerland ---------- 100,614
No. 6. Stone ax or hatchet; serpentine; ground; fitted in staghorn socket for insertion in wooden handle. Switzerland ---------- 100,554
No. 7. Bronze ax or hatchet; cast; flat blade pointed above for insertion in wooden handle. France ---------- 136,700
No. 8. Bronze ax or hatchet; cast; blade flat with raised edges, to be inserted in handle ---------- 148,628
No. 9. Bronze ax or hatchet; cast; wings and stop to aid in fixing handle ---------- 101,101
No. 10. Bronze ax or hatchet; cast; wide wings at sides and hood at upper end for attaching handle ---------- 101,172
No. 11. Bronze ax or hatchet; cast; socketed for insertion of handle; ring at side to aid in fixing handle ---------- 101,110
No. 12. Stone ax or hatchet, pecked into form and then ground; drilled for insertion of handle Sweden ---------- 101,046
No. 13. Stone ax or hatchet, pecked into form and ground; drilled for insertion of handle ---------- 137,138
No. 14. Modern iron ax; curved poll; used for timbering. Fusan, Korea, 129,495
No. 15. Modern chopping ax; iron and steel; in common use in United States.
No. 16. Wood-splitting ax; operated by steam power.

SERIES 3.—ABORIGINAL AMERICAN AX.

Plate 14.

A comparison of the American with the European stone ax is instructive. In America the typical implement is the grooved ax, which has a development well indicated in the series here shown. With the grooved ax there is associated a closely related family of

tools, generally known as celts, and it is these that present the closest analogy with the ax or hatchet of Europe, shown in series 2.

The first step in the series is a sharp-edged stone which is suited for use in the hand. Next comes the notched ax, which is roughly indented at the sides to facilitate hafting. Following are several examples indicating progress in the method of hafting. The West Indian and South American forms differ widely from the North American; they lack the typical groove, besides presenting other varieties of haft attachment features. The perforation seen in Nos. 12 and 13, although observed in many parts of America, was not in general use.

The order of development is not derived from any one people or group of peoples, but in a general way corresponds, no doubt, with the course of progress on the Eastern continent.

The uses to which the ax and its associated tool, the celt, were devoted cover a wide range of activities.

No. 1. Stone ax made by splitting a flattish bowlder. Held in hand and used as a chopper. Seen in use among California Indians---------- 139,793

No. 2. Stone ax made from oval water-worn bowlder; chipped from one side to a rude edge; held in the hand; possibly hafted. Virginia------- 1,073

No. 3. Notched stone ax; fragment of rock chipped slightly on margins and notched for attachment of handle. Virginia---------- 173,213

No. 4. Grooved stone ax; water-worn pebble of trap rock partially pecked or battered into shape and then ground to an edge; poll used as a hammer. Rhode Island---------- 17,639

No. 5. Grooved stone ax; porphyry; pecked into shape and then ground; encircling groove with bordering ridges. Massachusetts---------- 6,542

No. 6. Ground stone ax; fine-grained stone; ground all over; flat back; groove bordering ridges. Ohio---------- 29,014

No. 7. Grooved stone ax, two-edged; groove in middle, with bordering ridges; surface ground and part polished. Pennsylvania---------- 2,352

No. 8. Grooved stone ax; blade nearly round; ground all over; groove near poll, encircling ridge above; pointed poll. Costa Rica---------- 137,023

No. 9. Stone ax, squarish outline; polished all over, with notches in edges for attachment to handle; poll hollowed to fit handle above-------- 17,280

No. 10. Stone ax; semilunar blade, with tenon or stem for insertion in handle. Brazil---------- 27,003

No. 11. Copper ax with winged poll for attachment by cords to handle. Cuzco, Peru---------- 195,554

No. 12. Stone ax; water-worn pebble pecked and ground to edge; hole drilled through center flatwise; poll squared and ground lengthwise for attachment of handle by cords. Bolivia---------- 27,087

No. 13. Copper ax, chopping-knife form; stem or poll perforated for attachment of handle. Peru---------- 146,073

SERIES 4.—ADZ.

Plate 15.

The adz had its beginnings in the same forms and the same group of activities as the ax, the celt, and the scraper. Its differentiation

took place no doubt when the shaping of wood became an important feature in the savage economy. In the most primitive forms the stone blade is flaked into shape (No. 1), and in the more highly developed (Nos. 4 and 5) it is pecked and ground, the distinguishing characteristic of the implement being the single bevel of the edge. The hafting is accomplished in a variety of ways. One of the highest forms of the simple tool is the steel hand adz of the present period (No. 12). This implement may be regarded as the prototype of the modern planing machine, which is a compound adz, several blades being mounted on a revolving shaft. A model of this device appears in No. 13, which is the working part of the superb machines of to-day.

No. 1. Blade of flint, reduced to a beveled edge by flaking. Simpler forms are sharp stones identical with the earliest axes. Virginia_____ 1,073

No. 2. Adz made of column of conch shell by grinding an edge, mainly from one side. Simple style of hafting. Florida_____ 3,687

No. 3. Adz made of diorite flaked into shape and sharpened by grinding. Primitive hafting. Samoa_____ 19,342

No. 4. Stone adz, pecked and ground into shape; wooden handle attached with twigs. British Columbia_____ 88,720

No. 5. Polished stone adz, neatly fixed to an effective wooden handle. New Guinea_____ 73,355

No. 6. Stone adz, with hollowed blade, curved edge, and shell adz, showing origin of this form. Rhode Island and West Indies_____ 17,687, 747

No. 7. Copper adz blade, shaped by hammering; well specialized form; curved edge. New York_____ 18,960

No. 8. Copper adz blade, shaped by hammering; socket for handle, made by incurving margins. Wisconsin_____ 32,615

No. 9. Iron blade fixed on primitive handle by means of buckskin thong. Indians of Washington_____ 130,983

No. 10. Iron blade of modern type, with highly specialized handhold attached by leather strap. Indians of Washington_____ 74,770

No. 11. Small, rudely hafted adz; blade and method of hafting advanced shape. Ceylon_____ 168,684

No. 12. Common steel adz for use in one hand; highly specialized shape. United States.

No. 13. Cutter head of modern planing machine. May be regarded as a compound adz.

SERIES 1.—HAMMER.

Plate 16.

The hammer has been from the beginning an important factor in human progress. The earliest known forms are round stones, which were employed in various useful arts, for shaping implements, in war, and in the chase. Identical forms are used by such living tribes as still occupy the first few rounds of the ladder of culture.

As the pioneers of civilization advanced step by step to higher levels the hammer was modified and improved. The simple rounded stone gave way to the specially shaped stone, and then the art of hafting

was devised, which conferred on the user vastly augmented power. The implement was notched, grooved, or perforated to aid in fixing the handle. Later on stone was supplemented by metal. Copper, bronze, iron, and steel followed in order.

The triumphs of human effort and ingenuity may be realized by comparing the stone hammer, still in use by half the race, with the machine hammer of to-day, illustrated in No. 14.

In very early times with our own race the hammer served as a weapon, and it still serves as such with most primitive people. In civilization this office is taken by more highly perfected devices, but vast expanse of function has taken place in our modern industries.

No. 1. Hammerstones. Natural pebbles of quartzite, modified by use in shaping stone implements. New Mexico and Ohio_____ 98,343, 130,554
No. 2. Hammerstones. Nodules of flint worn round by use. The usual stone-shaping hammer in Europe and America. Switzerland_ 100,561, 98,342
No. 3. Hammerstones. Natural forms battered around the periphery, with depressions in the sides. New York and Arizona_____ 6,602, 133,590
No. 4. Grooved hammers, slightly grooved for attachment of withe handle. Lake Superior_____ ———, 2,334
No. 5. Grooved hammers, deeply grooved for mounting. Arizona.
No. 6. Stone hammer; rude granite; marks of use on face; ivory handle attaching by lashing of sinews. Eskimo_____ 89,655
No. 7. Stone hammer; bowlder modified by use; slightly grooved; withe handle covered with buckskin. Great Plains_____ 152,312
No. 8. Ivory hammer with modern handle, notched or grained in and fastened with cord.
No. 9. Hammers, one of staghorn, one of stone; drilled for insertion of handles. Swiss Lake, Yverdon_____ 100,634, 100,708
No. 10. Stone hammers, pecked and ground; drilled for handles; hammer face and ax or hatchet edge. Denmark and Prussia_____ 58,552, 137,134
No. 11. Old-fashioned claw hammer of iron, square face. Finland____ 167,876
No. 12. Modern blacksmith's hammer; cast steel; round face and peen.
No. 13. Modern claw hammer; cast steel; round face.
No. 14. Modern machine hammer.

SERIES 2.—SAW.

Plate 17.

The saw is a tool for severing materials by abrasion and cutting. The most primitive form of the saw is a siliceous stone having a ragged edge. Such an implement would be of great service to the savage in his working in wood, bone, horn, antler, ivory, and stone. The series passes through forms in stone, in sand cutting, and in metal, and finds its climax in the saw with composite edge in the sawmill, and in the refinement and specialization of the working part of the implement for various kinds of cutting. The prehistoric peoples of Europe as well as of America used stone saws for wood and bone. They were chipped flint, resembling knife blades, three or more inches long and serrated on one edge. As the objects cut did

not exceed an inch or two in diameter, these were ample for their needs. The Eskimos made their harpoon heads of hard serpentine and jadeite and by means of sand and slate were able to sever blocks of these stones 8 inches wide and 2 inches thick. The discovery of copper greatly added to the effectiveness of the implement, this metal being an excellent carrier of sand. The use of steel and of diamond edges and the perfecting of the teeth bring the saw to its latest effective forms.

No. 1. Flake, with rough edges, one portion better fitted for the hand_ 100,591
No. 2. Flakes specially made for saws, chipped_____ 100,471, 173,568
No. 3. Spearhead specially modified for saw_____ 171,454
No. 4. Flint saw, one edge specially chipped, the other curved to fit in a handle_____ 100,965
No. 5. Sand saw; cutting done by means of wet or dry sand carried by wood or soft stone_____ 13,120
No. 6. Saw of soft metal to carry emery, corundum, or hard cutting material, 55,945
No. 7. Steel saw blade with irregular teeth; handle variously attached__ 2,318
No. 8. Steel saw; serrate teeth; with or without backing_____ 120,501
No. 9. Steel saw with serrate teeth; set_____ 128,154
No. 10. Japanese saw with reversed teeth_____ 128,151
No. 11. Modern panel saw of steel; skewback; handle of wood to fit the hand; teeth set. Gift of Henry Disston and Sons.
No. 12. Crosscut saw for one man, with separate handles for each hand; teeth dentate, not set. (Model.) Gift of Henry Disston and Sons.
No. 13. Crosscut saw for two men; teeth dentate; back and front curved outward. (Model.) Gift of Henry Disston and Sons.
No. 14. Circular saw and band saw. Both have serrate teeth and are designed to have continuous motion, the one revolving on an axle, the other working over two drums. Gift of Henry Disston and Sons.
No. 15. Sections of crosscut saws: (1) teeth, three-fourths of an inch apart; (2) Humboldt pattern, with two cutting and one double-pointed scraping teeth; (3) "fleam tooth" with double cutting points, perforated. Gift of Henry Disston and Sons.

SERIES 3.—DRILL.

Plate 18.

A drill is a tool for making a hole. When acting in soft materials it plays the part of an awl or needle and is then moved by pressure. In hard substances drills of a class acted upon by hammers give rise to tools called punches. Drills of a third class, shown in this exhibit, act through circular friction, either by continuous or by reciprocating motion. This class becomes, according to the actions and sizes and the nature of their working parts, brad awls, gimlets, drills, augers, and so on. The most primitive form of the drill is a natural object with a hard point. Among savage peoples drills of hard stone are made by flaking one portion to a point and leaving the other for a hand hold. Stone drill points are followed by those of metal, which

are pointed, chisel-edged, tubular, screw-shaped, or bladed, as in the latest forms. The manual part of the drill is at first a mere adaptation to the hand of a portion of the tool. This is followed by crude handles, spindle shafts, strap drills, pump drills, and so on, up to the machine drills of our factories.

The Eskimos have three styles of apparatus for drilling—the hand drill, the strap drill, and the bow drill. The strap drill, as a rule, requires the services of two men, while the bow drill may be operated by one man, using also the mouthpiece for a pivot at the upper end of the shaft. The driller kneels or sits upon the ground and holds the object to be bored in his left hand. The working end of the shaft pierces this object, while the upper end is pointed and operated in a stone or other hard socket set into the wooden mouthpiece, which is grasped firmly by the teeth. With his right hand he revolves the shaft by means of a bow and cord.

No. 1. Cores of flakable stone, pointed for drilling. The grip may be finished with pitch or wrapping---------- 23,659, 18,302

No. 2. Chipped drills with slender bits and flattened or crutch-shape grip. This flattened portion could be inserted in a "saw cut" at the end of a handle---------- 32,526, 13,721, 173,790, 19.500

No. 3. Drill bits of stone and metal, the last named driven into the end of a piece of antler with crutch-shape grip---------- 181,655, 89,973

No. 4. Drill bits of copper; useful in boring soft material without sand and hard material with sand. Method of hafting not known---------- 147,334, 147,345, 147,309(2)

No. 5. Spindle drill. Bit of iron or stone. The shaft is held between the palms of the hands and driven by reciprocating motion or worked on the naked thigh with one hand---------- 128,751

No. 6. Strap drill, consisting of spindle and bit, mouthpiece and socket, and driving strap of rawhide, wrapped once about the spindle and driven by the two hands holding of grips of bear's teeth at the ends--- 33,654

No. 7. Bow drill. Spindle of wood, bit of iron, bow from seal's rib, mouthpiece of wood with stone socket. Reciprocating circular motion is produced by the backward and forward motion of the bowstring---------- 177,734

No. 8. Pump drill. (Model.) Its parts are spindle and stone bit, spindle whorl, horizontal grip pierced by the spindle, and string of buckskin for driving. Reciprocating motion is given by the vertical movement of the grip---------- 134,168

No. 9. Finland auger, consisting of bit inserted in the end of the stock; handle fitted in a mortise through the stock; socket of wood to fit against the breast, bolted to the upper end of stock---------- 167,785

No. 10. Drill bits made from hardened steel, for boring steel and iron.

No. 11. Steel bits for boring in wood and similar materials. In China and Japan such bits were worked in straight handles.

No. 12. Steel center bit with gauge to regulate the size of the hole.

No. 13. Common brace and center bit for boring. These braces have fixed connective joints, and bits all have the same size butt.

No. 14. Brace with adjustable connective to fit the top of the bit.

No. 15. Mechanical drill. Spindle a screw with long thread, pivoted in a fixed handle above, moved by a nut of wood forced up and down the spindle.

PRIMITIVE SKIN DRESSING.

Plate 19.

Sioux Indian women dressing hides.—The Indians of the Great Plains were excellent skin dressers. Two classes of operations were employed; one pertained to the dressing of robes and the other to the tawing of hides. In the first operation the hair was not removed, but in the case of the larger animals the inner part of the skin was split off, so as to render the hides soft and pliable. By the other operation the skin, after being sweated, was depilated by means of scrapers of bone.

The Sioux Indian woman here shown is engaged in thinning a hide with an iron-tipped scraping tool after the preliminary process of unhairing has been completed.

SERIES 4.—SCRAPER.

Plate 20.

The scraper is a tool with an edge for abrading by pressure and friction. A knife, a piece of glass, or any edged tool may become a scraper if dragged over a proper surface at a proper angle. Stone or shells are primitive scrapers; they undergo modifications of form to suit the materials scraped, whether they be hides and other soft substances or harder materials, as wood, horn, bone, or ivory. The primeval mechanic employed scraping processes extensively in his work. The Eskimos scrape ivory and antler into shape with flint stones chipped to an edge. The Pacific coast tribes remove the superfluous wood, in excavating canoes and dishes, with scrapers. Savage women rely on the scraper to reduce the thickness of hides. Simple forms of the scraper are still employed, but are made of steel, by butchers, cabinetmakers, and other craftsmen for precisely the function it had in the beginning. The scraper has not, in the progress of industry, become to any extent a machine tool.

No. 1. Scrapers; spalls of hard stone with natural edges---------- 99,610
No. 2. Spalls of hard stone with chipped edges for scraping---- 99,310, 10,910
No. 3. Chipped scrapers with steep edges, specialized; notched for hafting, 146,229, 99,311
No. 4. Chisel-edge scrapers of fine-grained material. If worked with a blow and not by friction these become adz blades---------- 36,290, 127,719
No. 5. Eskimo scrapers set in grips of wood or ivory that fit the hand, 63,847, 63,852, 24,361
No. 6. Chipped scraper fitting in handle of antler, working like an adz.
No. 7. Chisel-edge scraper of fine-grained stone fitted into the end of a curved handle. Pits at the manual end to fit the fingers---------- 43,927
No. 8. Scraper with iron blade, toothed slightly to render more efficient in special work of hide dressing---------- 89,926
No. 9. Currier's tools for scraping and scouring hides---------- 104,688

No. 10. Scraper used largely by merchants in erasing marks from packing boxes.

No. 11. Scraper in use among greengrocers and butchers to clean their blocks.

HISTORY OF HAND WEAPONS WITH BLADES.

Omitting the employment of fire, smoke, poison, etc., to destroy life, the weapons of mankind are of three kinds—pointed weapons to pierce some vital part; edged weapons to cut the muscular tissues and even to chop the bony structure; and striking weapons to stun, to bruise, and to break the bones.

They are (1) held in the hand; (2) attached to the end of a shaft; (3) hurled from the hand, as a javelin; (4) shot from a bow, arbalest, catapult, or gun, or (5) thrown from a sling, throwing stick, or balista.

Natural objects, slightly modified, were the first cutting or slashing weapons. In one area they were shark's teeth fastened on a handle; in another silicious stones, used singly or on shafts, did the murderous work. Weapons of this class, however, were crude until the age of metals, when they assumed the first rank.

In the two series here exhibited hand weapons for piercing and cutting are shown. The first sets forth the development of the dagger, the second that of the saber and the sword. The two series run into each other so that there are no sharp lines of demarcation.

SERIES 1.—HAND WEAPONS FOR PIERCING OR STABBING.

Plate 21.

Daggers undergo various modifications, according to the grade of culture, the materials at hand, and the taste or idiosyncrasies of peoples. The series here shown is suggestive of the steps of progress in hand weapons for piercing. The first forms were pointed spines of vegetal or animal substances, either in their natural state or ground to a point. Metal weapons of this class for merely piercing are scarce. The function of cutting as well is easily added by making the blade triangular and sharpening the sides. The effect is then to pierce a vital organ or to sever a blood vessel. The bayonet is the modern expression of the hand weapon for piercing added to a musket or rifle.

No. 1. Fragments of flinty stone slightly sharpened at one end to form a point---------- 100,257

No. 2. Prongs of antlers, one end sharpened, the other serving for a grip, 99,568, 137,208

No. 3. Split thigh bones ground to a point at one end, the other serving for a grip---------- 58,241, 167,760

No. 4. Pointed bone and antler, with grip cut out into forms------ 156,624, 19,269

No. 5. Long blades of chipped stone pointed at one end---------- 20,419

No. 6. Chipped blades, hastate in outline, with blade and grip in one piece, but distinctly outlined_____ 58,485, 32,831
No. 7. Blades of chipped stone, chipped glass, and iron set in the ends of spindle-shaped handles_____ 168,563, 131,220, 16,361
No. 8. Leaf-shaped blades of chipped stone and metal set in grips of wood and covered with pitch or hide_____ 5,532, 126,527
No. 9. Copper blades, lanceolate, with tangs for hafting_____ 191, 587, 149,722
No. 10. Bronze blades with socket or flat tang for hafting_____ 101,347
No. 11. Double dagger of copper from Sitka, Alaska. Lanceolate blade, plain on one side, fluted on the other; constricted to form the grip; butt end pentagonal and ornamented with the design of a human face___ 89,020
No. 12. African curved knife with crescent-shaped blade, pointed, and having angular offsets from the edges near the base; tang drawn into the hilt. Serves for slashing, cutting, picking, and throwing_____ 174,899
No. 13. Bagdad dagger saber with curved blade; ribbed along the middle on each face; tang driven into the hilt, which is a flat ellipse in section cut out to form the grip_____ 151,829
No. 14. Malay krises, one with straight, one with flame-shaped blade; hilt carved to fit the hand_____ 153,339, 153,341
No. 15. Catalan hinged dagger. Razor-shaped blade; hinge furnished with spring and with ratchet to set the blade at several angles; handle, of double design, adorned with brass and mother-of-pearl__ 151,161

SERIES 2.—WEAPONS FOR CUTTING AND THRUSTING.

Plate 22.

Cut-and-thrust weapons, with hilts, form the class, including sabers, swords, rapiers, claymores, and their congeners. When fastened to the end of a shaft or handle, they are halberts or Japanese long swords; when thrown from the hand, they branch out into the large class of African trumbases and throwing irons. The cut-and-thrust series here shown begins with a natural object, pointed and capable of slashing, and proceeds along the road of progress in ways suggested in this exhibit. The saber has but one edge, the back being thick and strong. The sword is the perfection of this type of weapons, having two edges and a point. The saber cuts flesh and blood vessels, and in its modern form with its dull edge also makes ugly bruises, and so comes into the category of bruising weapons. The sword is for piercing, cutting, and even for breaking bones, and in its largest form is used with both hands. Burton regards it as the most exalted weapon in single combats.

No. 1. Flakes of obsidian and flint suitable for slashing. Mexico_ 35,159, 149,866
No. 2. Beautifully chipped blade, both edges sharpened and both ends pointed. Kentucky. May have had fur wrapped around one end to form a grip _____ 2,407
No. 3. Sharks'-teeth slashing weapon, in which a wooden blade has sharks' teeth sewed close together on both edges. Gilbert Islands. Cocoanut-fiber armor coexists with weapons of this class___ 3,697, 178,064

No. 4. Copper blades for slashing, with grip, tang, or socket for hafting. Illinois, Greece, and Italy---------- 7,535

No. 5. Boarding blade turned into a slashing weapon by wrapping the tang with split spruce root. Eskimos, Mackenzie River---------- 2,077

No. 6. Slashing weapon, Malay blade, razor-shaped; tang driven into the end of the hilt. The latter is octagonal in section at the butt, curved, tapering forward, and ornamented with hair and basket work in bamboo ---------- 154,130

No. 7. Nepaul sword (*kookri*) with curved, leaf-shaped blade, thick on the back and chisel-edged; hilt of wood, fitting close to the blade, which has a shoulder on the tang; sword breaker on the blade near the tang. India---------- 126,691

No. 8. Cutlass or machete. Blade of steel, thin, wide, curved at the end, double grooved at the back; tang flat, riveted between two pieces of carved wood to form the grip---------- 151,162

No. 9. Japanese saber with nearly straight blade, pentagonal in section; grip of wood, with brass cap and ferrule and ornamented with knotted leather thong; guard against thrust.

No. 10. Cutlass. Straight two-edged blade; brass hilt, with guard. American Navy.

No. 11. Bronze sword. Blade long, leaf-shaped, and grooved, inserted into hilt piece and riveted; grip ridged; pommel adorned with open work. Roman.

No. 12. Gaboon sword, West Central Africa. Blade short, leaf-shaped, slightly ribbed, finely chased, and punched at inner end. This portion is furnished with sword-breaking attachment. Hilt elaborately adorned with wirework---------- 164,912

No. 13. Chinese sword. Blade tapering slightly, point angular, shoulder of chased brass, covering the end of the scabbard; grip of bone, fluted; pommel of chased brass, with figure of Good Fortune---------- 167,002

HISTORY OF PIERCING PROJECTILE WEAPONS.

Piercing weapons are either held in the hand or attached to a shaft. They are thrown from the hand, slung from the throwing stick, or moved by elasticity. Those moved by elasticity may be discharged from a blowtube, from a bow, from an arbalest, or from a firearm. The progress of invention in the piercing projectile is marked in the perfecting, firstly, of the projectile itself; secondly, of the elastic device or projector; and, thirdly, of the mechanism of release. Illustrations of the projectile are not shown. The series presented here serves to illustrate the progress of the bow and the arbalest, bringing the development to the gun and the pistol.

SERIES 5.—BOW AND ARBALEST.

Plate 23.

The bow is an elastic rod or stave which is bent, the two ends being united by a tough string. A bolt is shot from this apparatus, either to pierce, to cut, or to bruise. The first bows were unmodified staves;

the latest were made up of several pieces of different kinds of wood glued together and lined on the back with sinew or tough rawhide. The inner layer supplies the element of rigidity; the outer layer or back that of elasticity, and these two layers are held firmly in place by side pieces glued on. The limit of the simple bow is that of the muscular effort required to bend it; but if the bow be fastened to a stick, as in the bow gun or arbalest, then mechanical devices can be used to bend it, so that its rigidity and efficiency may be increased immensely; in fact, the different types of arbalest receive their names from the methods of bending the bow. There were three distinct varieties of this weapon—the *arbalete à pied-de-biche*, or hind's foot; the *arbalete à tour*, or rack-and-pinion crossbow, or great-stirrup crossbow; and the *arbalete à cry ro à cric*—lever crossbow in English.

No. 1. Zuñi bow. Plain sapling split and little modified; string of sinew cord. The Zuñi arrows are poorly made---------- 69,574

No. 2. Sioux bow of hardwood. In this example is illustrated the double curve produced by heating and bending---------- 1,769

No. 3. Yew bow of Oregon, overlaid on the back with sinew mixed with glue; grips covered with buckskin; nocks ornamented with fur; string of sinew.

No. 4. Eskimo sinew-backed bow of brittle wood, strengthened by ingenious wrappings of sinew cord, which is also laid in a cable along the back. The peculiar curve is that of the northern Asiatic bow.

No. 5. Compound bow of the eastern Eskimo, of three pieces of whale's rib, forming the grip and the wings. These are united with seizings of sinew thread and rivets, and the whole strengthened by sinew backing---------- 19,513

No. 6. Crossbow from northern Labrador. Probably a toy, but illustrating a very primitive type of this weapon. Stock of pine wood; bowstring of sinew---------- 73,017

No. 7. Chinese magazine crossbow. Darts are placed in a magazine having two slots and are discharged in pairs. The magazine is tilted, with the lever letting off the string.

HISTORY OF FISHING.

The art of capturing animals for food and other purposes has required a vast amount of tools and appliances. Herein the mind of man is pitted against the natural instincts of self-preservation, which animals have in a high degree. The result is an advanced order of inventions. From these the series relating to fishing has been selected.

The term fishing applies to the capture of animals living in the water. The apparatus used may be divided into two general classes—that by which the animal is taken involuntarily and that in which it effects self-capture or destruction. Those of the first class are usually called fishing implements, those of the latter traps. The

most primitive method of fishing is hand capture. Clubs for striking, nets and weirs for entangling, and poison for asphyxiating are all found among the instruments employed in this art; but the pointed implement is most common and has had varied differentiation. In this exhibit are shown four illustrative series—harpoon barbs, harpoon toggles, fishhooks, and sinkers. In the progress of invention the classes become intermingled. The first hooks or spears were very simple affairs. Aquatic animals, useful to men, were abundant and unwary. The increase of demand through enlargement of population rendered the animals more difficult to take, and the natural tendency of all peoples to accomplish the same end with less effort tended toward the improvement of the hook and the spear. So the efficiency of the hook, the length of the line, and the complication of the barb and the toggle have been modified and improved as culture advanced.

SERIES 1.—HARPOON BARB.

Plate 24.

The barbed harpoon (series 1) retrieves the animal by hooking into its skin or flesh. Its parts are the shaft or manual portion, and the head or working portion. In some examples the tang of the head is driven into the end of the shaft, in which case the implement is generally termed a spear; in other cases the butt end fits loosely into the shaft, so as to be easily withdrawn; it is then a harpoon. A short piece of line or rawhide is tied around a knob or through a hole in the head, and at the other end is fastened to the shaft. When the animal is struck the barb becomes hooked under the skin of the game, whose motions withdraw the head from the shaft, so that it is not broken. The line enables the hunter to retrieve. This type of apparatus begins with a natural object, which may have spines upon it, and passes through a refinement of the various portions of the structure in adapting it to animals of different sizes and habits. In fresh water the retriever is little more than a hand device for seizing, but among the Polynesians the handles to barbed spears used in sea fishing are 20 feet long. The Fuegians use a barbed head on a shaft quite as long, and the two parts are united by means of a short line.

No. 1. Bone head for small barbed harpoon; barb cut on one side. Heads of this kind are driven into the end of a shaft---------- 100,533

No. 2. Patagonian harpoon head with one large barb. This head fits loosely into the end of a long shaft and is attached by a short line---- 131,217

No. 3. Patagonian harpoon head with 21 barbs, all on one side. Fits loosely in the end of the shaft---------- 131,219

No. 4. Patagonian harpoon heads, arrow-shaped; tang fitting in a socket at the end of the shaft; attached to the shaft by short line-- 131,218, 129,488

No. 5. Ancient harpoon heads from French caves in form of arrowheads with many barbs; made to fit loosely in the end of the shaft; short connecting line tied in a hole or around the tang---------- 100,530, 8,145

No. 6. Ancient Peruvian harpoon heads, each having a bone shank and barbs of hardwood seized on near the point. The butt fits in a socket, and the head is attached to a line---------- 176,795 (3)

No. 7. Ancient Peruvian harpoon head in three parts; arrow-shaped blade of quartz inserted and wrapped with cotton thread; barb of bone wrapped on the shank; shank of wood, with butt terminating in a cone to be inserted in the shaft---------- 176,796

No. 8. Kodiak harpoon head, Alaska. Head of chert, set in a shank of bone and wrapped with sinew thread; shank winged and round on the back; barbs three, made by saw cuts in the wing, butt tapering to fit in a socket---------- 73,292

No. 9. Harpoon head from Mackenzie River, similar to No. 8, except that through trade with whalers and the Hudson Bay Company an iron blade, riveted, replaces one of stone---------- 7,420

No. 10. Harpoon heads of native copper and iron in one piece, from Sitka, Alaska. The barbs are all on one side---------- 6,564

No. 11. Harpoon head of iron, from the Haida Indians, of Queen Charlotte Islands. Blade, barbs, and shank all in one piece; barbs alternating on the two sides of the shank; tang flattened and rounded for insertion; line braided from sinew---------- 88,927

No. 12. Barbed seal harpoon from Norton Sound, Alaska, showing the barbed head, the foreshaft and its attachment to the shaft, the martingale or leader fastening the head to the shaft after the former is detached---------- 33,944

No. 13. Shell-point barbed whale harpoon with leader. Makah Indians, Vancouver Island, British Columbia---------- ———

No. 14. Gaff hook from China with harpoon point and single barb, socketed to be fixed on a shaft---------- ———

No. 15. Barbed harpoon head or lily iron, of brass, for swordfish; barbs hinged to close in entering the fish and open for retrieving; butt socketed; becket rove through line hole---------- 103,037

SERIES 2.—TOGGLE HARPOONS.

Plate 25.

The toggle harpoon is a piercing retrieving weapon driven into the animal by means of a shaft. The toggle is attached to the end of a line, and when the shaft is withdrawn it turns crosswise in the body of the game, enabling the hunter to retrieve. In the simplest forms a pointed bone serves for a toggle, but in the whaling harpoons much ingenuity has been exercised in perfecting the various parts, namely, the blade, the hinge, the barb, the socket, the line, the loose shaft, and the shaft. In some examples poison and explosives are used. There is a form of toggle used in catching water birds, fish, and crocodiles which is baited, and thus becomes a fishhook or gorge. The Aleuts shoot the sea otter with a delicate arrow which has all the parts of the toggle harpoon, and thus becomes a toggle arrow. For the smaller

seal the Eskimos of Norton Sound employ a very light harpoon, which is a model of delicacy and effectiveness. It is lanced from a spear thrower. In the same and in adjoining regions the large whale toggle is found of the same pattern, but clumsy looking, and it is used in the hand as well as lanced from a spear thrower. In the neighborhood of Point Barrow a seal is shot with a rifle from the edge of the ice and then retrieved by hurling a toggle harpoon at it in order to get a hold.

No. 1. Toggle harpoon of Shasta Indians. Toggle, a bone 3 inches long, pointed at one end, socketed at the other, and attached in the middle to a cord of hemp covered with a coating of pitch. California---------- 76,199

No. 2. Toggle harpoons of the Hupas, in three parts; points of bone or iron; double bone barbs; rawhide leader; held together by a wrapping of twine covered with pitch; socket for the shaft between the barbs; line of hemp. California---------- 126,525

No. 3. Toggle harpoon heads from North Pacific tribes, similar in structure to No. 2, with the addition of arrowheads for points; lines woolded with cotton string---------- 34,397, 74,175

No. 4. Similar in structure to No. 2, with the addition of a barbed harpoon head for point; line in one example woolded. From Nimpkish Indians, British Columbia---------- 129,980

No. 5. Toggle harpoon head for whale fishing. Body of whale's bone with line hole across the middle; blade of flaked chert inserted in a saw cut in front. Point Barrow, Alaska---------- 89,749

No. 6. Toggle harpoons from Norton Sound, Alaska. Body of bone; barb single, beveled upwards; blades of slate and ivory; sockets for loose shaft in the butt end; becket of rawhide for attachment to the great line---------- 169,104, 7,422

No. 7. Toggle harpoon from Alaska, with double barb and steel blade; becket of seal hide; leader, of sinew twine, attaches the blade to the becket; blade cover two pieces of wood lashed together with spruce root, 16,125

No. 8. Toggle harpoon (*Tokung*), from Cumberland Gulf. Body flat and line hole concealed underneath; blade of iron riveted in; barbs two, flat. The type also of western Asia---------- 34,070

No. 9. Toggle harpoon from Alaska. Body of walrus ivory, with two or three barbs; blades of metal. In this example the loose shaft is shown fixed in its socket. Ornamented after Russian motives---------- 37,945

No. 10. Toggle harpoon head from Nunivak, Alaska, showing the method of hinging the foreshaft and wooden cover for the head. Body of walrus ivory, with two barbs, decorated---------- 176,222

No. 11. Toggle harpoons from the Eskimos of Mackenzie River, similar to the foregoing in general outline, but furnished with barbs on the iron blades or on the body. Combination of barbed harpoon head with the toggle harpoon---------- 3,975, 2,092, 7,422

No. 12. Seal harpoon with toggle head and foreshaft. Line of seal hide; bone detacher---------- 72,397

No. 13. Toggle harpoon head of iron for swordfish, with hastate point and lateral flukes or barbs; line hole across the middle; shaft works in in socket in the butt---------- 102,536

SERIES 3.—FISHHOOKS.

Plate 26.

A fishhook is a device for catching aquatic animals by means of a hook. It is a pointed but not a piercing implement. In its simplest form it is merely a bent piece of hard substance pointed at one end and attached to a rod at the other, becoming a gaff, or to a line and becoming a fishhook, properly so called. The parts of a hook are the fluke, the shank, and, later on, the barb. It is always attached to a line held in the hand or suspended from a rod (in which case its use is called angling) or attached to a fixed rope (becoming then a set line or trawl). The manual part of angling devices are not here considered. In order to entice the fish to take the hook, baits and flies are employed. In the fishhook the two processes of hunting water animals are shown—capture and trapping. With the gaff, fish rake, and all such devices the animal is seized and retrieved involuntarily. This series has not undergone much elaboration; but in the baited hook, with its accessories, with the lure and with the fly, human ingenuity has been well nigh exhausted. In the end the taking of intelligent and wary fishes with tackle adapted to the habits of the different species becomes a sport in which large sums of money are paid for single outfits.

No. 1. Fijian fishhook consisting of a curved root, with the bend pointed for fluke, and a line of coconut fiber fastened to the straighter shank_ 3,674

No. 2. Fishhooks from Sandwich Islands and from California, made from a single piece of bone or shell. The first named has braided line, 3,676, 97,828

No. 3. Plain hooks of metal, Peru. A bit of wire bent, pointed at the shorter end and attached to a line at the other_____ 17,501

No. 4. Halibut hooks from North Pacific coast of America. Shank bent around so as to form a fluke. The barb is provided by bending in the point of the shank or by lashing on a spindle-shape bone, pointed inward__ 72,648

No. 5. Chilkat halibut hook from Alaska, made of a forked stick. The smaller prong acts as shank, with line tied to its middle. An iron spike lashed to the larger prong acts as a barb. It has for a float a piece of wood carved in shape of a duck.

No. 6. Polynesian fishhook. Shank of stone or shell, perforated at the top for a line; fluke of bone or shell, without barb, perforated at the butt and lashed to the shank_____ 9,797, 2,844, 8,894

No. 7. Eskimo fishhook from Alaska. Shank of bone or stone carved in form of lures; fluke of metal fixed into the bottom of the shank, 89,550, 153,461

No. 8. Tomcod hook, Eskimo, Plover Bay, Siberia. Single barbed lure, as in No. 11_____ 46,264

No. 9. Fishhooks from North Pacific coast of America. Shanks of whalebone and wood; flukes of wood or bone, pointed and lashed at a small angle to the bottom of the shank_____ 74,188, 49,172

No. 10. Eskimo fishhooks from Alaska with two or more points of bone__ 40,264
No. 11. Eskimo fishhooks from Alaska in which a barbed spreader has a number of composite hooks attached_____ 44,370
No. 12. Eskimo and Polynesian fishhooks showing a primitive form of the barb; shank of wood or shell; fluke of bone or tortoise shell lashed on the bottom of the shank_____ 126,984
No. 13. Barbed fishhooks, of shell and metal, with lure_____ 89,545
No. 14. The latest pattern, with steel hooks and artificial bait.

SERIES 4.—SINKERS.

Plate 27.

A sinker is a heavy object attached to a fishing line or net in order to bring the hook into the area of the animal or to hold the line or the net upright in the water. The earliest type of the sinker is a common stone. Such forms would naturally be chosen as would not slip from the line in the water, so notched stones were used. Most savage tribes have discovered that by a peculiar method of lashing they can fix any heavy object in a sling to serve for a sinker. Among civilized peoples metal sinkers of various forms, which include also the characteristics of a lure to entice the animal toward the net or bait, have been substituted for the simpler boulder. In a large collection of sinkers will be found special forms for special fishes, or environments, or appliances. For some uses the sinker must rest on the bottom, as an anchor; for others it drags, as in the drail; for others it is suspended in the water simply as a weight. As with other fishing devices, so with this, there has been a refinement coincident with culture progress. The first fishermen used no lines or sinkers, the latest exhibits a new style of sinker for each kind of fish.

No. 1. Pieces of turtle shell tied to a cord, forming a crude sinker. Bengal, India _____ 103,312
No. 2. Stone sinkers, rough or slightly modified by pecking, lashed in slings of rawhide. Alaskan Eskimos_____ 63,737, 63,744
No. 3. Stone sinkers notched or grooved for purposes of attachment_ 42,920, 17,837
No. 4. Polished stone sinkers or plummets grooved or notched for suspension. These objects could easily have been fastened in a sling of cord or bark. From mounds of the Ohio Valley_____ 7,790, 42,491
No. 5. Sinkers, ivory or stone, perforated for attachment to a line or net. In one example there is a suggestion of a lure in the form of a small fish_____ 63,377, 44,935, 56,577
No. 6. Eskimo sinkers of bone or ivory, carved in the form of fishes to act as lures. The Eskimos are clever in making sinkers of this kind to imitate various small animals on which the larger ones prey____ 38, 277, 33,194
No. 7. Eskimo sinkers of bone and colored stones, perforated for suspension. Bottom, of bright colors to attract the fish, ingeniously riveted or lashed to the upper portion. One example is perforated for two sets of hooks_____ 46,313, 44,277

No. 8. Polynesian sinker for giant squid, consisting of a shell for lure, a grooved stone for sinker, and sharpened wire flukes in the wooden shaft to excite the animal 4,842
No. 9. Lead sinker from Greece, with wire attachment 103,299
No. 10. Double-gaff hook or drail from Lapland. Lead sinker 28,169
No. 11. Double gaff or drail from Greenland. Sinker of lead, in the form of a fish; extra line attached 103,098
No. 12. Whiffling mackerel line with four flies and spinner 103,112
No. 13. Eskimo fishing line from Point Barrow for catching small cod through the ice, complete; hook, lure, sinker, baleen line, and reel 89,545
No. 14. Scotch codfish hook. Lead lure in form of a fish, painted, to which are attached six barbed hooks 103,153
No. 15. English mackerel and pollock whiffing line with spinner and Challenger bait 103,013

HISTORY OF WEAVING.

The textile art embraces all work in fibers, whether they be vegetal, animal, or mineral. It includes the processes of procuring the fiber from nature, the cleaning and hackling of material, the spinning of yarn, the twisting of thread, twine, or rope, as well as weaving, netting, knitting, lace making, and embroidery. Each one of these several processes has had a development from some natural process, such as the lacing of fiber, the twining of vines, or the web making of spiders. The apparatus at first was of the most simple character, cooperating with human fingers; but in the unfolding of the art the powers of nature and machinery have been called more and more into play. The latest automatic looms are marvelous expressions of the human mind speaking through mechanical devices.

Illustrations of this art are here limited to three series of objects, each showing something of the steps of progress from simple to highly perfected forms. Series 1 represents the spindle, series 2 the shuttle, and series 3 the loom.

WEAVING BY HAND.

Plate 28.

Zuñi Indian woman weaving.—Plaiting with the fingers, as well as the simplest loom work, is done by persons sitting or stooping. The feet are not used, either in decussating the warp or in throwing the shuttle. A simple harness of wood is provided, or one is made by seizing each alternate warp thread and attaching it to a rod. The figure here shown represents a Zuñi Indian woman, of New Mexico, weaving with the blanket loom. The attachment of the warp to an upper and lower beam is an ingenious provision for the tension. The shuttle is a short stick and the batten is a wooden sword. Patterns are wrought by a process of darning the alternate sheds.

SERIES 1.—SPINDLE.

Plate 29.

A spindle is a device for twisting fiber. Human fingers formed the first spindle, and there are now tribes living in British Columbia, Alaska, and other parts of the world where excellent yarn and thread are produced with no instrument whatever. The class of implements called spindles begins with a simple, pointed rod which acts also as a bobbin. It is the first device for converting rectilinear into continuous circular motion. The stick is rolled on the thigh with the palm of the hand, and the twisted fiber is then wound upon this simple shaft. There were added the spindle whorl, the hook at the top of the spindle to enable the operator to walk about, and the fixed bearings by which the apparatus becomes a machine. The band wheel and other devices for multiplying motion led through the large wheel and the small or Saxon wheel to machine spinning.

No. 1. Simple form of spindle. A wooden peg on which yarn or thread is wound.

No. 2. Silk winder. Forked bamboo rod spread for holding wound silk filament. China.

No. 3. Spindle with whorl. Shaft of hard wood; whorl of bone; for winding coarse cedar bark. British Columbia---------- 20,640

No. 4. Central American spindle. Shaft of palm wood; whorl a hard seed. For spinning cotton yarn---------- 7,490

No. 5. Peruvian spindle, for fine staple. The thread is looped over the top of the shaft when the spinner walks along---------- 7,942, 17,510

No. 6. Tibetan spindle. Shaft a twig of cherry, with hook atop; whorl a yak bone. The hook on the spindle shaft enables the spinner to walk about ---------- 167,248

No. 7. Tibetan spindle. Shaft a twig with notch and groove on the top; whorl of clay at the bottom of the shaft. The spinner walks about-- 167,247

No. 8. Primitive spinning wheel. Spindle whorls of various materials and forms---------- 155,598, 195,572, 100,642

No. 9. Shaft set in bearings; whorl enlarged for flywheel. The beginning of machine spindles. Finland---------- 10

No. 10. Bobbin winder in which the spindle is driven by a primitive flywheel. China ---------- 7,694

No. 11. Model of large spinning wheel for cotton and wool. Simplest form, without speed pulley.

No. 12. Spindle of small or Saxon spinning wheel, with different sized pulleys to regulate speed. The Saxon wheel works with treadle.

No. 13. Spindle used most generally in cotton-spinning machines in the United States. Gift of George Draper and Sons.

SERIES 2.—SHUTTLE.

Plate 30.

The shuttle is a device for passing weft filaments between warp filaments. This process was first performed by the human fingers in plaiting, as in the mat making of the Polynesians, Africans, and

American Indians. The simplest shuttle is a rod on which the weft is wound. Improvements in the shuttle consist of devices for guiding the apparatus more quickly and smoothly between the warp filaments and end in the modern machine shuttle, which is automatically driven with incredible rapidity backward and forward between the "sheds" of the warp. The objects presented in this series are suggestive of the salient features in the line of progress. The Pueblo Indians use a rod of wood and wrap yarn upon it, somewhat as children wind a kite string. A twig with a notch at each end, a slat with closed points, as in netting needles, and hollow stick pointed and furnished with the rudest sort of bobbin have been used by different peoples in the hand epoch of culture. With the domestication of the physical powers and the improvement of the loom the shuttle became more and more effective.

No. 1. Primitive shuttle. Twig of osier, with thread simply wound about it, 151,738

No. 2. Wooden rod with weft wound diagonally about it.

No. 3. Shuttle or antler, pronged at each end. Eskimos of Norton Sound__ 33,266

No. 4. Rag-carpet shuttle. A block of wood notched roughly at each end and used in the domestic hand loom for weaving carpet of rags, coarse chain of jute, cotton, and other materials.

No. 5. Japanese shuttle. Pronged at one end, closed at the other, with "skewer" in the opening_____ 19,408

No. 6. Eskimo shuttle. Prongs at either end, approaching each other and pointed_____ 163,781

No. 7. Hupa shuttle. Slender shaft, prongs at the ends, approaching like the beak of a bird. California_____ 131,151

No. 8. African shuttle. Body toggle-shaped; bobbin a simple cylinder of wood revolving on a splint of palm-leaf stem. Liberia_____ 168,079

No. 9. Hand-loom shuttle. Body toggle-shaped; bobbin a hollow reed working on a splint of hard wood_____ 7,688

No. 10. Early machine shuttle, of several pieces of wood and iron pointed; open on both faces; bobbin a strip segment of bamboo running on a splint of wood_____ 153,172

SERIES 3.—LOOM.

Plate 31.

The loom is a framework on which weaving is done. Essentially it consists, first, of two crossbeams, called the "yarn beam" and the "cloth beam," on which the warp is laid evenly; secondly, the devices for crossing the alternate warp threads, so as to form "sheds," through which the shuttle is passed backward and forward, and, third, of some sort of batten, by means of which the weft is beaten home after the shuttle has made an excursion.

Many other mechanical parts have been added to this machine from time to time; but the simplest loom is a framework in which much

of the operation is still performed by hand, while in the most complicated looms all the operations are performed automatically. In some tribes of our Indians and among rude peoples elsewhere the loom is little better than a darning machine. The fingers are the only harness, and often the side of the hand acts as the batten. In Chinese matting looms and in the belt-weaver's outfit of the southwestern United States the warp is shifted by a wooden harness and the weft is beaten home by a wooden sword. Pedals are not used in any of these early forms, because in all occupations both men and women sit on the ground at their work.

No. 1. Aino loom for weaving belts of ohiyo (elm) bark. Single heald; primitive shuttle; sword batten; warp spreader with holes burnt through.
No. 2. Mexican loom with single heald rod, primitive shuttle, and sword batten.
No. 3. Navaho loom with three heald rods, sword batten, and weft of different colors in hanks, not in shuttles.
No. 4. Babylonian loom with four sets of healds and reed batten.
No. 5. Heddle cut from a single board. Other examples are made of reeds held in parallel crosspieces.
No. 6. Italian loom, same as No. 5, in its heddle, with yarn beam and ratchet.

HISTORY OF METAL WORKING.

Among savages, generally, the ores of metals and pure nuggets of copper, gold, and silver are treated as stone. They are chipped, battered, abraded, and polished. A little higher in culture the softer metals are cold hammered, or cut, or pressed into shape, and in some cases, swaged. The third step in the elaboration of this art is found among those African tribes that have iron ore in sufficient purity to reduce it in an open forge. The smelting of metal comes last, and this portion of the art gives rise to an infinite number of modern industries.

In the reduction of metals the first and simplest process is "heap roasting"; the second is the "open-hearth roasting"; next comes the earth hearth with a cavity, which is the primitive crucible. This is followed in order by the crucible without draft, the crucible with draft, natural or forced, and the crucible with a flame playing above and below, leading up to the reverberatory furnace with its hot blast. The electrical furnace, without fuel, is the latest step in the process.

After the crude substance has been rendered tractable it is then the object of innumerable manipulations, the consideration of which would form the second series of exhibits. The tools employed at first in metal working were of stone, then of metal held in the hand. Finally, a wide range of machine tools has been devised for the purpose of manufacturing objects of use and beauty.

PRIMITIVE METAL WORKING.

Plate 32.

Navaho Indians making silver ornaments.—The Navaho Indians of Arizona and New Mexico were taught a rude sort of metal working by the Spanish conquerors, and they have become very adept in the use of their primitive tools and apparatus. It is not known that they mined for silver, all of their products being made from Mexican and American coins. The silver is either cold hammered or melted in open crucibles by the use of charcoal and flux, with blast produced by bellows having two air sacks of leather, as crude as those of the Congo Negroes. Much metal is wasted in the operation. It is brought into final shape by hammering, punching, chasing, and engraving. The objects made are mainly personal ornaments, such as buttons, ear ornaments, beads, and bracelets. Examples are placed with the figures.

SERIES 1.—REDUCTION IN METAL WORKING.

Plate 33.

By this phrase is meant those arts that are practiced upon metals in order to prepare them for the manufacture of useful things.

This series begins with those metallic ores which were treated by the lower races after their manner of stoneworking, for paint, for simple tools, or for ornaments. The next steps in these primitive processes are the cold hammering of ores, the forging of rich ores, smelting, casting, riveting, welding, alloying, and soldering. In each case a bettering of tools and a complication of wants would go hand in hand.

No. 1. Nuggets of iron ore, slightly modified, from the mounds of Kentucky.

No. 2. Pieces of iron ore modified by flaking and rubbing to form the blades of common tools. Mounds of the Mississippi Valley, 90,733, 19,601, 62,024

No. 3. Pieces of iron ore polished. Mounds of the Mississippi Valley, 34,652, 34,521

No. 4. Pieces of crude copper ore cold hammered into shape. Lake Superior region---------- 1,136, 31,937

No. 5. Copper cold hammered into sheet and arrowhead. Mounds of Ohio and Michigan---------- 10,213, 113,733

No. 6. Sheets of copper cold hammered into shape and perforated. Embossed by punching. Mounds of Wisconsin---------- 88,387, 90,737

No. 7. Sheet of copper crimped and corrugated by hammering. Mounds and Northwest coast---------- 61,174, 67,947

No. 8. Copper cast into form of ancient half-socketed ax or adz. Wisconsin.

No. 9. Bronze hatchet blades from Europe. Casts showing the steps in the art of socketing---------- 140,721, 101,109. 10,116

No. 10. Cast-iron fish, showing the latest results of fine casting---------- 95,021

No. 11. Example of rude forging. Angola, Africa---------- 131,311
No. 12. Example of anvil work and swaging of a rude kind. Angola, Africa, 153,176
No. 13. Example of common welding or uniting two pieces of the same metal by heating in open fire with a flux and hammering them together.
No. 14. Example of riveting two pieces of iron together with pegs of the same metal.
No. 15. Example of uniting two edges of metal by soldering or brazing-- 167,854

SERIES 2.—MANUFACTURES IN METAL WORKING.

Plate 34.

The processes of metal working include all of those arts which go by the general names of hammering, casting, overlaying, inlaying, damascening, swaging, twisting, linking, chasing, embossing, carving, niello work, and others of a more refined character. They are embraced in the general term of manufactures or elaborative industries. For each process there is a craft with its own appliances, tools, and processes, creating and supplying new wants. In the series here shown the results of these processes are set forth in the order of their refinement, although the presentation is far from complete.

No. 1. Overlaying with cold metal. Stilletto or staff of wood; handle overlaid with thin sheets of copper pressed into depressions of the wood and marked with crosslines. Congo region, Africa---------- 174,743
No. 2. Armlets and necklaces in twisted wire and metal beads. Africa-- 174,723
No. 3. Glove belonging to ancient armor. This specimen shows the method of wireworking in armor-forming chain mail.
No. 4. Edged weapon with socket, showing raised work on the surface. West Africa---------- 169,255
No. 5. Double-bladed dagger from the northwest coast of America. Siberian type. Blade fluted and punched into the suggestion of a wolf's head and inlaid with haliotis shell---------- 9,936
No. 6. African knife in common use among the Congo natives. Surface of the blade punched in lines to form a leaf-shaped pattern---------- 130,931
No. 7. Brass plate, Turkish pattern. Surface chased and decorated by punching---------- 76,542
No. 8. Brass work chased, punched, and carved in geometric patterns. Piece in the center scraped---------- 169,233
No. 9. Scabbard of a dagger. Example of embossed or repoussé work.
No. 10. Simple inlaying. Lead in pipestone, Sioux Indians; silver in iron, Korea---------- 130,786, 77,038
No. 11. Knife and sheath from Cordoba, Spain. Sheath of brass, chased; blade steel, with brass ornaments set in---------- 167,569
No. 12. Siamese dish of silver, the flattened border ornamented with overlaying in gold, embossed figures, the interstices filled with black cement.

SERIES 3.—TOOLS AND APPLIANCES USED IN METAL WORKING.

Plate 35–37.

This series includes all tools used in working metals, only a few of which are here exhibited, namely, the hammer, the drill, the punch,

the pincers, and the bellows. The latest manifestations of this series are found in trip hammers, rolling mills, hydraulic welding and riveting, traveling derricks, which are only elaborated tongs, and the host of mechanical tools in foundries and machine shops.

No. 1. Stone hammer from Gaboon, Africa ---------- 154,088
No. 2. Japanese hammer. Head a plain cylinder of iron; helve of oak, fitting into a rectangular eye in the head ---------- 19,460
No. 3. Ordinary smith's hammer. The face is octagonal and the peen is wedge-shaped; handle hickory; eye oval ---------- 166,679
No. 4. Modern blacksmith's hammer. Face circular; poll flat and distinctly outlined; peen wedge-shaped, constricted at the top; handle hickory; eye oval.
No. 5. Japanese jeweler's hammer, with poll and face of uniform size. Rectangular peen, long, pyramidal, and pointed; handle of oak set in a square eye ---------- 19,461
No. 6. Japanese jeweler's anvil. Thick spike of iron, with the upper portion squared and polished for hammering ---------- 19,461
No. 7. Model of a pump drill, all of iron. Used in country blacksmith shops for boring carriage tires ---------- 126,744
No. 8. A country blacksmith shop (pl. 36).
No. 9. Tibetan bellows without valves. The air is let into the goatskin by opening the end and forced out by closing it. (No cut.) ---------- 175,321
No. 10. Double bellows with simple valves of monkey fur. Gaboon, Africa (pl. 37) ---------- 164,873
No. 11. Common bellows used in houses 70 years ago.
No. 12. Dividers, with loop for setting ---------- 167,879
No. 13. Square-faced tongs or nippers ---------- 168,747
No. 14. Pincers for drawing nails ---------- 19,430
No. 15. Dividers for gauging.
No. 16. Copies of ancient molds in which socketed axes were cast. Bronze Age ---------- 139,755

HISTORY OF MUSICAL INSTRUMENTS.

Musical instruments have had an interesting history on account of the great development which has taken place along four lines, each furnishing a tremendous variety of instruments. This history is early shown on account of the numerous surviving examples of every type of invention connected with the subject. The following text will give a clear idea of the development.

SERIES 1.—PERCUSSIVE INSTRUMENTS OF MUSIC.

Plates 38–39.

The earliest and simplest function of music was to mark time in singing and acting. Later came melody and harmony. Even those instruments that simply mark time belong to several classes—those with no determined tone, such as rattles, cymbals, gongs, and bells, or those that have some determined tone, as the xylophone, gong chimes, and bell chimes. Another branch of these instruments are

picked, such as the jew's-harp and music boxes. A third branch would involve instruments that are rubbed, like the musical glasses. This series terminates with examples in which membrane is used, such as hand drums and military drums, and presents, in outline only, progress in the development of percussive or autophonous musical instruments.

No. 1. Hopi rattle of gourd. Handle the neck of the gourd. Arizona---- 94,637
No. 2. Hopi rattle (*mu-shi-la*). Flat gourd with wooden handle passing through. Arizona ---------- 11,787
No. 3. Rawhide bag inclosing pebbles and seeds. Sioux---------- 165,685
No. 4. Rattle of plaited fiber, with pebbles inside. British Guiana------- 54,186
No. 5. Tlingit rattle carved in imitation of a fish hawk. Southeastern Alaska---------- 88,727
No. 6. Rattle made of cocoons of moth fastened to twigs. California.
No. 7. Clallam rattle. Pecten shells strung on wooden hoop; ornamented with feathers and colored cloths. Washington State---------- 13,117
No. 8. Tortoise shell, with dewclaws of deer on leather thongs for clappers. Arizona---------- 68,791
No. 9. African rattle. Wrought-iron disk with handle, to the border of which are hung iron bells. Congo---------- 174,748
No. 10. Hupa rattle. Cloth belt, to which are attached pendants of deer hoofs, ornamented with beads. California---------- 77,190
No. 11. Brahman and Mohammedan anklet rattle, Hindustan. Rope of grelots or hawk bells worn by both sexes and held sacred. Put on with special religious ceremonies---------- 92,717
No. 12. Musical bones or clappers. Used chiefly by minstrel bands in America ---------- 55,727
No. 13. Chinese clappers (*chut-pan*). Three tablets of hard wood united by a string piercing all of them---------- 96,567
No. 14. Sheep bones strung on a cord, forming a rattle. Spain.
No. 15. Block of hardwood hollowed through an incision in the side. China.
No. 16. Fijian war drum (*sa li*). Log of wood hollowed like a canoe, ornamented with beads inlaid. Struck with wooden club-------- 23,949
No. 17. Tambourine made by pegging skin over a wooden hoop. American Indian.
No. 18. Hindu kettledrum (*tabla*). Sonorousness increased by weighting the head with a circular patch of black cement. Struck with the finger---------- 92,726
No. 19. Japanese two-headed drum (*kah ka*). Head larger than the body. Different tones are produced by striking in the center or at the edge---------- 94,954
No. 20. Chinese gong (*lo*) of bronze. Peculiar to the Far East, having a bossed or raised center and the rim turned back a little more than a right angle---------- 94,850
No. 21. Chinese cymbal (*po*). Made of hammered bell metal in shape of Chinese hat ---------- 94,861

SERIES 2.—OPEN-STRINGED INSTRUMENTS OF MUSIC.

Plates 40 and 41.

Stringed instruments are divided into two classes, namely, open and stopped, and each of these is subdivided into the picked, the

struck, and the rubbed, according to the method in which their strings are set into vibration. The most simple form of the open-stringed instruments is a musical bow, which is both picked and struck, and the most complex forms are the harp, the dulcimer, the harpsichord, and the piano. The stopped-stringed is one whose vibratory length may be shortened, thus raising the pitch and making it possible to produce on a single string one or more octaves, with all the chromatic intervals. Of the stopped strings a simple form is the African zeze, which has only two frets and often but one string, while the most complex forms are the lutes, guitars, and violins. The few examples here shown illustrate the progress of invention in perfecting the open-stringed instruments.

No. 1. Mahuga musical bow, from Mashonaland. Piece of cane with single string of twisted cotton. Player holds it in his teeth to hear the sound---------- 167,518

No. 2. Angola musical bow. Plain stick for bow; string of twisted hemp cord; gourd resonator tied to grip of the bow; open part of gourd rests against the stomach of the player; inclining the gourd gives two or three tones (pl. 41)---------- 167,517

No. 3. Egyptian tambour or African lyre. Body boat-shaped, covered with rawhide; neck a bent stick; strings twisted fiber, reaching from median line of the body to the overhanging neck; tuning pegs transverse.

No. 4. Finnish open-stringed psaltery (*kantele*). Wire strings, of graduated length stretched over wooden pegs tightened by wire keys------ 95,690

No. 5. Kanoon, from Morocco. Body, a trapezoid; gut strings of graduated lengths tuned in groups of threes; fixed bridge at oblique end; raised bridge resting on four squares of fish skin. Sound holes in sounding-board.

No. 6. Italian psalteria or dulcimer. Trapeze formed body. Series of strings of graduated length, tuned in groups of four each. Fixed bridges at each end of sounding board, and two diagonal rows resting on it.

No. 7. Autoharp. Harmonics only are sounded. Inharmonic sounds dampened by pressing down a series of spring bars---------- 95,237

SERIES 3.—WIND INSTRUMENTS OF MUSIC.

Plate 42.

Wind instruments are divided into several classes, namely, horns, flutes, flageolets, flue-organ pipes, and reed instruments. Horns are musical tubes in which the lips of the player set the column of air within the tube into vibration. The longer the tube of a horn the lower the note produced, the greater the number of harmonics that can be obtained by varying the pressure and velocity of sound passing through the tube. There are two methods of changing the pitch of the fundamental note of a horn, and consequently its harmonics; first, by adding to the length of the windway, either by a sliding joint, as in the trombone, or by adding fixed lengths of the windway, as in cornets and other similar instruments; second, by placing lat-

eral holes in the tubing, which can be opened or closed by the finger or by valves, which has the same effect of raising the pitch as by shortening the vibratory length of the cords in a stringed instrument. The old zink, serpent, and key bugle are of this class.

No. 1. Fiji conch shell with mouth hole in the side of the spiral_____ 3,825
No. 2. Burmese horn made from the horn of a buffalo_____ 95,509
No. 3. Finnish wooden horn (*soittotorbi*), bottle-shaped. Made of two sections of wood, with long neck, bound together with birch bark_____ 95,684
No. 4. Bamboo horn from Philippine Islands, open at one end, closed at the other. Mouthpiece a cylinder of bamboo set on the side; bent bamboo sections to imitate crooks and valves of European cornet_____ 95,054
No. 5. United States Army regulation cavalry trumpet. Tube bent on itself in two coils; mouth trumpet-shaped_____ 55,606
No. 6. French horn. Brass tube bent three times on itself; mouth trumpet-shaped. Tones are produced by the player's hand moved in the bell_____ 95,269
No. 7. Finnish trumpet (*soitto sarvi*) of ram's horn, with four finger holes on the side of the instrument. Bore the natural cavity_____ 95,689
No. 8. Key bugle with lateral holes closed by seven finger keys. Bore conical; size of finger holes corresponding to size of bore_____ 95,652
No. 9. Ophicleide. Conical tube bent on itself; lateral holes closed by finger keys; size of finger holes corresponding to diameter of bore____ 95,272
No. 10. Trombone, old English sackbut. Cylindrical tube of brass, with sliding joint long enough to give seven tones; mouth trumpet shape. The chromatic scale is thus produced.
No. 11. Cornet with cylindrical tube and trumpet-shaped bell. Piston valves three, which add different fixed lengths of tubing to the windway _____ 55,602

SERIES 4.—REED INSTRUMENTS OF MUSIC.

Plate 43.

Reed instruments are of two classes, namely, the double and the single, and it is doubtful which is the more primitive. Should one take a straw and bite off one end square, the act of biting the straw would flatten the tube, and thus form a simple double reed, whereas to form a single reed of such material one should take a section of straw, open it at the lower end, with the upper end closed by the joint, then with a sharp instrument cut a short distance into the tube and split the section an inch or two, and he would form the vibrating tongue of a single reed. Either method, with finger holes cut or burnt in the tube, would form the rustic oaten pipe. Single reeds are of two kinds—the beating and the free. The beating reed is formed of wood, metal, etc., the width and length of its vibrating tongue being sufficient to allow it to strike against the walls of the tube or mouthpiece, as seen in the clarinet or instruments of its class. The free reed is usually made of metal. In this form the vibrating tongue is slightly narrower and shorter than the opening in the metallic overplate, to which it is firmly fastened, so that it vibrates

without touching at its sides or free end the opening in this plate. It was first introduced into Europe in 1770 by Prof. Kratzenstein, of St. Petersburg, but it was known in the Far East, as seen in the Chinese Ching and instruments of the same class in Japan, Siam, Burmah, and the Malay Archipelago. Examples of the free reed are the harmonicon, mouth organ, accordion, and reed organ.

No. 1. Chinese shalm or shawm (*ch'iang-ti*). Section of bamboo with thumb hole and seven finger holes; double reed, a section of thin reed scraped down and flattened---------- 94,864

No. 2. Korean shalm (*piri*). Double reed, a section of bamboo worked down and flattened; thumb hole and seven finger holes---------- 95,211

No. 3. Chinese oboe (*k'ai-ti*). Tube of wood with conical bore; one thumb hole and seven finger holes; mouth tube of brass, tapering; reed, section of rice stalks tied on brass tube---------- 96,575

No. 4. Oboe or hautboy. Tube of wood; bore conical; four joints, six finger holes, and thumb keys; mouth tube of brass; double reed of two pieces of cane---------- 95,290

No. 5. Egyptian clarinet (*zummarah*). Tube, section of bamboo open at both ends; finger holes four; reed smaller section of bamboo, with tongue cut and split on one side.

No. 6. Arabic double clarinet (*mijwiz*). Tubes two, of cane, with four finger holes each, and two reeds also of cane. Similar to that of the zummarah ---------- 92,863

No. 7. European fagot or bassoon. Tube in four parts, of maple, with conical bore, six finger holes, and eight keys; double reed of two pieces of cane; mouthpiece set on a wing---------- 95,275

No. 8. Clarinet. Tube and bell of boxwood, with a conical bore, one thumb hole, seven finger holes, and six keys; mouthpiece of rosewood, with a single beating reed of cane lashed to it---------- 55,618

No. 9. Inverted double reed from Fort Simpson, Alaska. A tapering cylinder of wood split, excavated to form a tube open at the upper end and closed at the lower. The stock is then bound around with leather thongs ---------- 20,700

No. 10. Double inverted reed instrument from Bella Bella Indians. The same as No. 9, but with the lashings perfect---------- 20,699

No. 11. Italian bagpipes (*zampogna*). Bag the skin of a sheep. The pipes start from a wooden stock inserted in the neck of the skin. It has one chanter and three drones. Mouth tube of wood, set in one of the legs of the animal---------- 95,047

No. 12. Harmonica or mouth organ. A free-reed instrument without tubes, 55,662

No. 13. Accordion. A free-reed instrument with a double bellows and keyboard ---------- 55,638

No. 14. Cheng. Chinese mouth organ and free-reed instrument, with tubes, 96,657

No. 15. Jew's-harps. A variety of reed instruments in which the vibration is made by the finger of the player. The cavity of his mouth acts as a resonator ---------- 95,559(2), 94,651

No. 16. Japanese jew's-harp (*mokuri*). In this the tongue is vibrated by a string attached to it near its base---------- 150,720

No. 17. Wooden jew's-harp from Sulu. This differs from the preceding in that the frame of the instrument is vibrated instead of the tongue-- 5,692

HISTORY OF THE CERAMIC ART.

Clay working is one of the arts most widespread in space and time. The industry has had part in all phases of material progress, and the imperishable products of the clay worker form one of the most valuable indices of the stages of civilization. Included under the head of ceramics are glass and enamel, which appear to have developed with the facilities of increasing heat in ceramic and metallurgical processes.

The ceramic art includes the production of all objects formed by modeling, molding, and baking clay. The classes of products are vessels, statuary, architectural details, and miscellaneous objects of almost endless variety. This art has been practiced by nearly all peoples that have passed into what is known as the upper status of savagery. The beginnings were extremely simple, but the highest products are marvels of industrial and esthetic achievement.

The history of this art, from its inception to its fullest development, is illustrated here in epitome by two series of exhibits, one comprising the products and the other the implements and appliances of manufacture. The principal series begins with the rudest forms of earthenware and ends with porcelain. The second begins with archaic modeling tools and closes with the wheel and the mold. Firing devices are omitted for want of room, and no attempt is made to present the varied and interesting phenomena of embellishment.

One form of pottery—the vase—is taken to represent the entire range of products.

Short series of objects representing glass and enamel are placed with ceramics proper, bearing the relations of offshoots from the main stem.

Although no single people has passed through precisely the stages of progress here indicated, the pottery industry of all civilized nations must have had a somewhat analogous succession of phases. These series, therefore, illustrate with reasonable accuracy the general history of the art as practiced by mankind, and especially indicate something of the growth and conquests of the human mind.

FIRST STEPS IN CERAMICS.

Plate 44.

Zuñi Indian women making pottery vases.—The woman is the potter among very primitive peoples. She digs the clay, cleanses and mixes it, and when the paste acquires the proper consistency rolls it and builds the vessel. The rolls are added to the edges of the incipient vessel and pressed into place, one after another, until the desired height is reached. Paddles and other tools are used in

shaping and finishing, and the firing or baking is accomplished without the aid of a furnace.

In the center (pl. 41) is a Zuñi woman building up and smoothing the walls of a vase, using her fingers. When the shape is perfected, a white wash is put on, and the surface is polished with a smooth stone (right). The other woman paints the design in black and red pigments with rude brushes (left), and the baking is later accomplished in a hot fire.

Finished specimens of the work are shown.

SERIES 1.—IMPLEMENTS USED IN POTTERY MAKING.

Plate 45.

The processes involved in the manufacture of earthenware are varied, and the course of their development is perhaps better understood than are the processes of other arts, because the plastic clay has received and preserved the record in ways peculiar to itself. The implements and devices are of several classes. There are the modeling tools, bits of gourd (No. 1), shell, wood, or bone; the modeling-texturing tools, which serve for shaping and decorating at one and the same time (Nos. 2 and 3); the polishing stones (No. 4); the incising tools (No. 6); the brush (No. 7); stamps (No. 8); the mold (No. 9). Besides these there are devices for baking or firing, glazing, and ornamenting, not shown here for want of room.

No. 1. Modeling-texturing tools. Rolled back and forth over the soft clay. Algonquian and Pueblo Indians_____ 165,372

No. 2. Modeling implements made of gourd shell. Pueblo Indians_____ 47,925, 165,373 (2)

No. 3. Modeling-texturing paddles. Used in shaping and finishing earthenware. Cherokee and Mohave Indians_____ 10,329, 132,990

No. 4. Polishing stones. Used in shaping and finishing earthenware. Various Indian tribes_____ 82, 953, 76,081, 197,124

No. 5. Pointed tools used in incised decoration. Roman stylus and Indian needles_____ 115,575, 101, 795, (no number), 141,002, 126,610, 101,792

No. 6. Modeling and decorating tools used by Mexican Indians_____ 126,600, 126,695, 126,594, 126,610, 126,597

No. 7. Brushes of hair, frayed bark cord, and chewed straws, used in decorating pottery_____ 126,635(3), 126,601(3), 2476

No. 8. Earthenware stamps for decorating pottery and impressions from them. Mexico_____ 133,195, 133,188

No. 9. Mold for shaping an ornament. Sèvres, France.

SERIES 2.—VASE.

Plates 46 and 47.

From the whole field of products of the ceramic art the vase alone is chosen for illustration in this exhibit. The simplest forms are the rude, unpolished cups and bowls of primitive tribes (Nos. 1, 2, and 3).

Somewhat higher in the scale are Nos. 4 and 5, which have slightly polished surfaces and rudely incised decorative designs. Following these are examples illustrating advances in polishing, painting, stamping, casting, and throwing on the wheel. Glazing came in with or shortly after the invention of the fixed wheel. In the latter part of the series are shown illustrations of the higher forms of shaping, surfacing, decorating, and firing, closing with that marvelous product, porcelain.

No. 1. Cup from a grave in Arkansas. Simplest form of vessel; hand shaped; hand finished; Middle Stone Age---------- 91,040

No. 2. Bowl of the Andaman Islanders, one of the most primitive pottery-making peoples known. Hand made; hand finished; Middle Stone Age---------- 164,750

No. 3. Rude hand-made cup; simple incised decoration; Eskimos, Alaska; Middle Stone Age---------- 33,073

No. 4. Incised cup of archaic character from a grave in Arkansas. Hand made; stone smoothed; incised decoration---------- 71,465

No. 5. Vase of simple type. Stone polished; incised decoration; Bronze Age; Switzerland. Culture of people, all phases considered, inferior to that of mound builders of Mississippi Valley---------- 100,820

No. 6. Coil-built vessel; ancient Pueblo, Arizona; Middle Stone Age---- 155,241

No. 7. Mound builder's bottle. Polished; decorated with incised lines in highly developed combinations; Advanced Stone Age—Copper Age (?)- 87,710

No. 8. Mound-builders's jar. Beginning of color decoration. Polished with stone implement; painted with brush; Advanced Stone Age—Copper Age (?)---------- 90,958

No. 9. Ancient Pueblo vase, Arizona. Stone polished; geometric painted designs; Advanced Stone Age---------- 114,866

No. 10. Vase from grave in Chiriqui, Panama. Hand built; stone polished; brush decoration; Late Stone Age—Copper Age (?)---------- 132,974

No. 11. Vase from grave in Chiriqui, Panama. Refined shape suggesting Greek outlines; hand made; plain finish; Advanced Stone Age—Copper Age (?)---------- 108,475

No. 12. Ancient Mexican vase. Hand made; stone polished; polychrome decoration; Late Stone Age—Copper Age (?)---------- 132,974

No. 13. Ancient Peruvian bottle. Pressed in shell mold; hand finished; stone polished; Advanced Stone Age—Copper Age (?)---------- 1,397

No. 14. Ancient Peruvian whistling bottle. Pressed in figured molds in parts and joined; stone polished; Advanced Stone Age—Copper Age (?), 107,552

No. 15. Spanish-American bottle. Turned on rude wheel; stone polished; washed with color; Iron Age.

No. 16. Ancient Cypriote bottle. Turned on wheel; plain finish; Bronze Age or Iron Age---------- 101,834

No. 17. Ancient Korean jar. Turned on simple wheel; hard burned; beginning of glaze; Bronze Age or Iron Age---------- 94,518–15

No. 18. Ancient Korean jar. Turned on simple wheel; hard burned; glazed; Bronze Age or Iron Age---------- 94,518–31

No. 19. Spanish-American bottle. Hand modeled; elementary glaze; Iron Age.

No. 20. Spanish-American pitcher. Turned on simple wheel; fully glazed; Iron Age---------- 176,799

No. 21. Old English stoneware. Turned on wheel; slight glaze; Iron Age. 140,006
No. 22. Italian faïence jar. Turned on wheel; soft paste; stannniferous glaze 94,977
No. 23. Faïence bottle; Kioto, Japan; crackled glaze 93,431
No. 24. Bottle, English; heavy glaze.
No. 25. Faïence bottle; Satsuma; enamel and gilt. Japan 94,734
No. 26. Bottle; colored enamels; Kioto, Japan 94,578
No. 27. Porcelain jar; Copenhagen, Denmark.

SERIES 5.—POTTER'S WHEEL.

Plate 48.

The potter's wheel was at first merely a crude device for turning the work to a proper position in front of the potter without deforming it. The support for the vessel may have been a slab of stone at first lifted into the required position by the potter. Then the necessity of freer movement would cause the use of supports which rotate haltingly at first and gradually more freely, moved by the hand of the potter. A vast improvement is seen in the continuously rotating wheel moved by muscular energy at a speed sufficient to admit of "spinning" the clay. Previously the clay was worked with the wheel at rest between turnings to position, the vessel being built up painstakingly with coil on coil of clay. Now clay in mass is made to soar into form and the world-wide economic stage of ceramics is born.

It is possible that in early times a dish-shaped stone was used for supporting and revolving the vessel while in process of building, as among the Pueblo Indians.

No. 1. Shallow earthenware dish used for supporting and revolving the vessel while in process of building. Pueblo Indians.
No. 2. Cylindrical block, a form of wheel in use by the primitive potters of Yucatan. It is revolved between the soles of the potter's feet on a soaped or greased board while the shaping of the vessel goes on.
No. 3. Egyptian wheel, restored from an ancient mural painting.
No. 4. Kick wheel of simple form. The feet of the potter are employed to revolve a disk attached by a vertical shaft to the wheel upon which the modeling is done.
No. 5. Kick wheel in which the wheel is revolved by a lever operated by the potter's foot.
No. 6. Wheel with mechanical contrivance for relieving the potter of the necessity of operating the wheel.
No. 7. Model of wheel of highest type. Rookwood pottery, Cincinnati, Ohio.

SERIES 4.—GLASS.

Plate 49.

The use of glass began in prehistoric times, doubtless in what is known as the Bronze Age. The accidental melting of silicious material in pottery kilns and in furnaces for reducing metals naturally led to the manipulation of the plastic substance, and the beauty of

the product gave it value for ornamental purposes. Scenes illustrating glass blowing are sculptured on the walls of ancient Egyptian tombs. Other eastern peoples practiced the art with surprising skill at an early date. It is difficult to secure specimens to illustrate either the steps of progress in glassmaking or the articles produced by the various nations. Strangely enough it can not be said that the moderns have advanced beyond the ancients in the art of working in glass, save perhaps in the invention of mechanical devices for shaping and in expansion of use. It is a question whether we are able to imitate some forms of their work. There really are no primitive steps in this art, since culture must have been well advanced before the properties of the materials were discovered or the necessary processes developed.

No. 1. Volcanic glass—obsidian. Natural product.
No. 2. Furnace slag—glass. Accidental product of such as may have suggested use of glass.
No. 3. Glass ornament; head of hairpin; Bronze Age. Europe---------- 101,341
No. 4. Ancient Roman glass; toilet bottle---------- 101,906
No. 5. Ancient Roman glass; toilet bottle---------- 95,840
No. 6. Modern glass; American; Tiffany---------- 96,446
No. 7. Modern glass; American; Tiffany---------- 96,438
No. 8. Modern glass; American; Tiffany.

SERIES 5.—ENAMEL.

Plate 49.

The discovery of processes by means of which glassy compounds could be produced on or applied to the surface of earthenware by the aid of fusion opened new fields to the worker in clay and the decorator of metal. When the glassy substance is distributed in a more or less transparent film over the surface of objects treated, it is usually classed as glaze, but when rendered opaque by the addition of color, and especially when applied in thick bodies as decoration, it is known as enamel. As applied to metal surfaces there are three well-marked varieties—surface enamel, champlevé enamel, and cloisonné enamel. In the first vase (No. 1) the colored glass is applied to the plain metal surface; in the second vase (No. 2) it fills in designs excavated in the surface of the metal; and in third vase (No. 3) the design is outlined by metal wire fixed to the surface and then filled with colored glass. Five successive stages in the progress of the latter work are shown.

No. 1. Vase; porcelain with lacquer—cloisonné decoration.
No. 2. Vase; enamel on metal. China.
No. 3. Five successive stages in the cloisonné process. Japan.

HISTORY OF SCULPTURE.

The term sculpture is here applied to the whole range of processes and products pertaining to the shaping of stone, but is not extended

to the modeling of pastic materials, the shaping of metal or the carving of wood, bone, ivory, or other hard substances. The history of this art, briefly epitomized here, constitutes a most important chapter in the record of human progress, for its products tell an eloquent story of technical development and at the same time preserve invaluable records of the history of religion, esthetics, and general culture. It is observed that with very primitive peoples the shaped forms are implements and utensils merely, but that with advancing culture life forms, generally as symbols, gradually appear, and that in civilization realistic and ideal phases are prevalent.

A striking illustration of the condition of the art among primitive races is found in the work of the prehistoric peoples of central, northern, and western Europe. Examples of this work are shown in series 1. This phase of sculptural development is duplicated in the more primitive stages of our native American work (series 2, Nos. 1 to 6), but many of the American tribes had advanced far beyond this, and, as seen in the continuation of series 2, had acquired very considerable skill and taste in the treatment of life forms. Series 3 illustrates the tools and utensils employed in the art.

FIRST STEPS IN SCULPTURE.

Plate 50.

Indian flint flakers.—Primitive peoples shape stones by four processes—flaking, pecking, abrading, and cutting. Fracture processes were probably first to come into general use. Splinters or flakes produced by striking one brittle stone against another become useful as arrowheads, knives, perforators, and scrapers. Skillful flaking enables the workman to shape implements with great neatness. Larger implements were made by flaking an entire stone, thus reducing it to the form of a blade. The most remarkable work of this class known is that observed in a variety of large flint knife found occasionally in ancient Egyptian tombs.

The figures here shown represent Powhatan Indians, of Virginia, engaged in shaping rude implements from quartzite bowlders. The scene is laid in the ancient quarries on Piney Branch, near Sixteenth Street, in Washington City, where vast numbers of implements were made by the aboriginal occupants of this part of the Potomac Valley.

SERIES 1.—EUROPEAN SCULPTURE.

Plate 51.

No. 1. Simplest forms of shaped stone; paleolithic implements; England. Process: Flaking with stone hammers 172,644

No. 2. Simple flakes used as tools; also cores from which they are struck. Europe 99,881, 99,908

No. 3. Neatly shaped implements; Stone Age; Europe. Process: Flaking by percussion and possibly also by pressure_____ 1,922, 35,144, 287,972
No. 4. Highest forms of European flaked implements; upper limit of shaping by flaking process; Stone Age_____ 100,968, 101,074
No. 5. Implement roughed out by flaking hammers and finished by abrading process. Northern Europe_____ 136,738
No. 6. Implements reduced to general shape by pecking and finished by abrading process. Europe_____ 100,614(2)
No. 7. Highest forms of shaped stone produced by Bronze Age races of Central Europe. Pecking-abrading processes_____ 100,720

SERIES 2.—ABORIGINAL AMERICAN SCULPTURE.

Plates 52–54.

The American tribes seem to have displayed a strong predeliction for sculpture. They shaped their stone implements with great skill and delighted in the representing of animal forms. Religious motives inspired most of the more elaborate work, although esthetic appreciation was not wanting.

The series of objects here presented covers nearly the full range of native achievement, although the best examples shown fall far short of the highest types of Aztec and Maya work. The simplest forms are shown in plate 52, and a series of progressive steps lead up to the higher forms in plates 53, 54. It is believed by some that germs of culture have occasionally reached America from other lands and that sculpture on this continent is not wholly of native growth.

Many tribes are still practicing the lowest forms of the art, while others, such as the Northwest coast peoples, are well advanced.

No. 1. Simple flakes used as implements and worked into useful forms; also a core like those from which they were struck. American Indians.
No. 2. Implement roughed out by flaking a single stone_____ 169,943
No. 3. Progressive form from a single stone_____ 202,105
No. 4. Further work in producing a flat blade_____ 208,109
No. 5. Finely worked implement made by skillful chipping. Missouri_____ 137,927
No. 6. Implements roughed out by flaking and finished by abrading processes, 85,276, 116,272, 147,668
No. 7. Highest type of form and finish by this process. Porto Rico, West Indies_____ 16,902
No. 8. Celt showing work in representing a human figure. Elementary life-form sculpture. Santo Domingo_____ 220,535
No. 9. Implement roughed out by pecking. Georgia_____ 170,895
No. 10. Pecked implement, partly smoothed surface. Georgia_____ 170,333
No. 11. Highly finished stone ax worked into shape by pecking. West Virginia_____ 90,512
No. 12. Stone hammer, showing rude sculpture by pecking. Elementary stage of life-form sculpture. Alaska.
No. 13. Human figure. Water-worn stone modified to represent features in relief. New Mexico.
No. 14. Human figure. Block of stone with most work done in freeing the head. Kentucky.
No. 15. Human figures. Block of hard stone with head worked out. Mexico.

No. 16. Human figure. Head and legs worked out, body a mere block.
No. 17. Human figure. Body, head, and arms posed and well worked out in the round.
No. 18. Human figure with free limbs. Worked in relief and posed. Costa Rica.
No. 19. Human and animal figures posed and in action. American Indians. Northwest coast.
No. 20. Masks in serpentine and onyx, showing appreciation of facial characters. Larger mask probably a portrait. Mexico. (Three to right in lower row.

SERIES 3.—IMPLEMENTS USED IN SHAPING STONE.

Plates 55 and 56.

The series begins with the stone hammer, used very generally by primitive peoples in shaping stone. Analogous forms of the tool occur the world over, and European and American forms are identical. In shaping brittle stone the discoid or globular hammer (Nos. 1, 2, and 4) is held in the hand and flakes are removed by sharp blows, while tough varieties are shaped by pecking, or bruising, and grinding. The bone implement (No. 3) is used in removing small flakes or chips by pressure (see result in No. 4, series 1, and No. 5, series 2). Drills (Nos. 6, 7) are employed in perforating or in deep cutting. The core made by the copper tubular drill is shown in lower figure 7. Abrading stones (No. 5) serve to rub down surfaces and sharpen edges, and chisels (No. 9) are employed in carving soft varieties of stone, as soapstone, shown in lower figure 9. The shaping instruments of advanced peoples are of metal (No. 10), but are extremely simple, save where a machine is used as the motive power.

No. 1. Hammerstones made of boulders and used in flaking stone. Stone Age. Europe and America furnish identical forms_____ 231,866, 231,865
No. 2. Hammerstone, artificial shape. Used in flaking and pecking stone; Stone Age. Europe and America furnish identical forms_____ 172,758
No. 3. Implement of bone used in flaking stone by pressure. Alaskan Eskimos _____ 176,549
No. 4. Pitted hammer used in flaking and pecking stone; Stone Age. Europe and America furnish identical forms_____ 131,526
No. 5. Abrading stone; Stone Age. Europe; America_____ 231,881
No. 6. Drill. Section of cane used in boring stone; sand used with drill as cutting agent. American Indians.
No. 7. Tubular drill. Copper and partially drilled stone implement; sand used with drill as cutting agent. American Indians_____ ———, 45,588
No. 8. Sawing tool of slate and specimens of sawed stone. Alaskan Eskimo. 56,666. 44,621

(NOTE.—The modern diamond drill, which works by abrasion by fixed diamond points, would come here.)

No. 9. Stone chisel for cutting soapstone and piece of the shaped stone. American Indians _____ 35,480
No. 10. Sculptor's four essential tools: (*a*) Bow drill, (*b*) drove, (*c*) tooth chisel, (*d*) mallet, (*e*) chisel, (*f*) point_____ 34,864

(NOTE.—The machines used in cutting stone which are in general use mark the great advance of the stoneworking industry.)

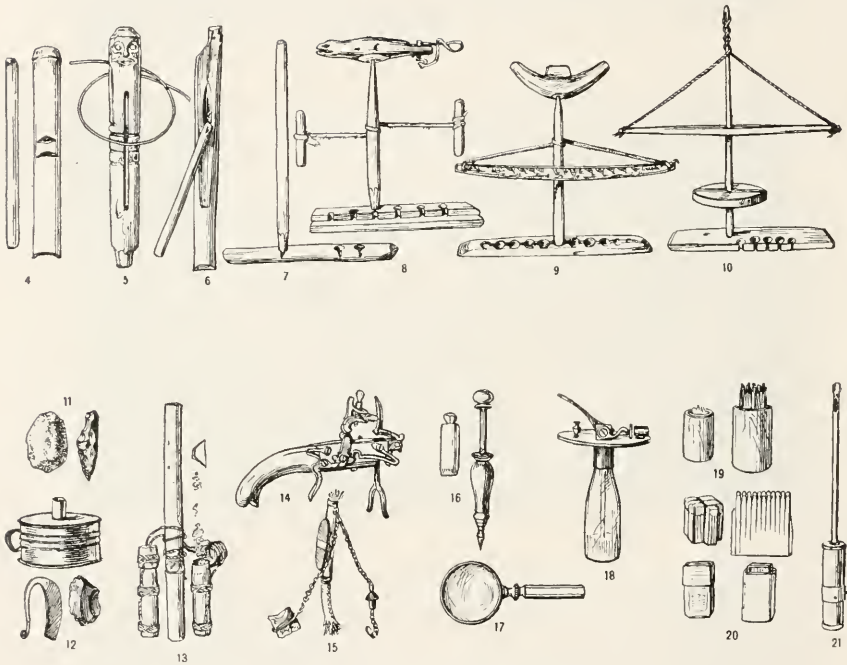
1

2

3

HISTORY OF FIRE MAKING.

FOR EXPLANATION OF PLATE SEE PAGE 3

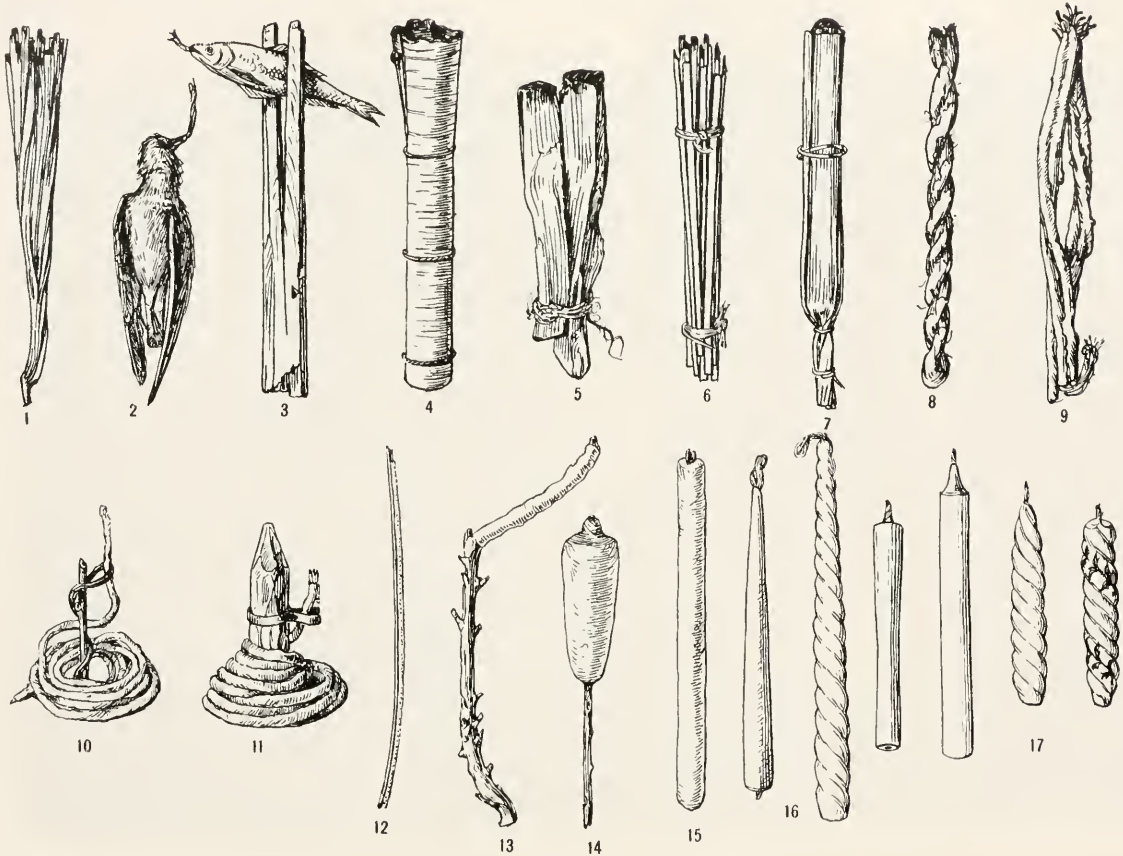


HISTORY OF FIRE-MAKING TOOLS.

FOR EXPLANATION OF PLATE SEE PAGE 3.

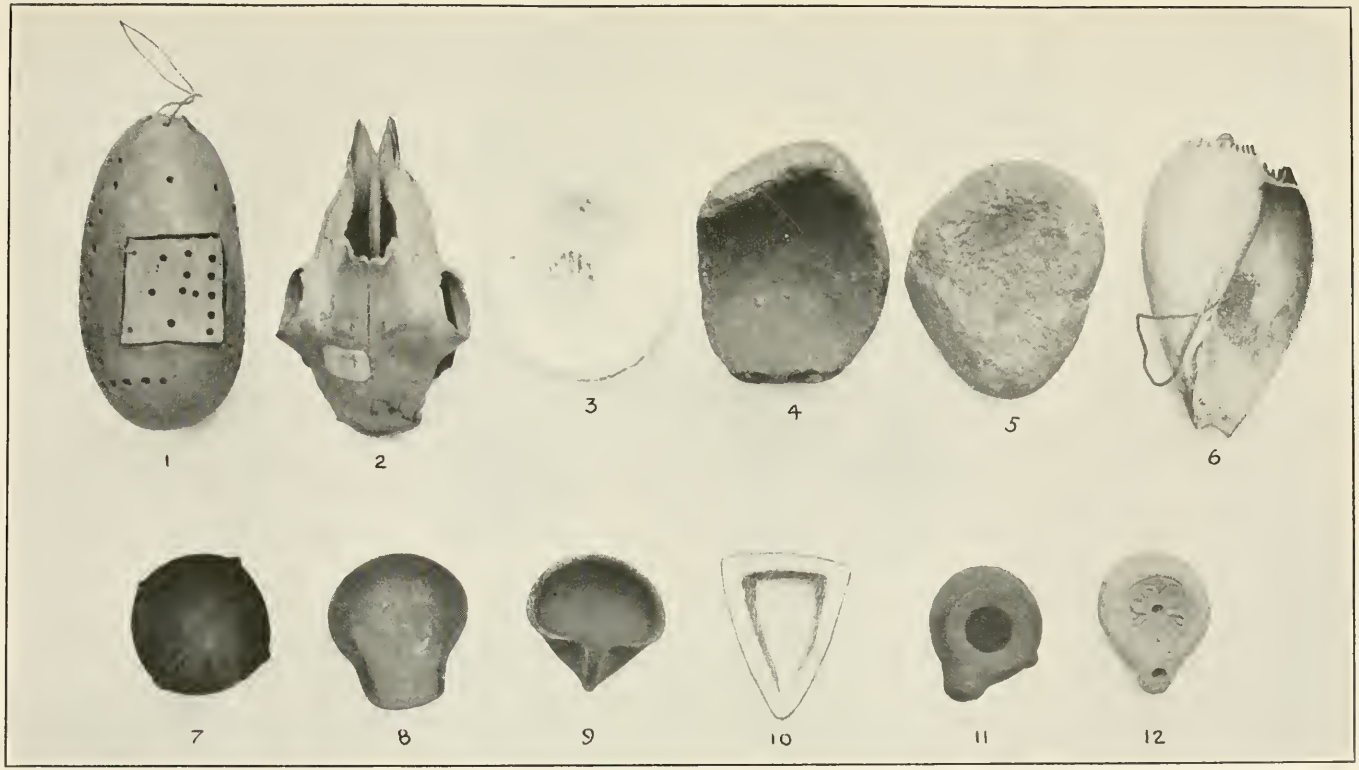
MAKING FIRE BY FRICTION.

FOR EXPLANATION OF PLATE SEE PAGE 5



HISTORY OF TORCH AND CANDLE.

FOR EXPLANATION OF PLATE SEE PAGE 5.



HISTORY OF LAMP.

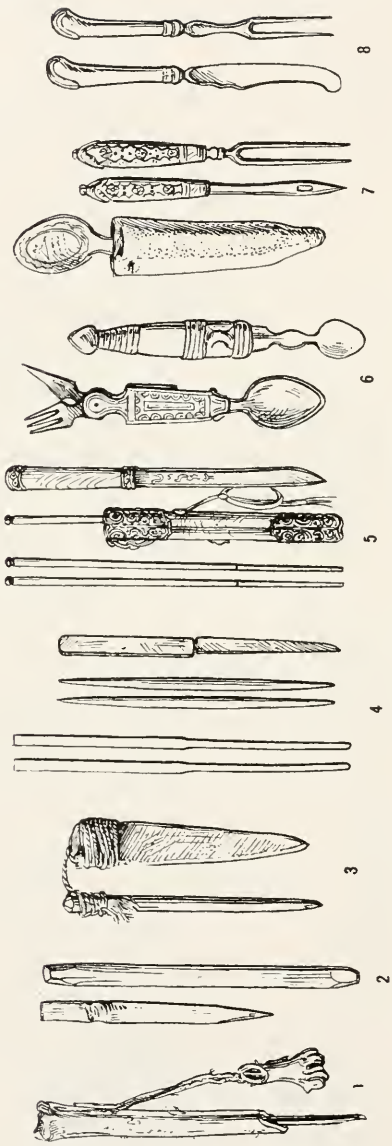
FOR EXPLANATION OF PLATE SEE PAGE 6.

HISTORY OF LAMP CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 6.

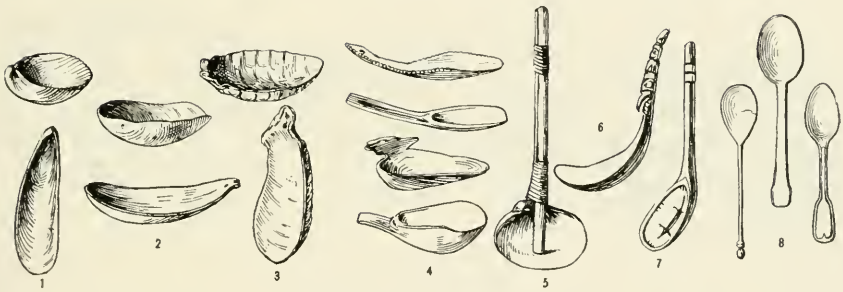
HISTORY OF COOKING UTENSILS.

FOR EXPLANATION OF PLATE SEE PAGE 7



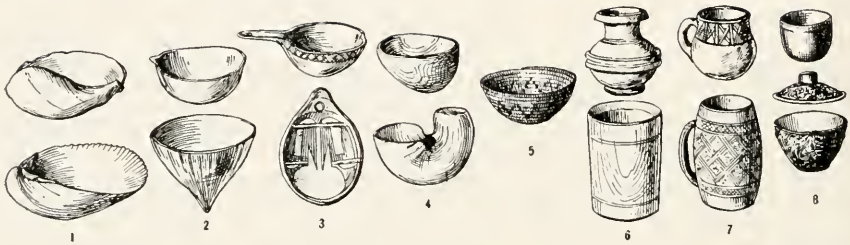
HISTORY OF KNIFE AND FORK.

FOR EXPLANATION OF PLATE SEE PAGE 8.



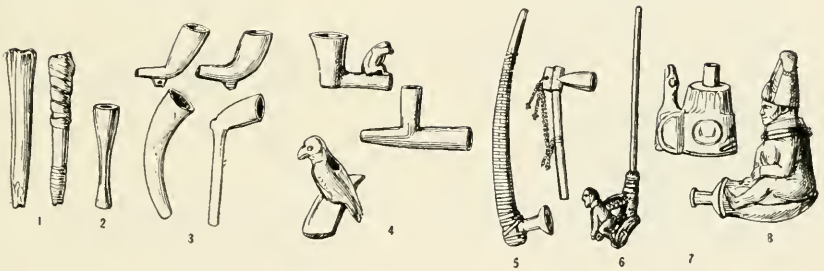
HISTORY OF SPOON.

FOR EXPLANATION OF PLATE SEE PAGE 9



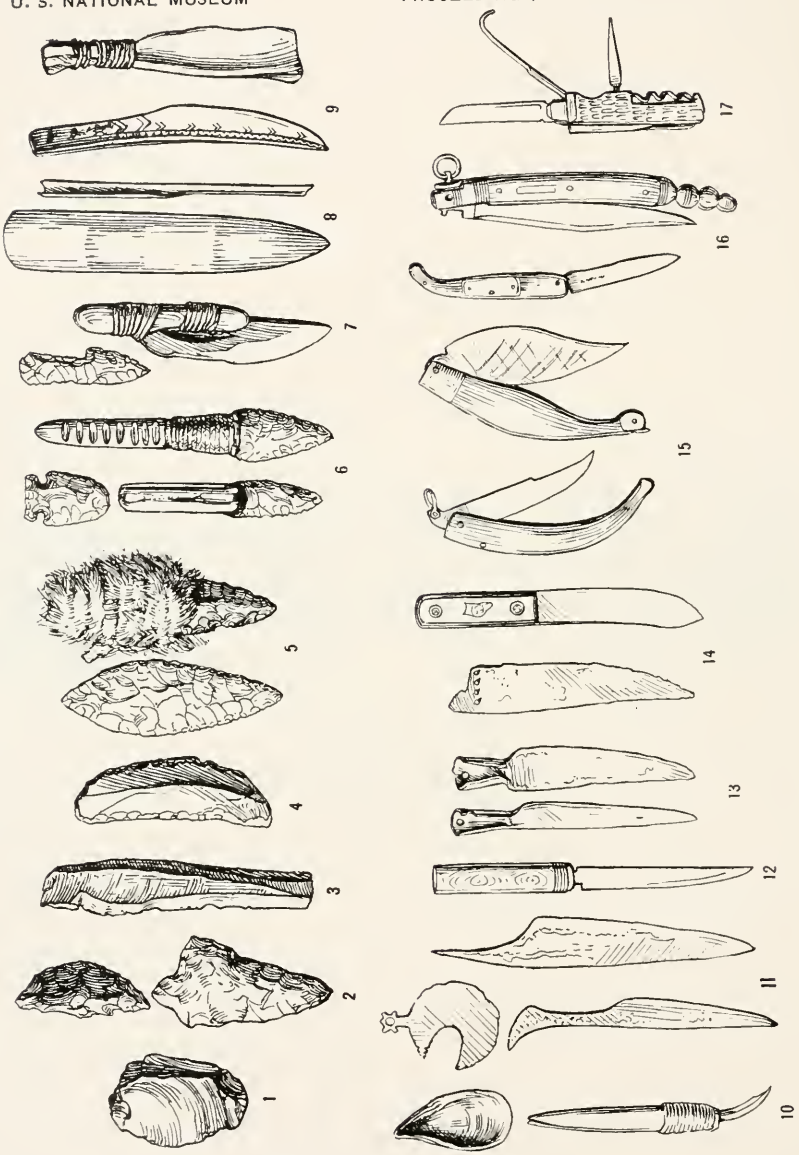
HISTORY OF CUP.

FOR EXPLANATION OF PLATE SEE PAGE 10.



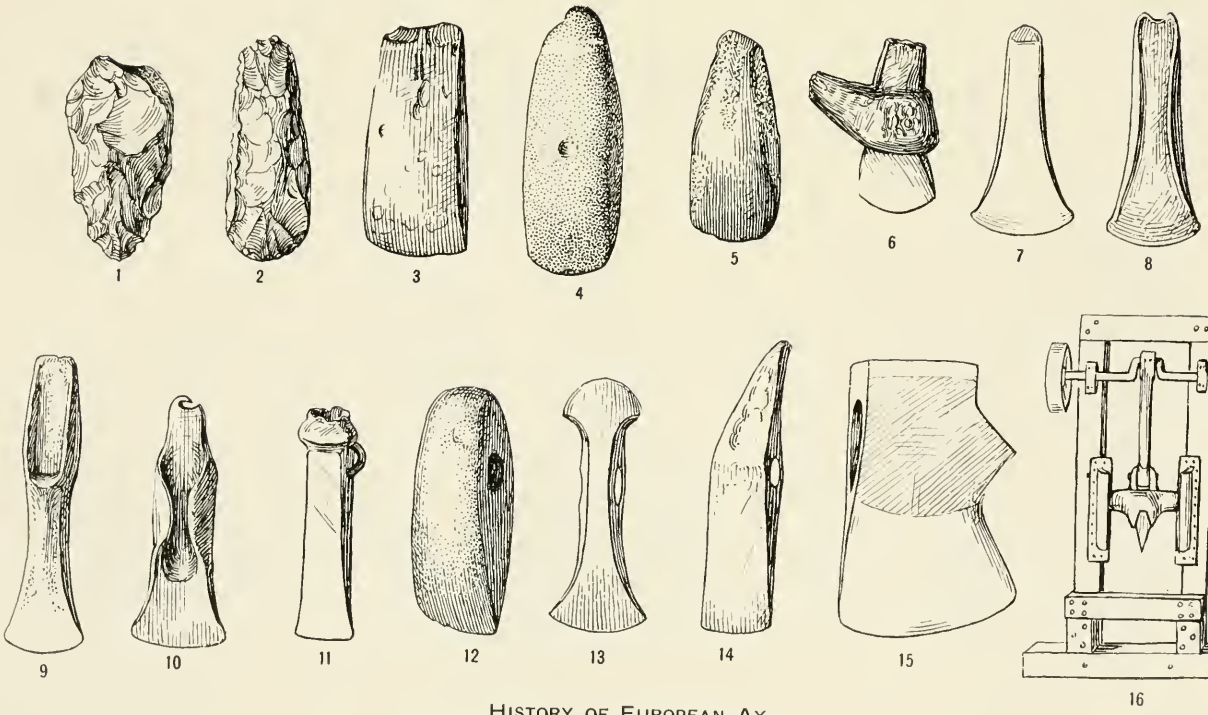
HISTORY OF TOBACCO PIPE.

FOR EXPLANATION OF PLATE SEE PAGE 10.



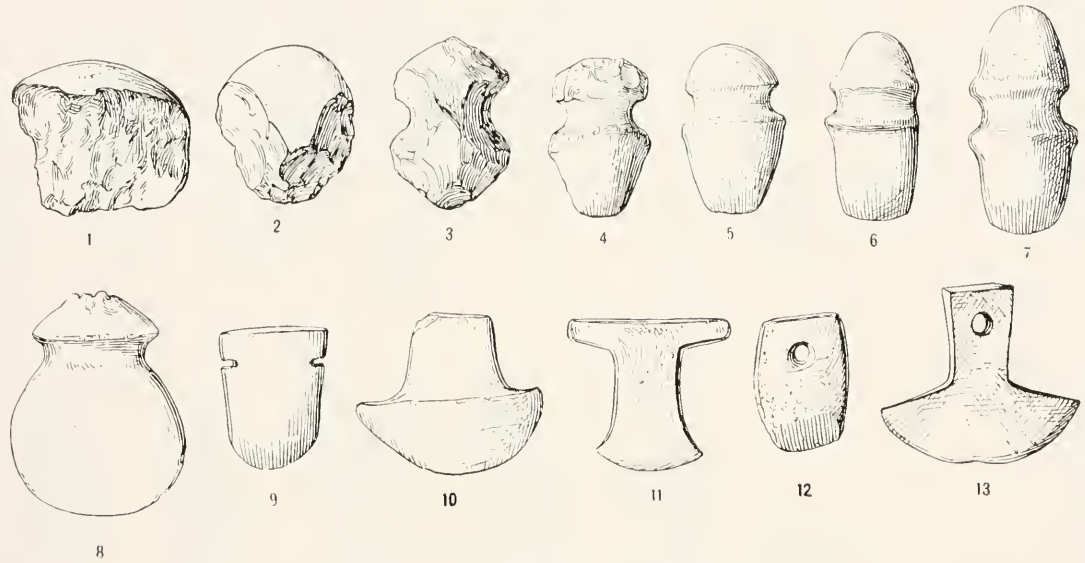
DEVELOPMENT OF JACKKNIFE.

FOR EXPLANATION OF PLATE SEE PAGE 11.



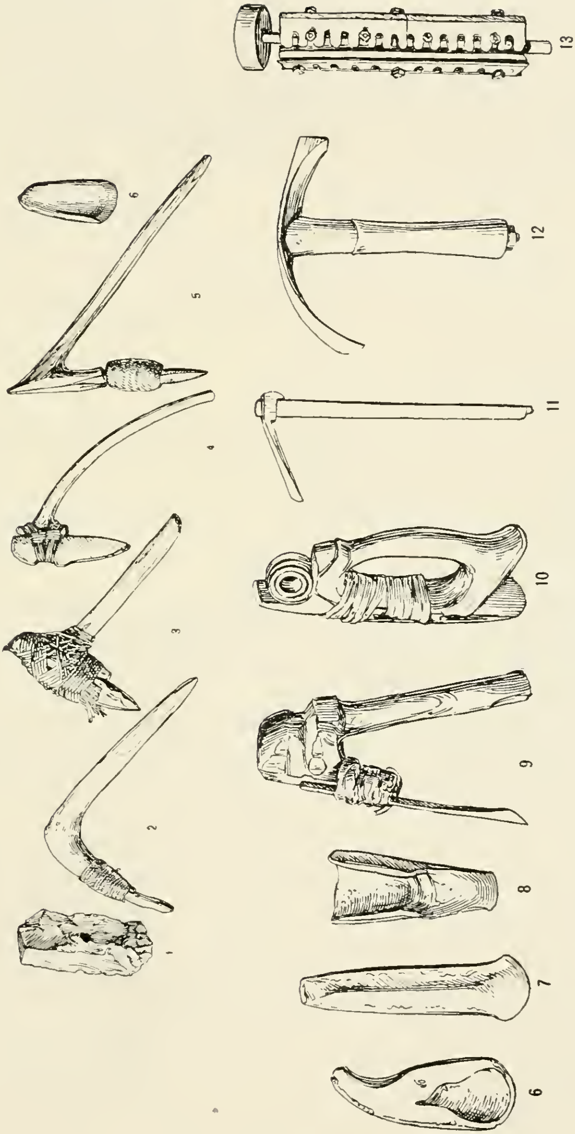
HISTORY OF EUROPEAN AX.

FOR EXPLANATION OF PLATE SEE PAGE 12.



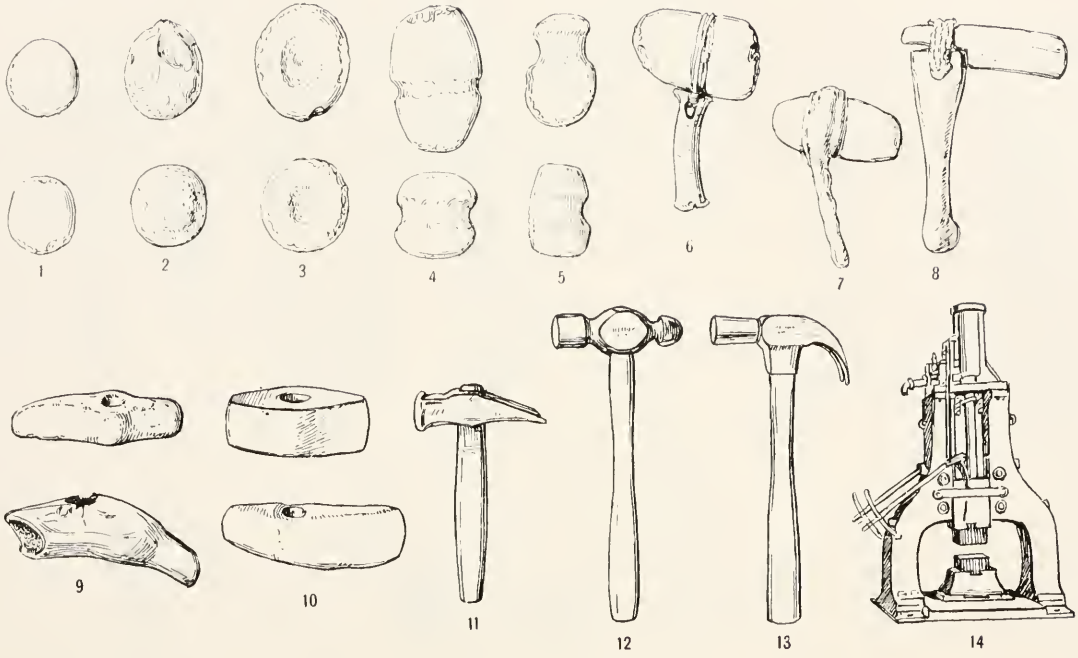
HISTORY OF ABORIGINAL AMERICAN AX.

FOR EXPLANATION OF PLATE SEE PAGE 13.



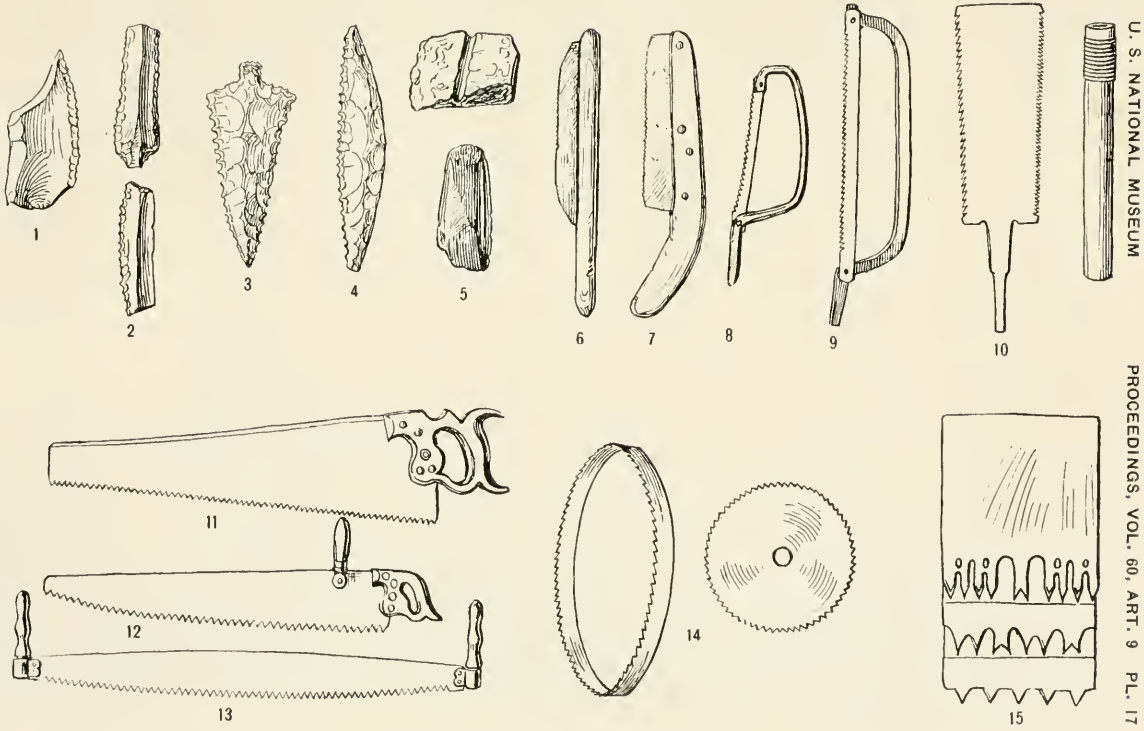
HISTORY OF ADZ.

FOR EXPLANATION OF PLATE SEE PAGE 14.



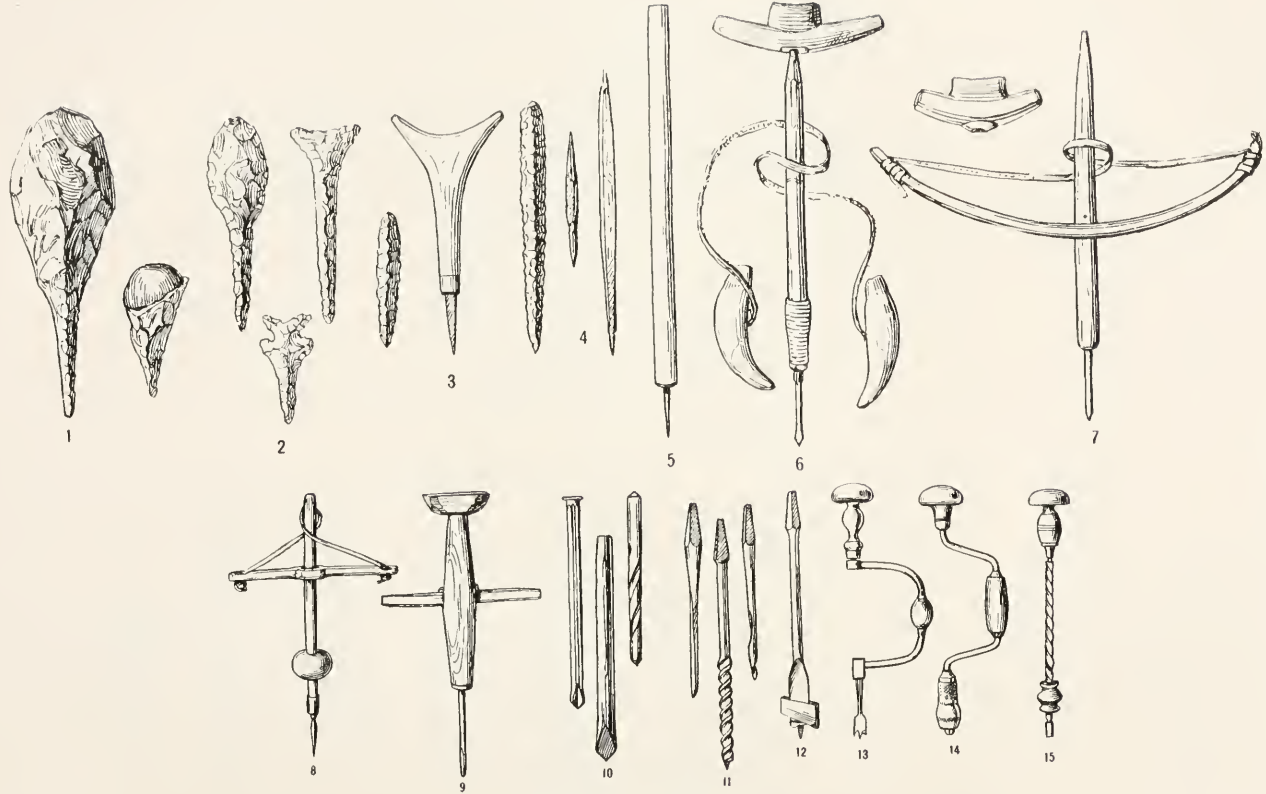
HISTORY OF HAMMER.

FOR EXPLANATION OF PLATE SEE PAGE 15.



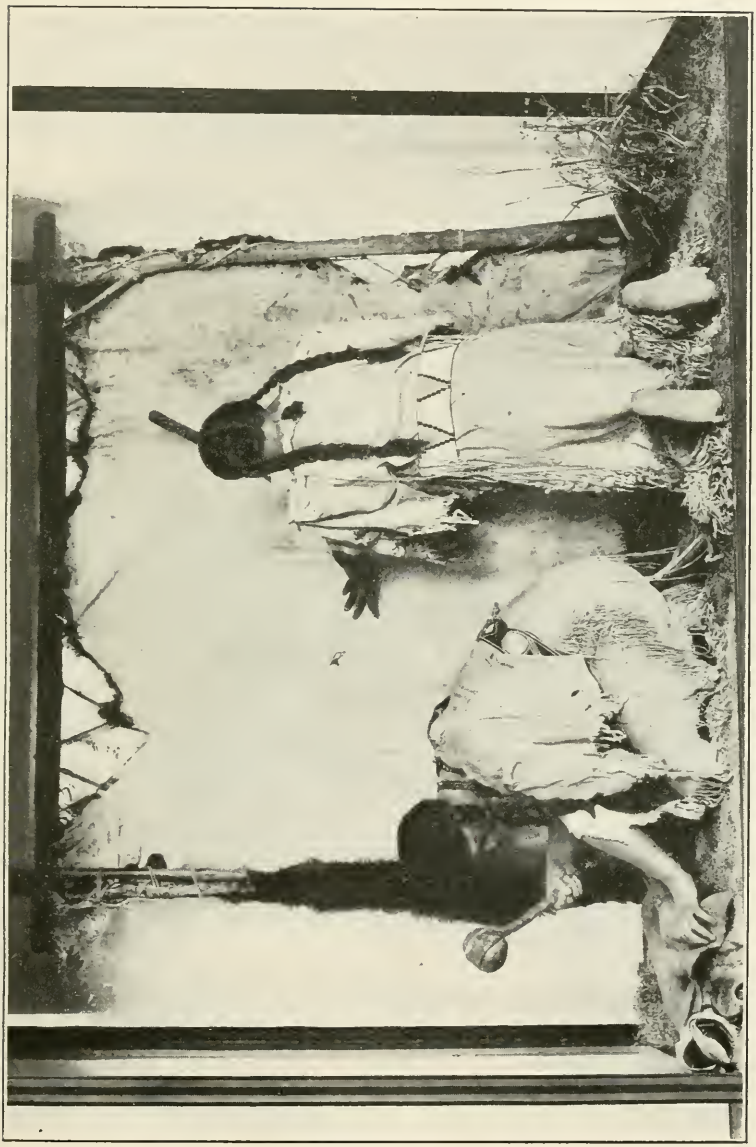
HISTORY OF SAW.

FOR EXPLANATION OF PLATE SEE PAGE 18.



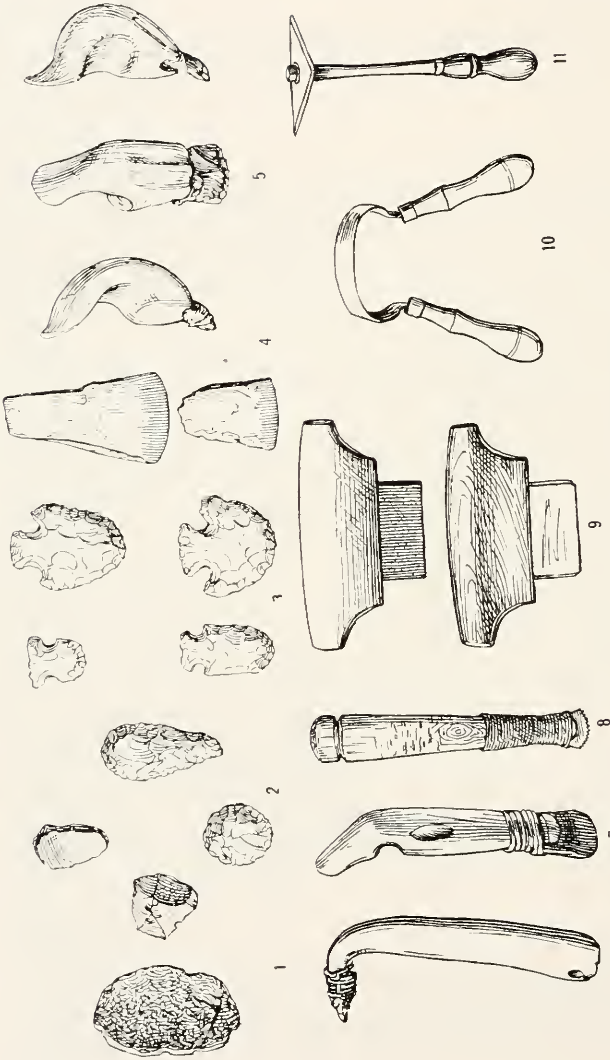
HISTORY OF DRILL.

FOR EXPLANATION OF PLATE SEE PAGE 17.



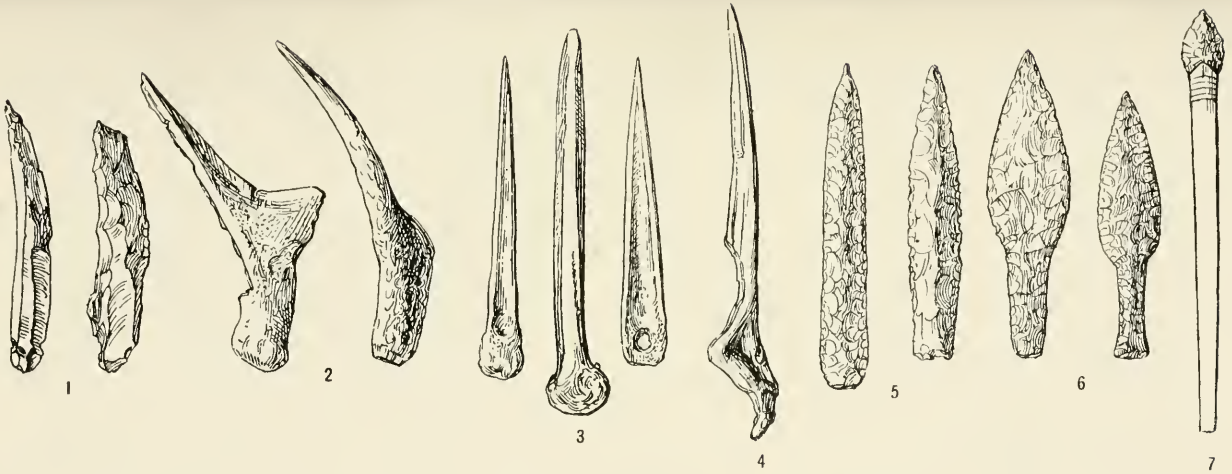
INDIAN WOMEN DRESSING HIDES.

FOR EXPLANATION OF PLATE SEE PAGE 19



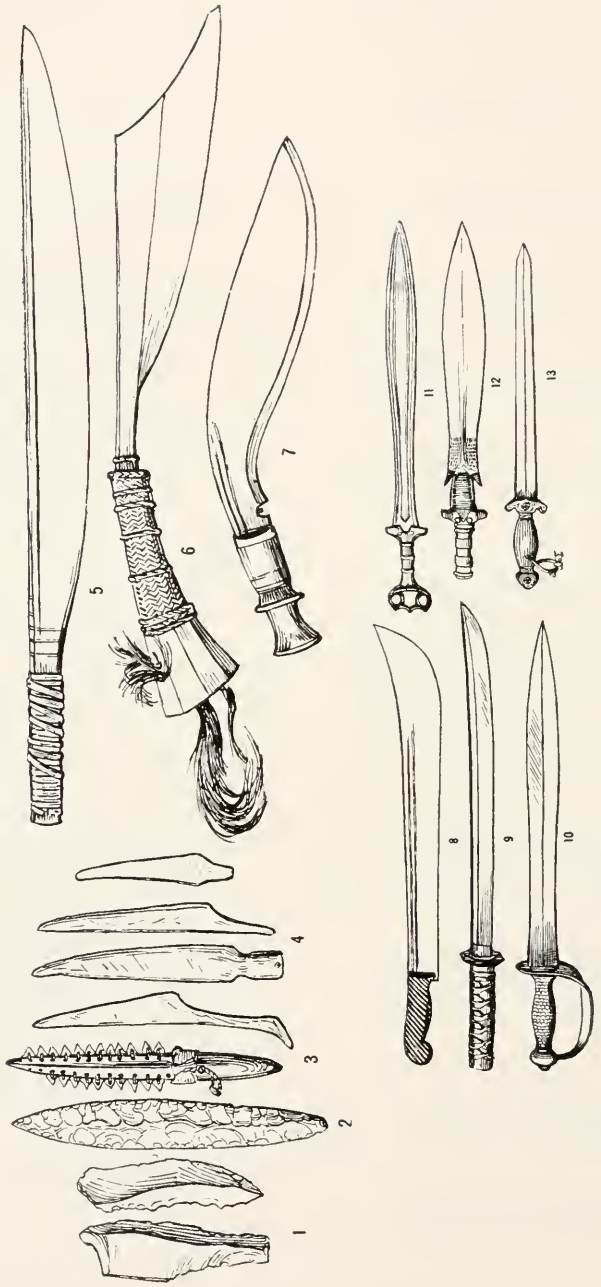
HISTORY OF SCRAPER.

FOR EXPLANATION OF PLATE SEE PAGE 19.



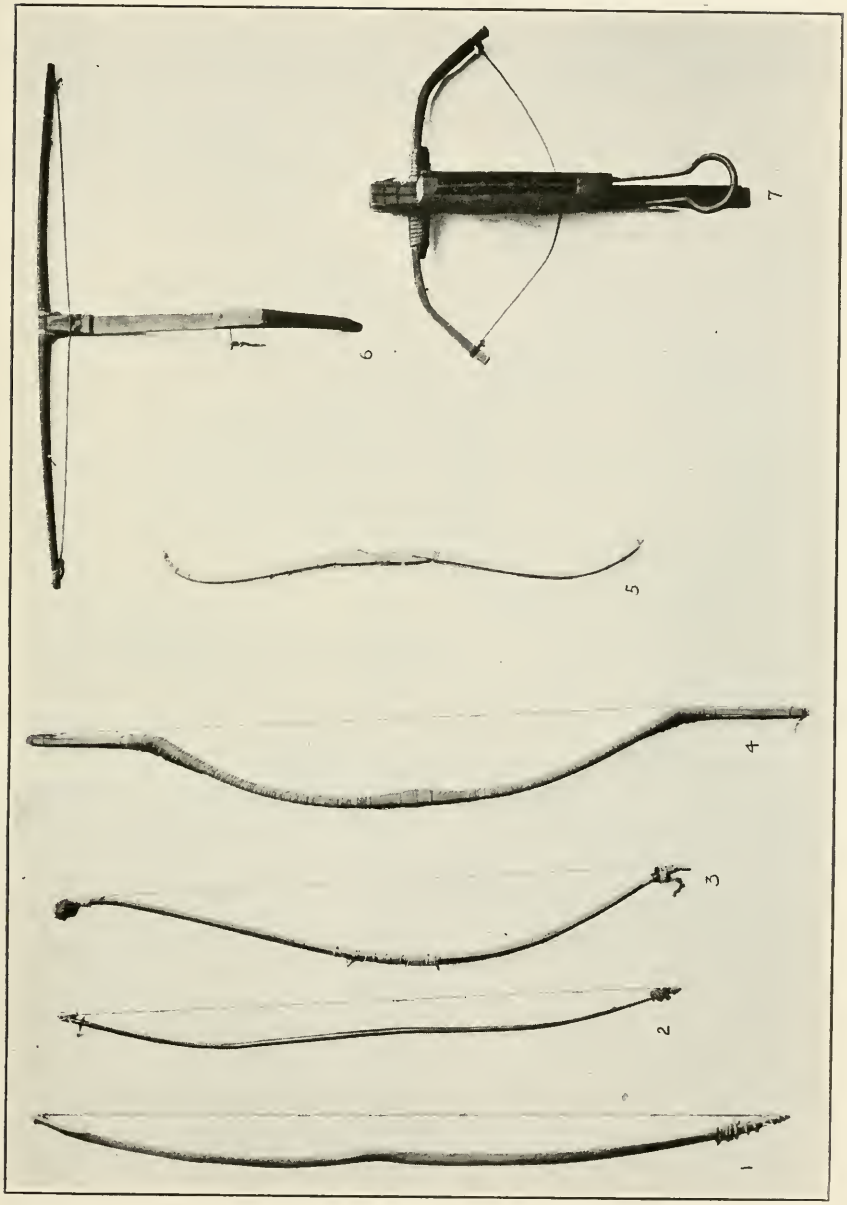
HISTORY OF WEAPONS FOR STABBING.

FOR EXPLANATION OF PLATE SEE PAGE 20



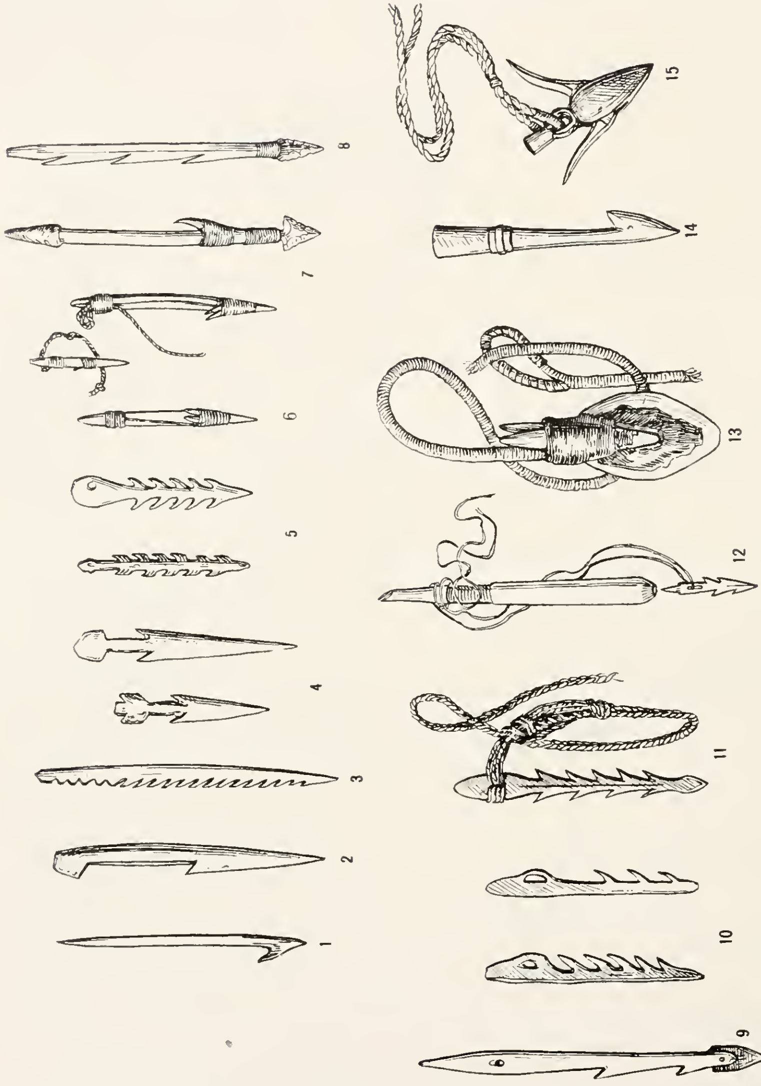
HISTORY OF WEAPONS FOR CUTTING AND THRUSTING.

FOR EXPLANATION OF PLATE SEE PAGE 21.



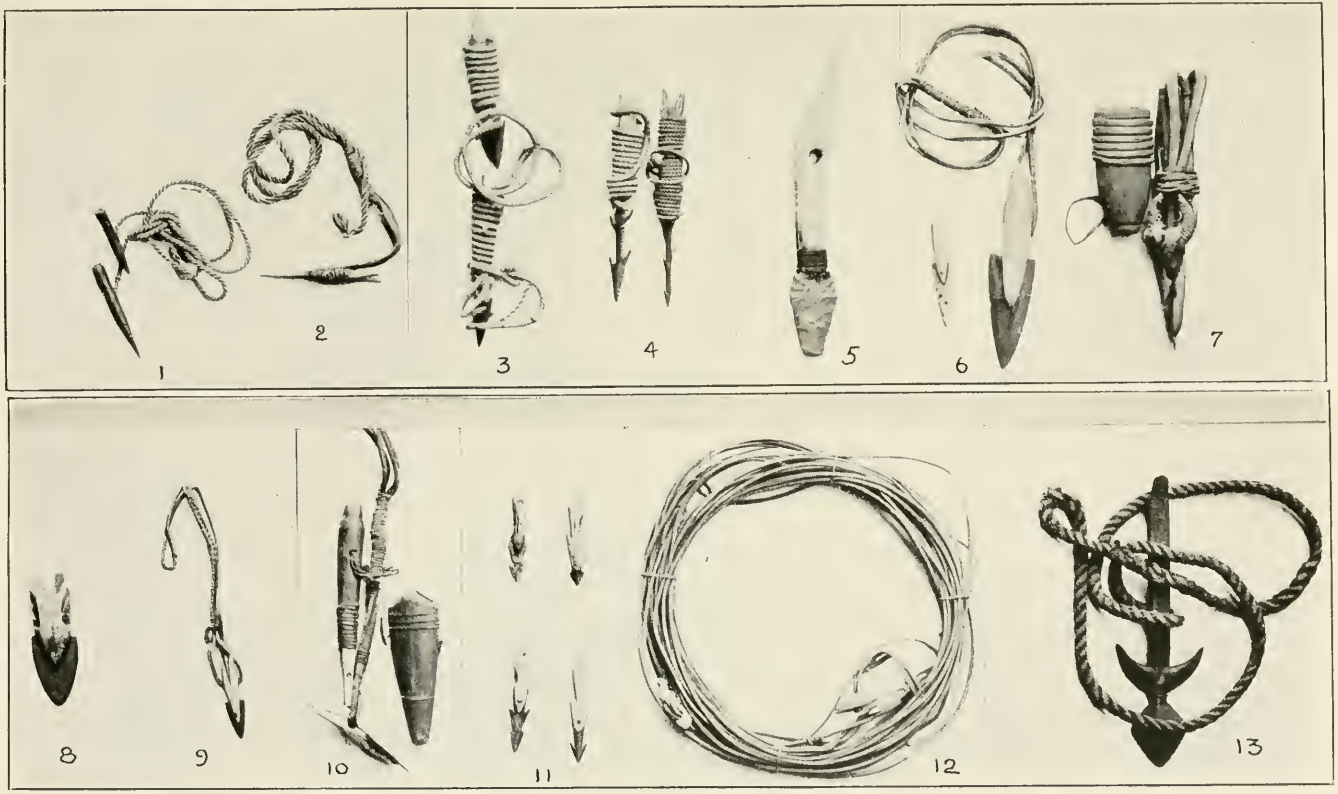
HISTORY OF BOW AND ARBALEST.

FOR EXPLANATION OF PLATE SEE PAGE 22.



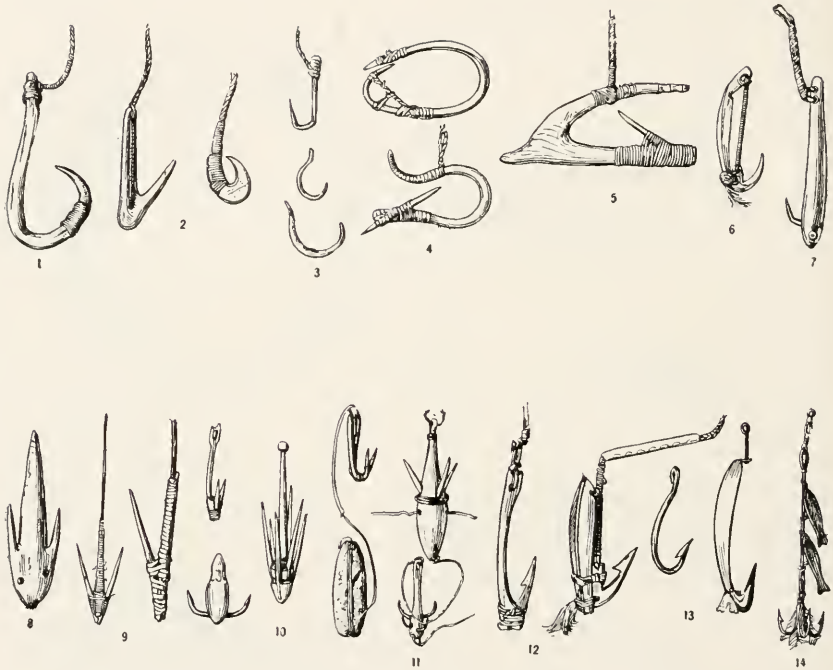
HISTORY OF HARPOON BARB.

FOR EXPLANATION OF PLATE SEE PAGE 24



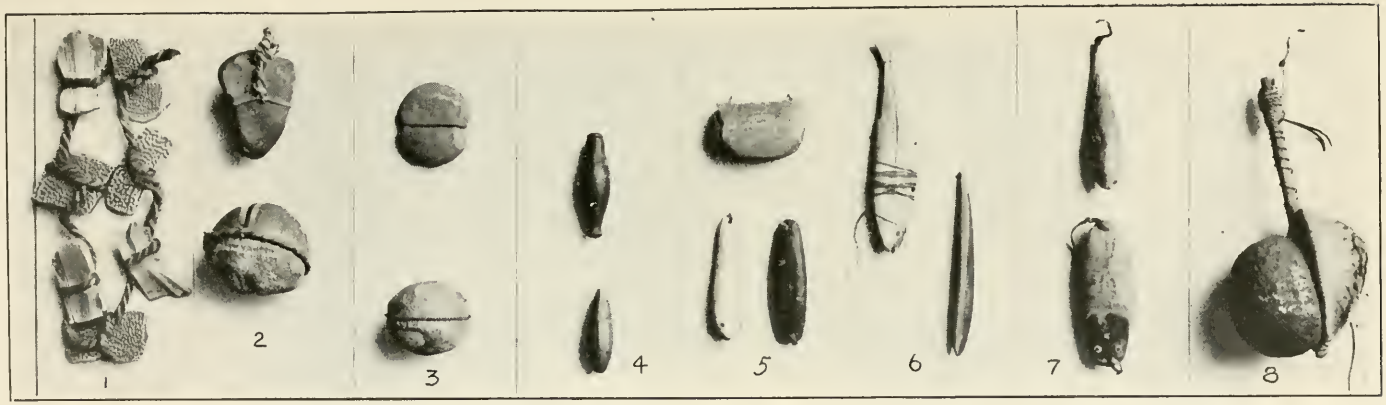
HISTORY OF TOGGLE HARPOONS.

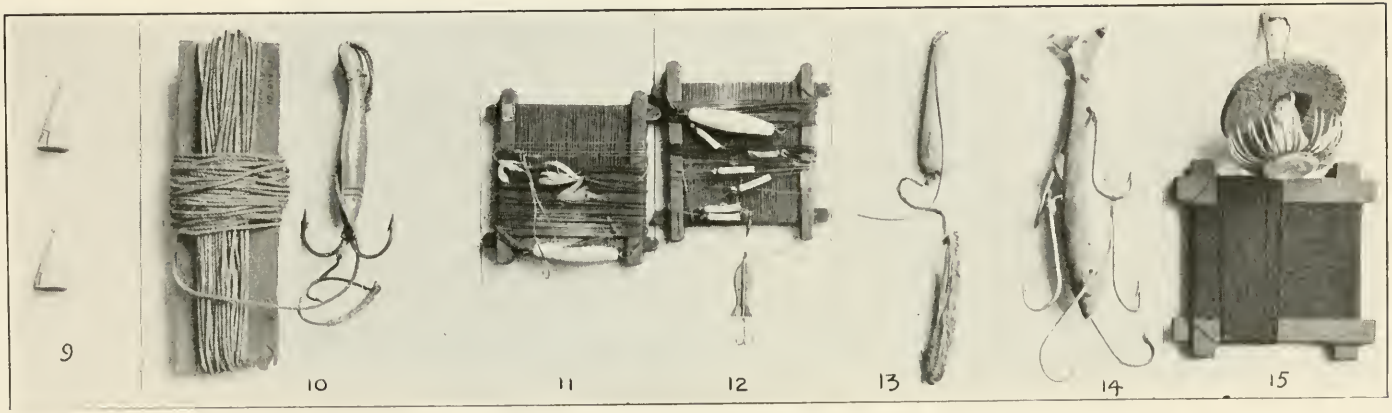
FOR EXPLANATION OF PLATE SEE PAGE 25.



HISTORY OF FISH HOOKS.

FOR EXPLANATION OF PLATE SEE PAGE 27.



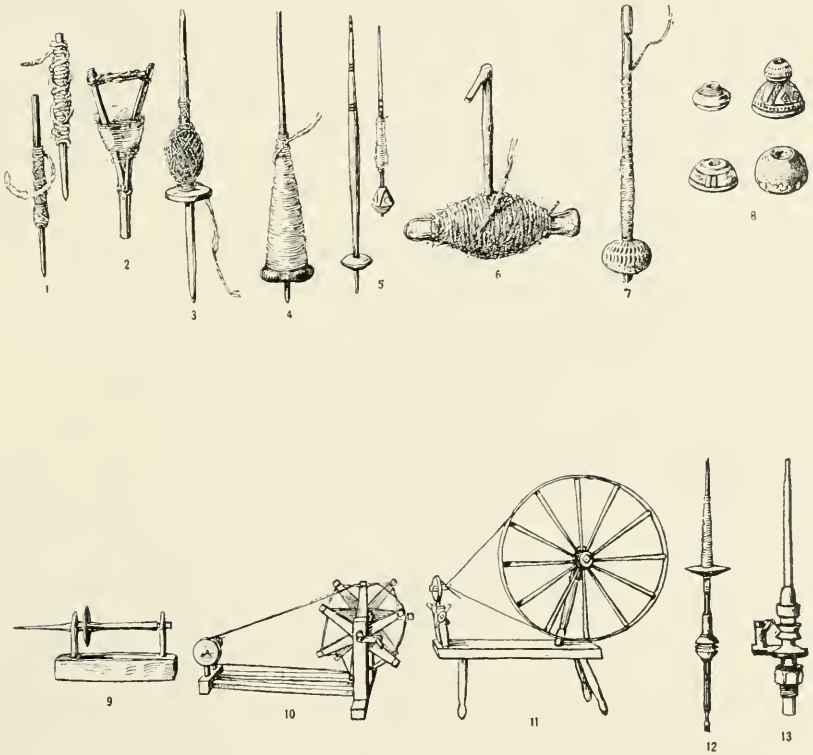


HISTORY OF SINKERS.

FOR EXPLANATION OF PLATE SEE PAGE 28.

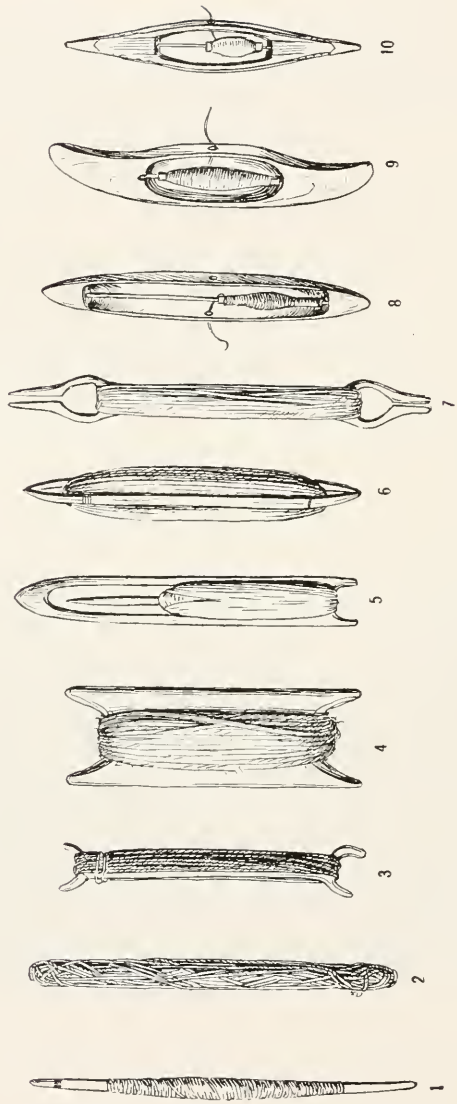
ZUNI INDIAN WEAVER.

FOR EXPLANATION OF PLATE SEE PAGE 29.



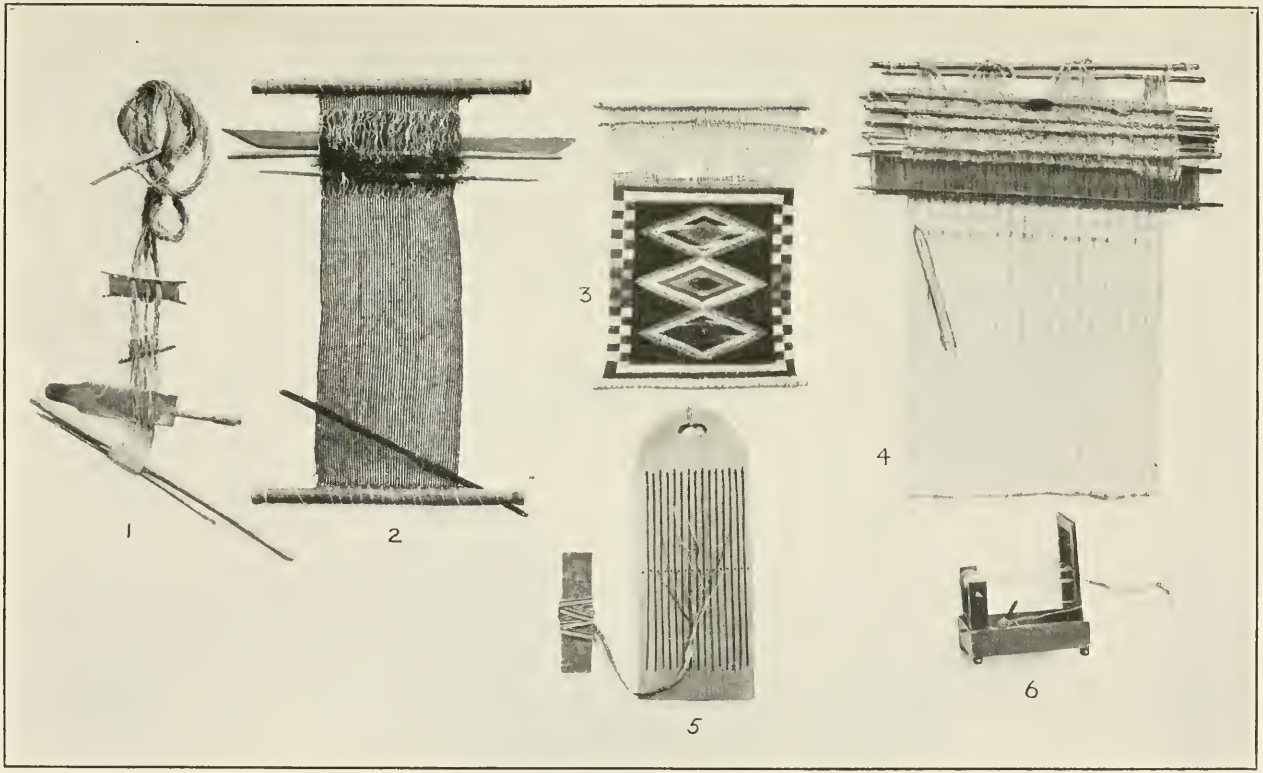
HISTORY OF SPINDLE.

FOR EXPLANATION OF PLATE SEE PAGE 30.



HISTORY OF SHUTTLE.

FOR EXPLANATION OF PLATE SEE PAGE 30.

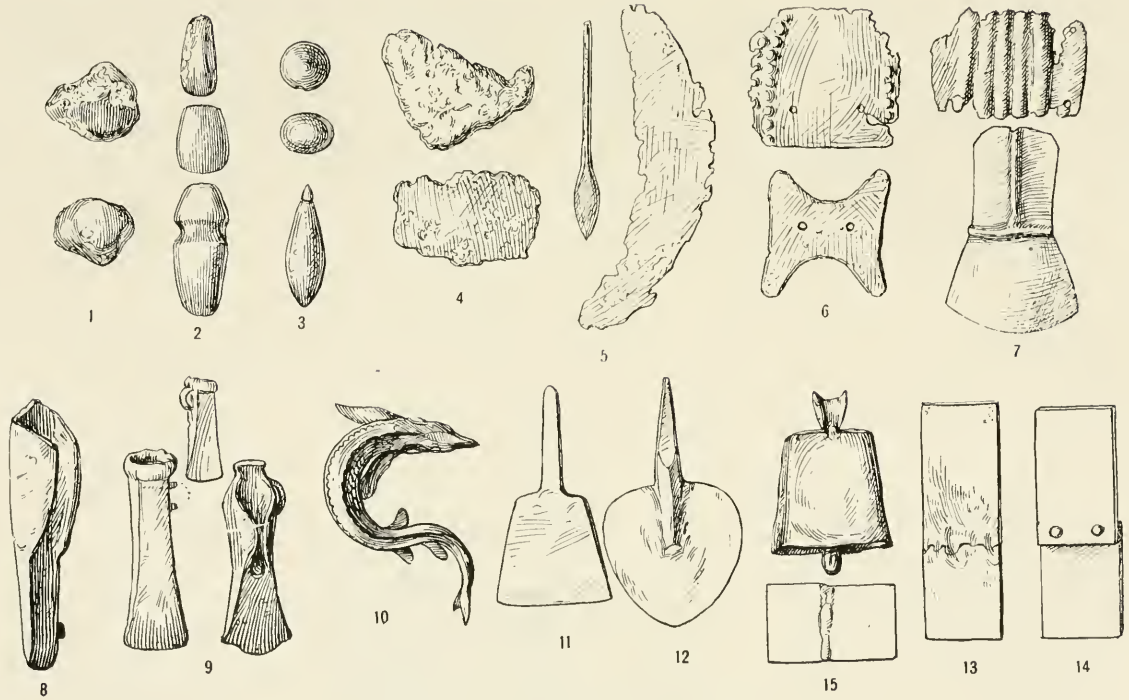


HISTORY OF LOOM.

FOR EXPLANATION OF PLATE SEE PAGE 31

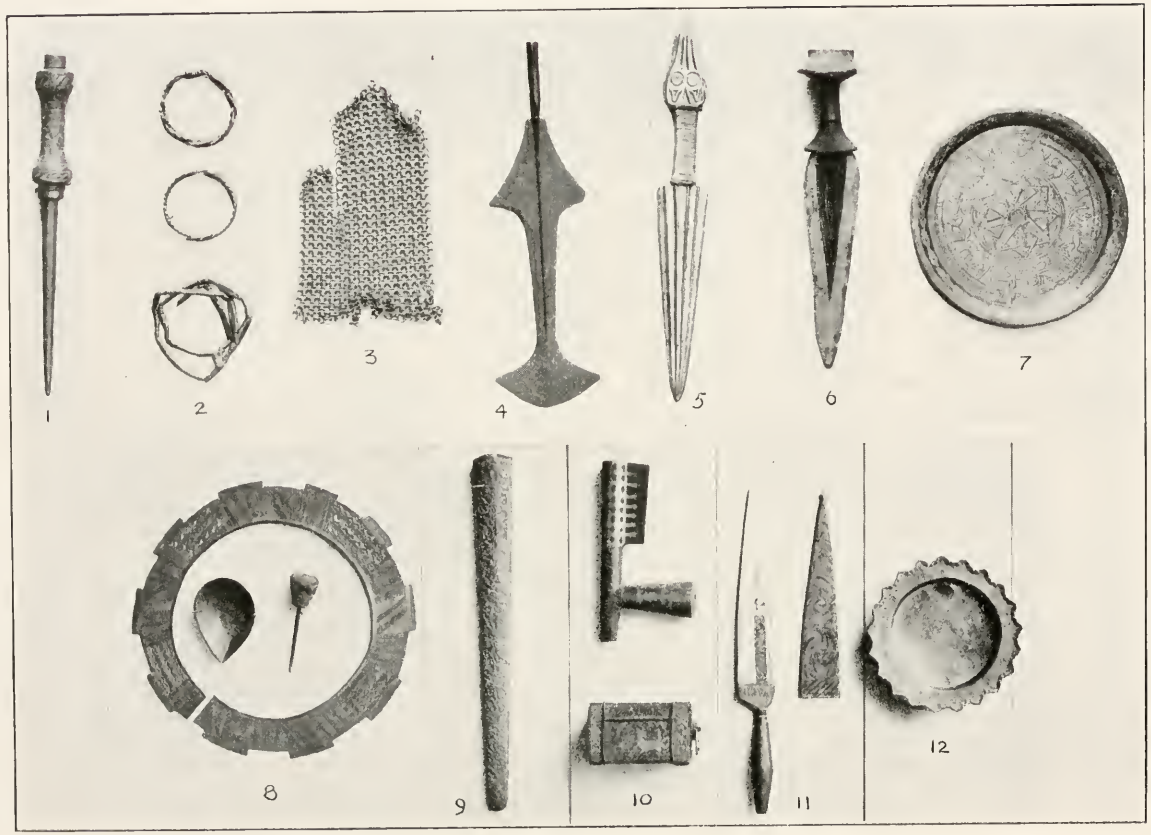
NAVAHO METAL WORKERS

FOR EXPLANATION OF PLATE SEE PAGE 33



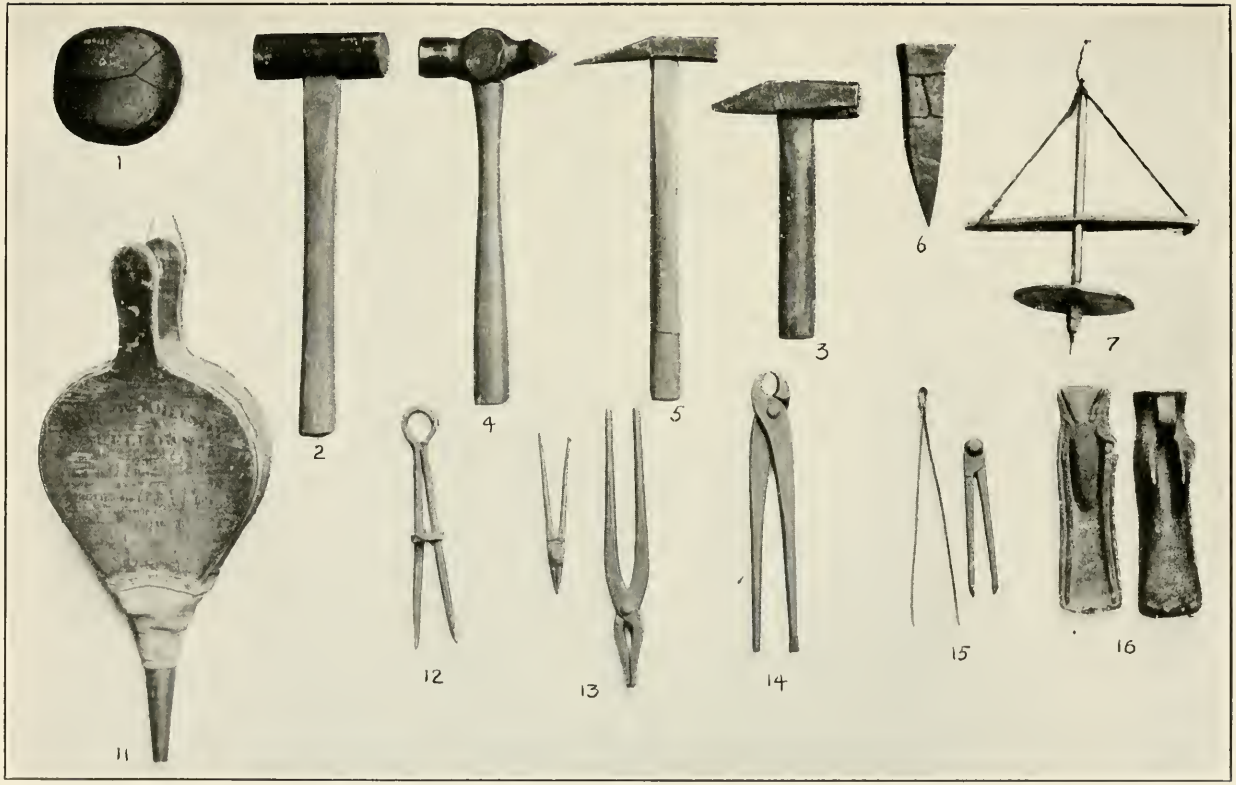
HISTORY OF METALLURGICAL PROCESS.

FOR EXPLANATION OF PLATE SEE PAGE 33.



HISTORY OF METAL WORKING.

FOR EXPLANATION OF PLATE SEE PAGE 34.

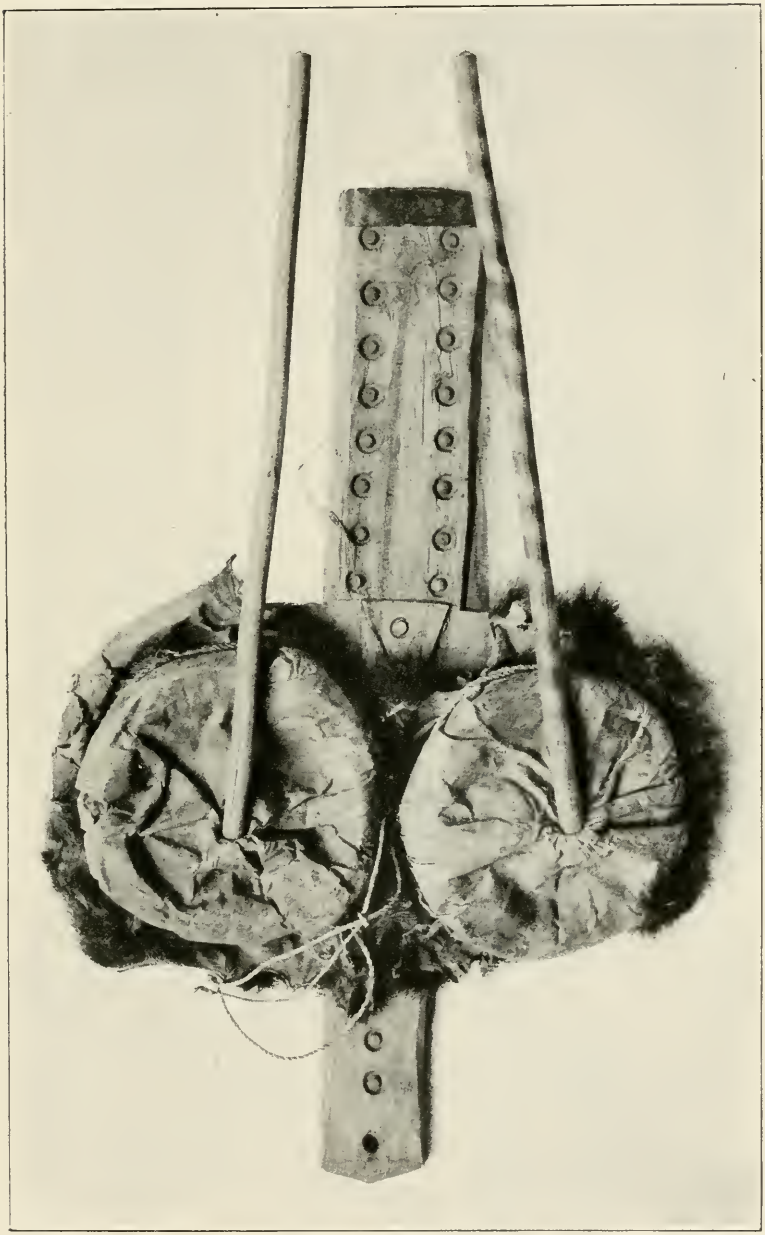


HISTORY OF TOOLS FOR METAL WORKING.

FOR EXPLANATION OF PLATE SEE PAGE 34.

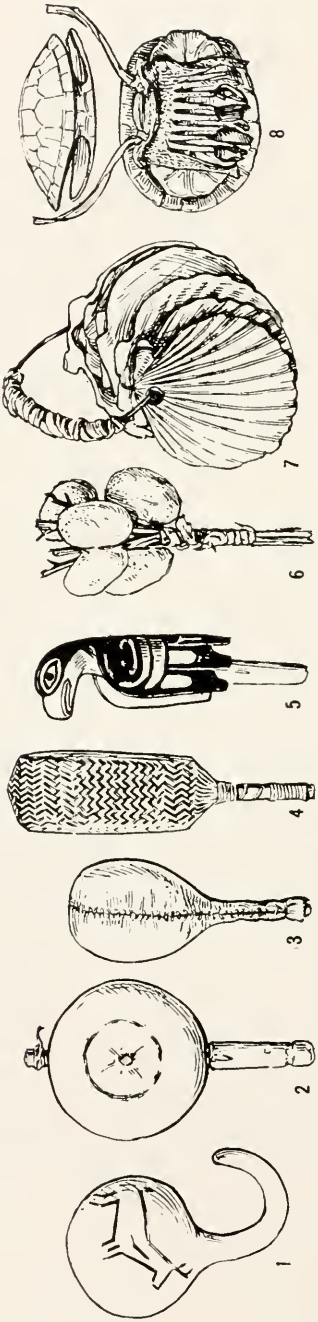
A Country Blacksmith Shop.

For explanation of plate see page 35



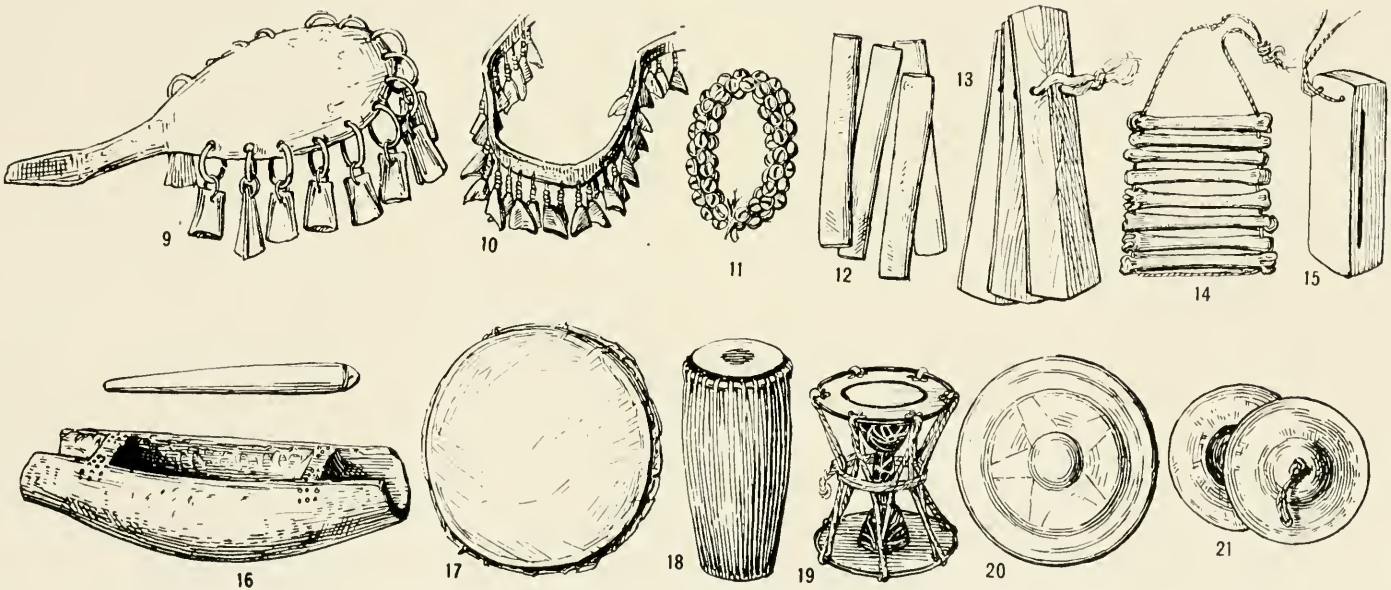
PRIMITIVE FORM OF DOUBLE BELLOWS.

FOR EXPLANATION OF PLATE SEE PAGE 35



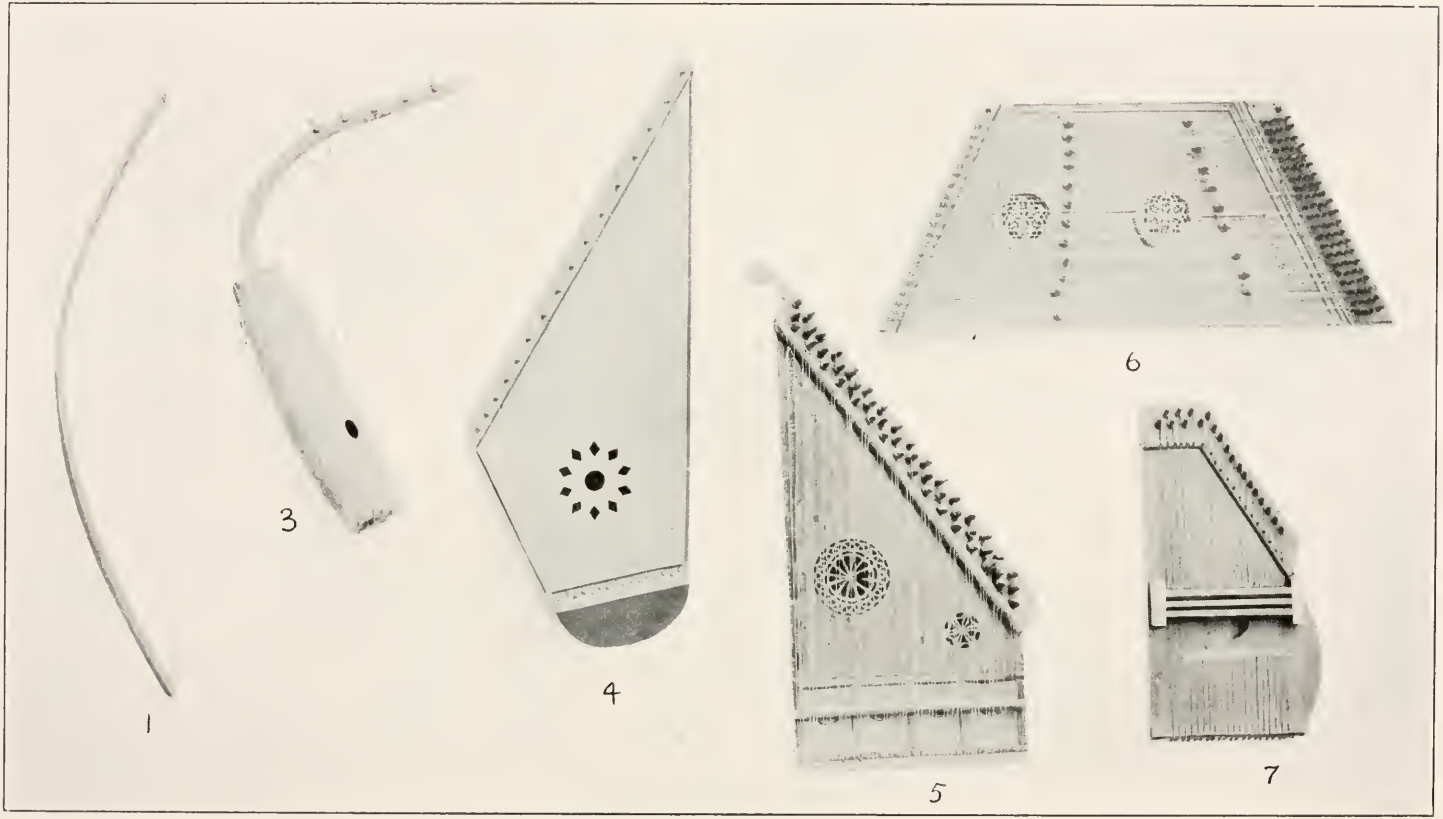
HISTORY OF PERCUSSIVE MUSICAL INSTRUMENTS.

FOR EXPLANATION OF PLATE SEE PAGE 35



HISTORY OF PERCUSSIVE MUSICAL INSTRUMENTS—CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 35.



HISTORY OF STRINGED INSTRUMENTS.

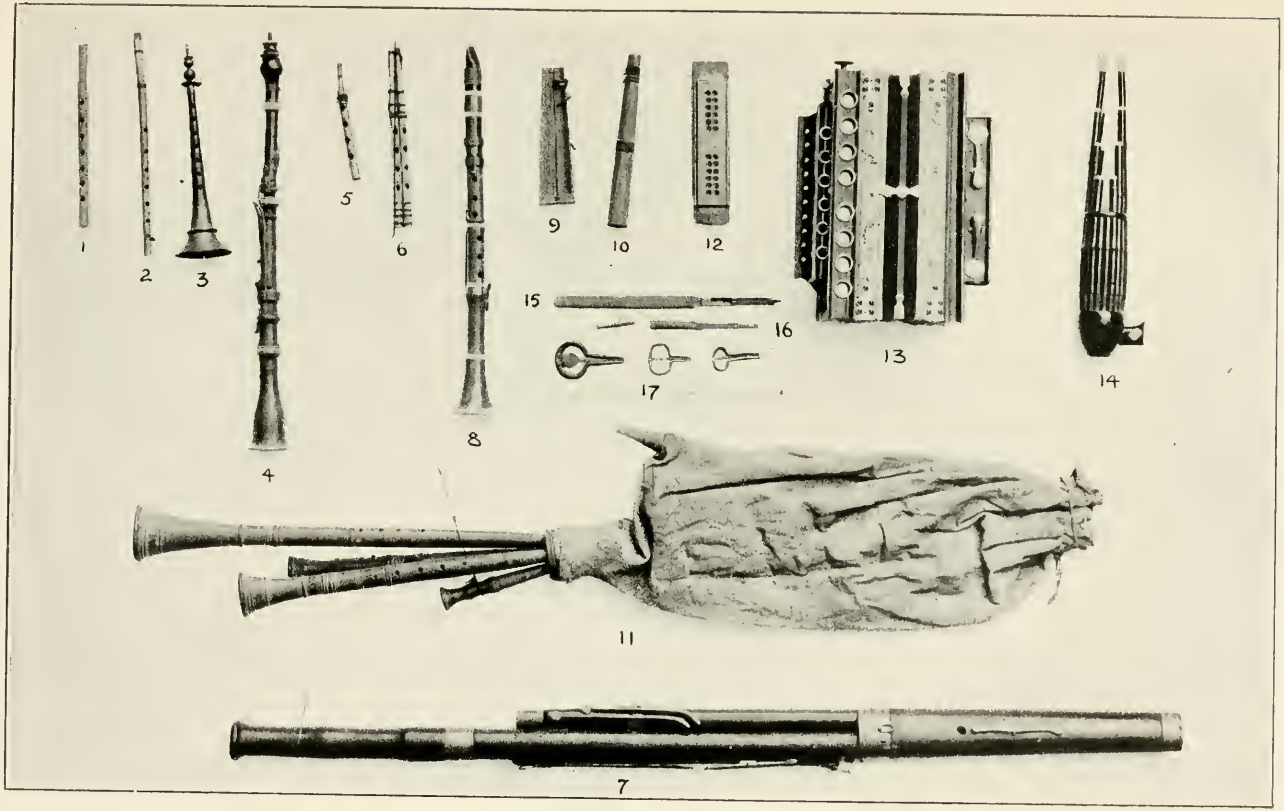
FOR EXPLANATION OF PLATE SEE PAGE 36

ANGOLA MUSICAL BOW.

FOR EXPLANATION OF PLATE SEE PAGE 37

HISTORY OF WIND MUSICAL INSTRUMENTS.

FOR EXPLANATION OF PLATE SEE PAGE 37.

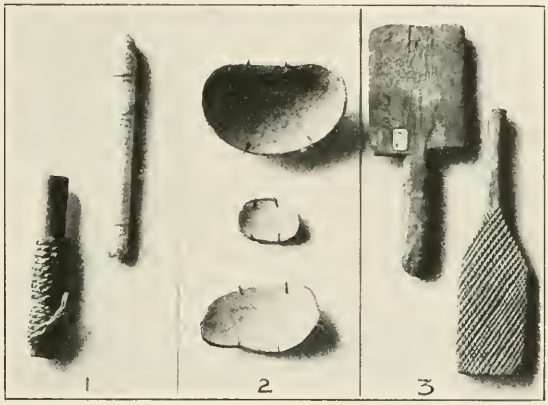


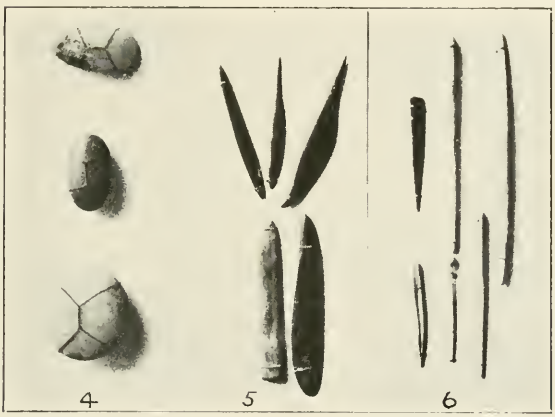
HISTORY OF REED MUSICAL INSTRUMENTS.

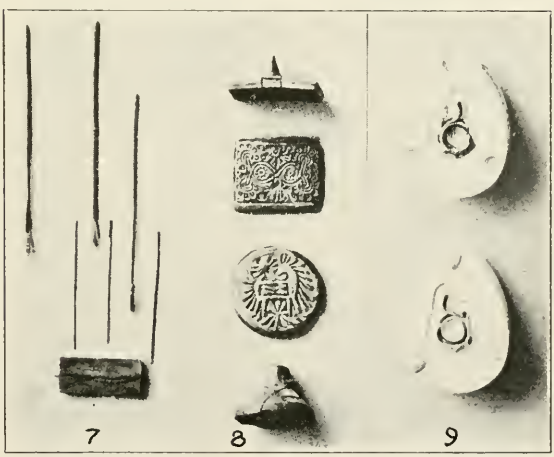
FOR EXPLANATION OF PLATE SEE PAGE 38

INDIAN WOMEN MAKING POTTERY.

FOR EXPLANATION OF PLATE SEE PAGE 40.

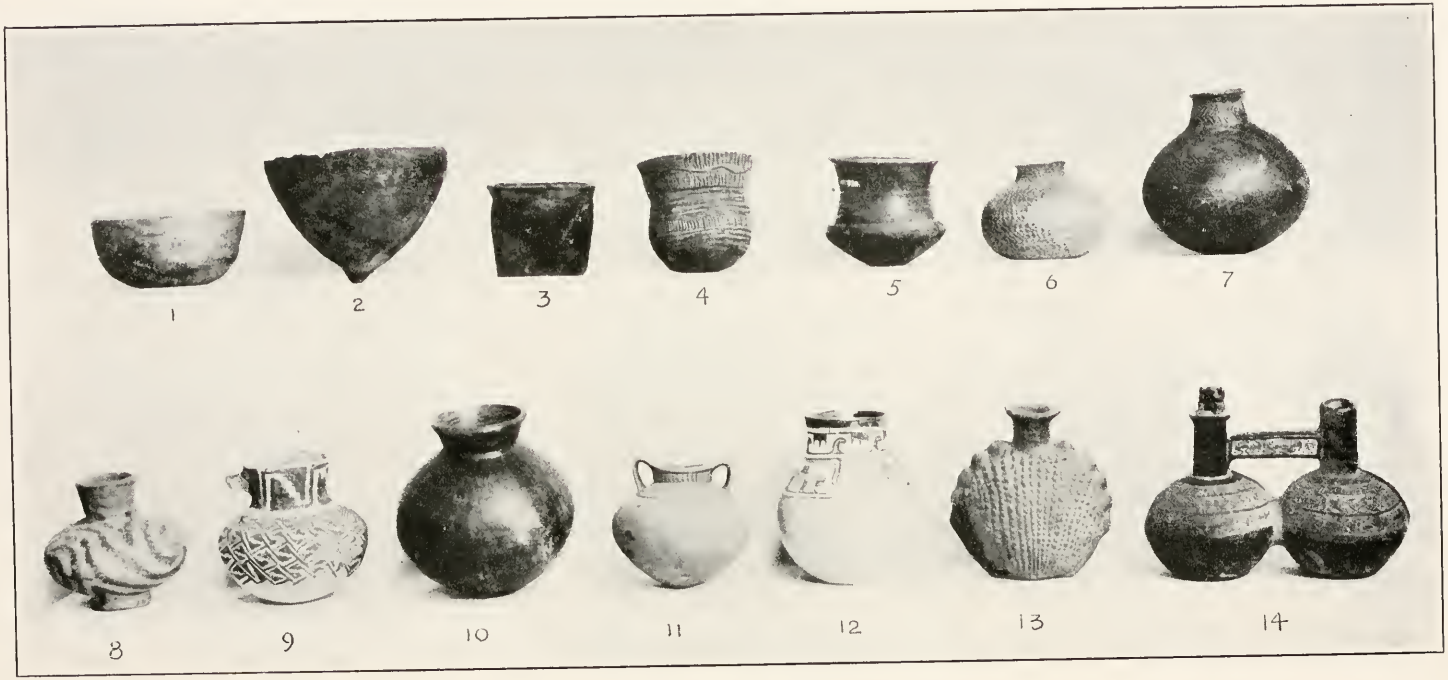






HISTORY OF TOOLS USED IN POTTERY MAKING.

FOR EXPLANATION OF PLATE SEE PAGE 41

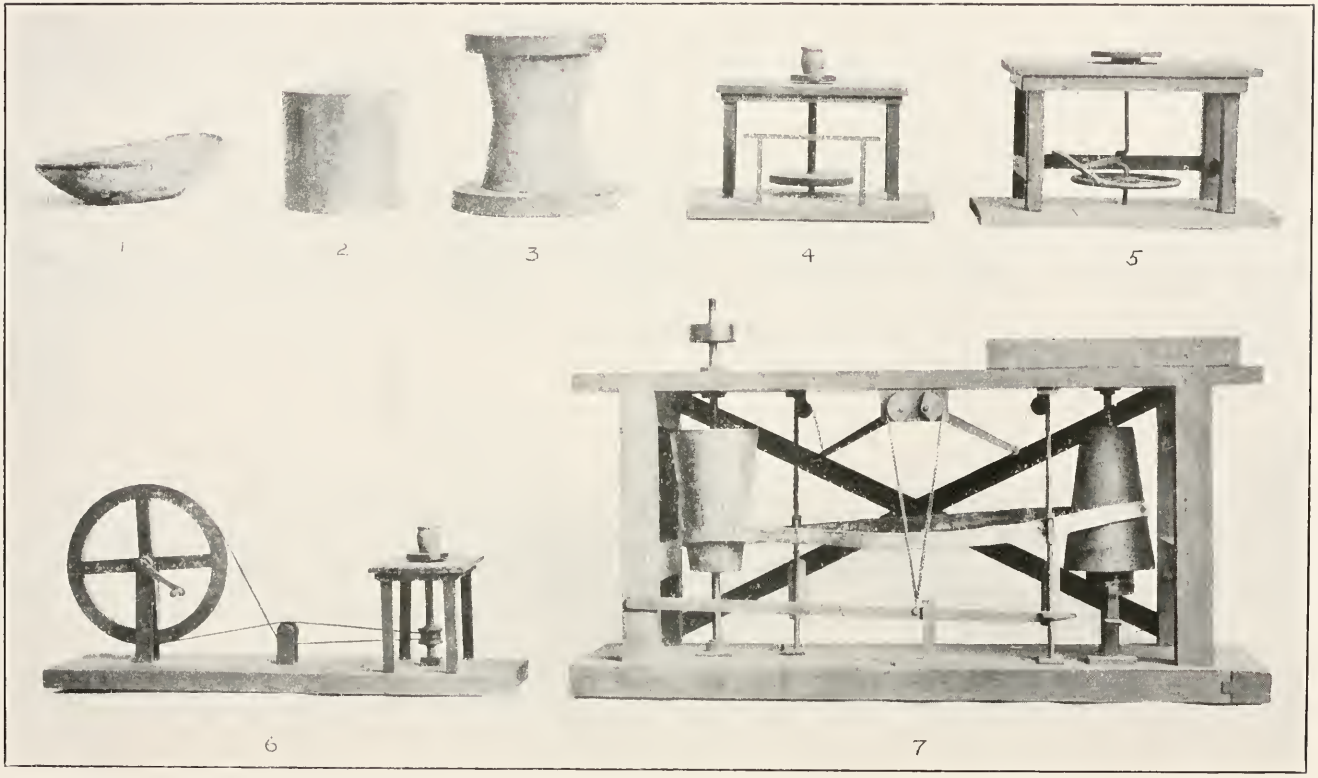


HISTORY OF VASE.

FOR EXPLANATION OF PLATE SEE PAGE 41.

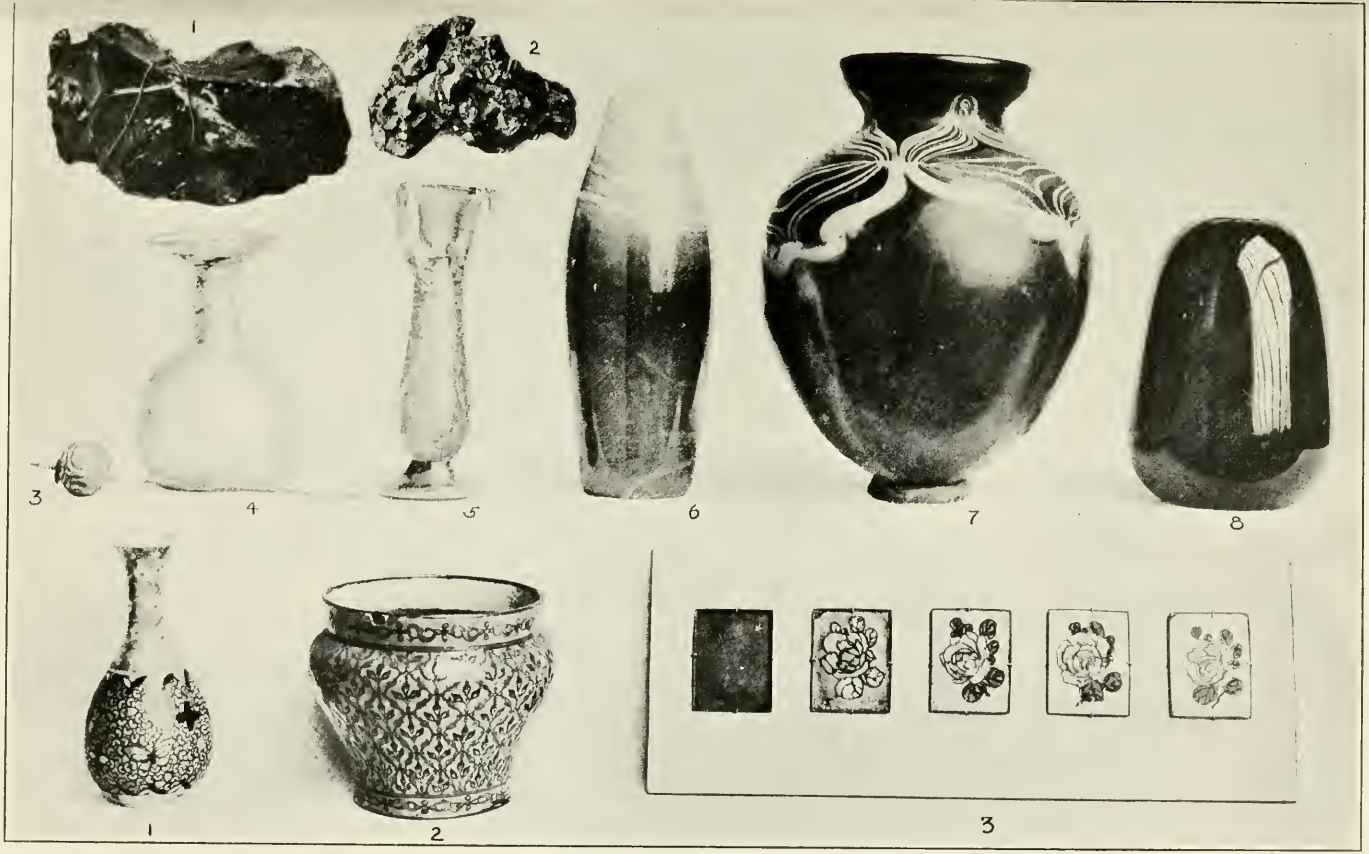
HISTORY OF VASE—CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 41.



HISTORY OF POTTER'S WHEEL.

FOR EXPLANATION OF PLATE SEE PAGE 43.

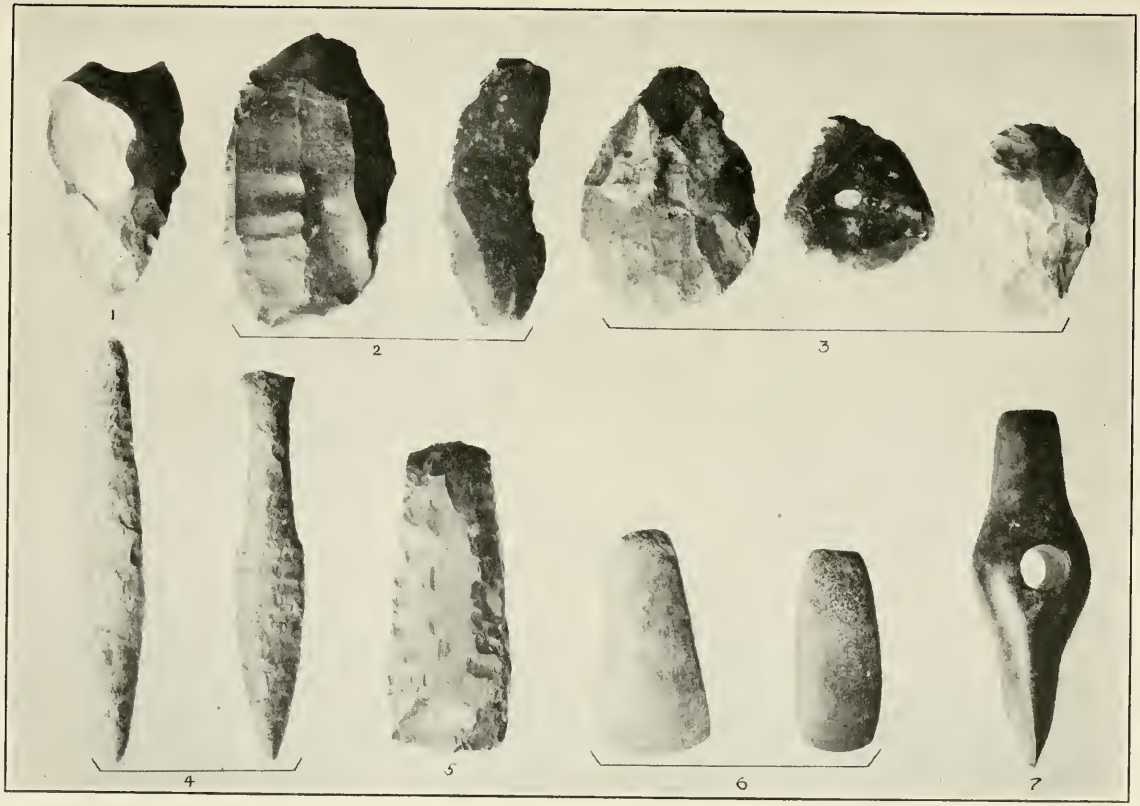


HISTORY OF GLASS AND ENAMEL.

FOR EXPLANATION OF PLATE SEE PAGES 43 AND 44

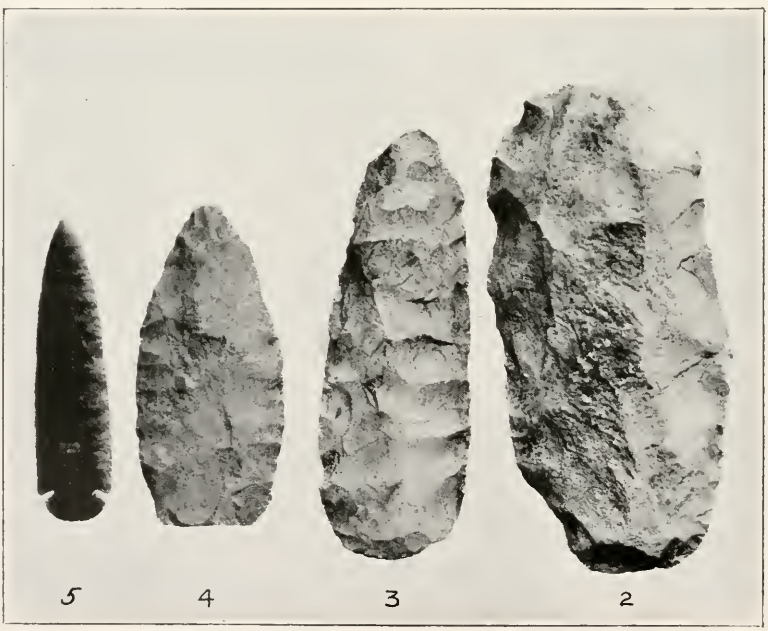
INDIAN FLINT BREAKERS.

FOR EXPLANATION OF PLATE SEE PAGE 45.



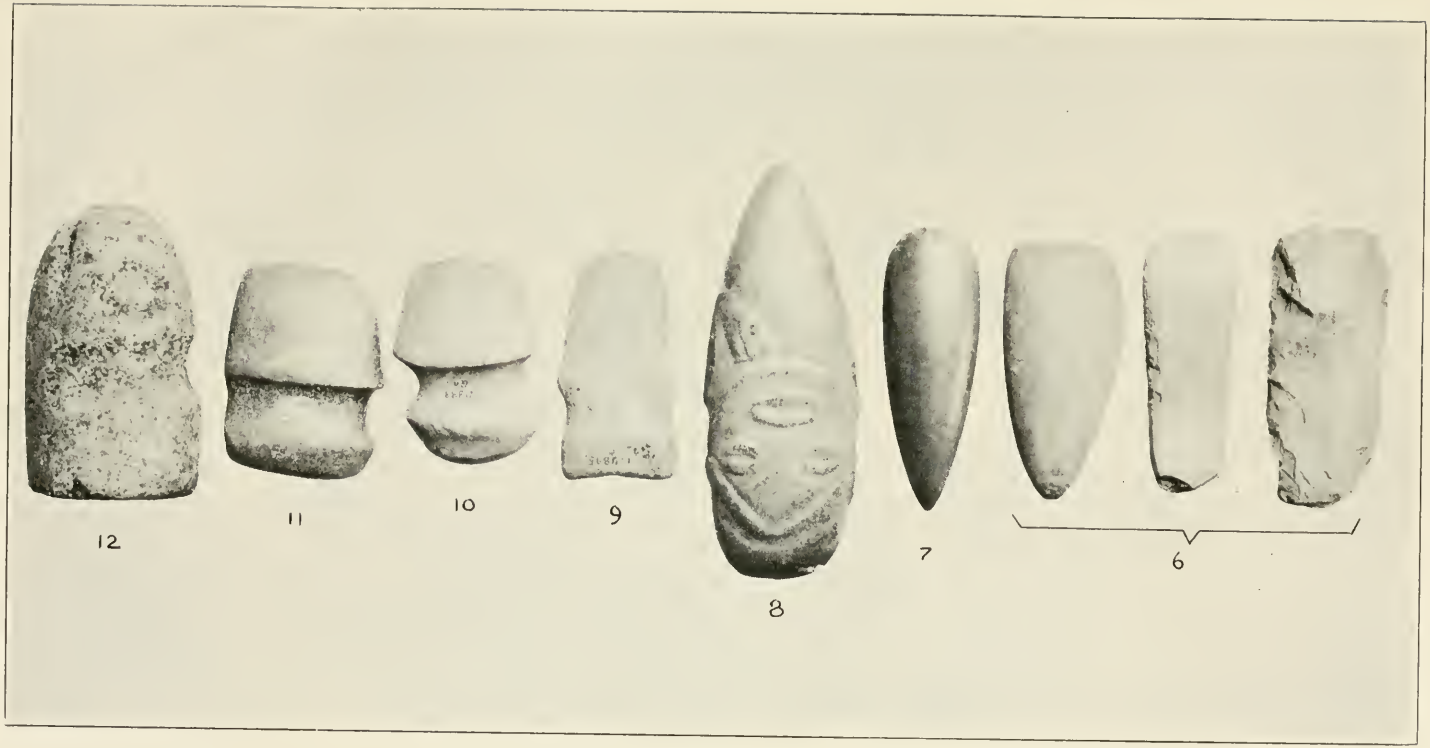
HISTORY OF EUROPEAN SCULPTURE.

FOR EXPLANATION OF PLATE SEE PAGE 45.



HISTORY OF ABORIGINAL AMERICAN SCULPTURE.

FOR EXPLANATION OF PLATE SEE PAGE 46.

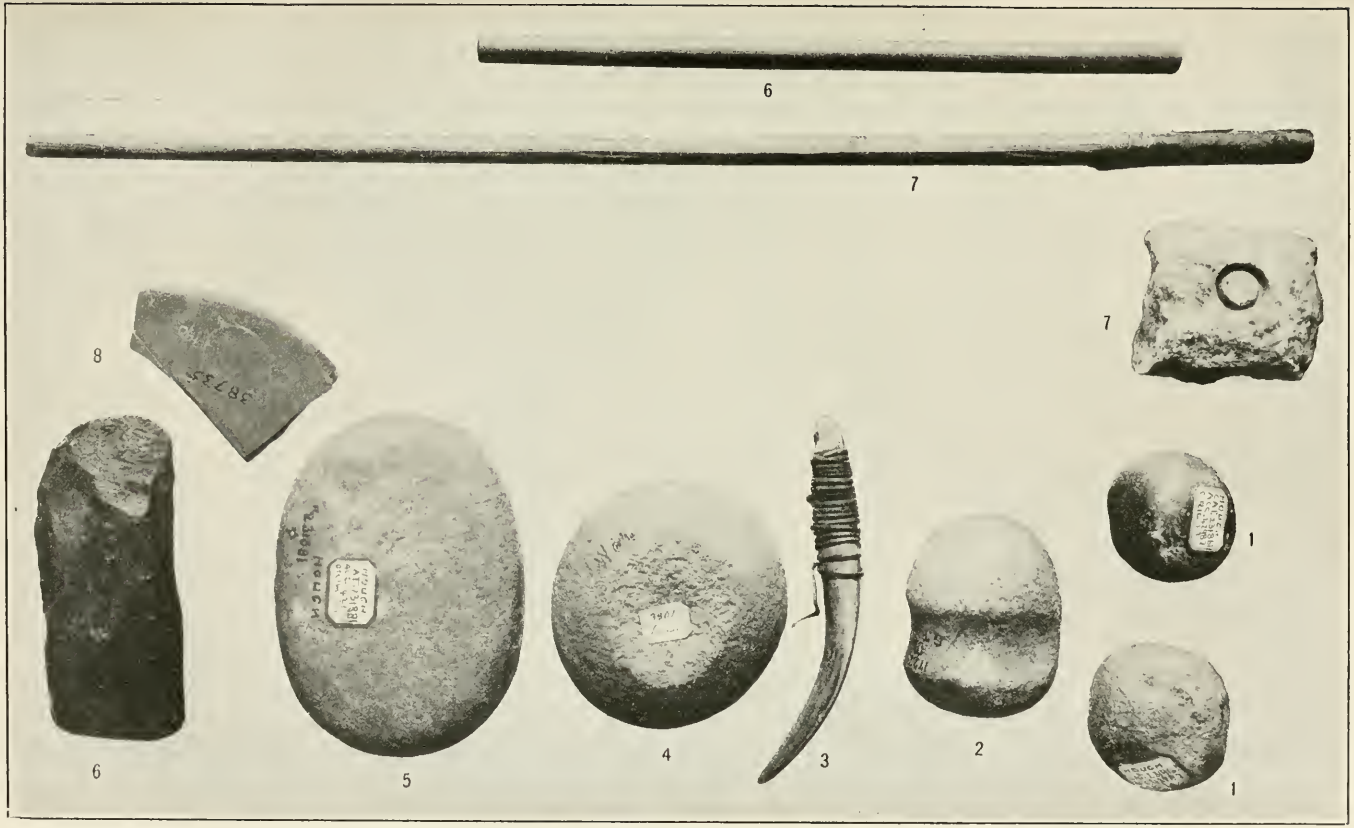


HISTORY OF ABORIGINAL AMERICAN SCULPTURE—CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 46.

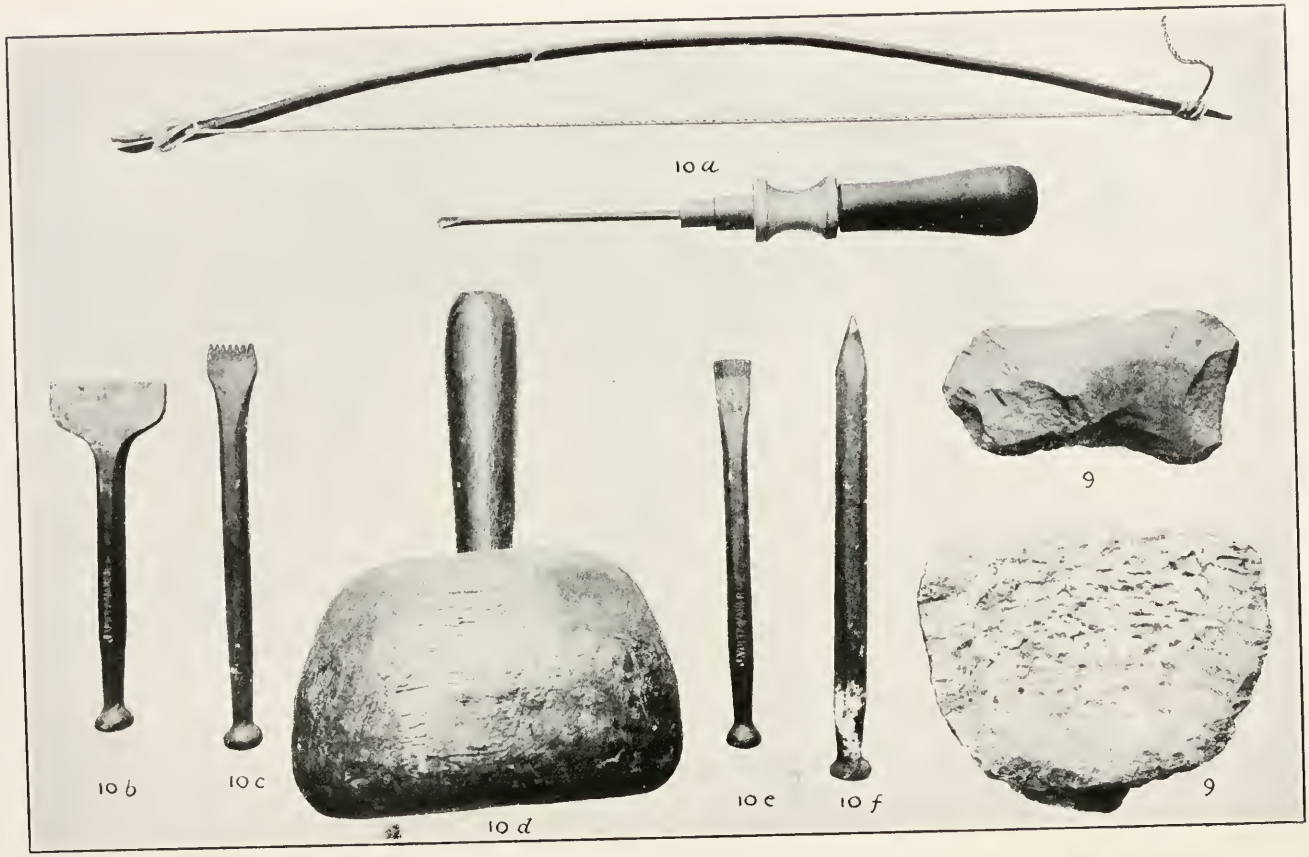
HISTORY OF ABORIGINAL AMERICAN SCULPTURE—CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 46.



HISTORY OF TOOLS USED IN SHAPING STONE.

FOR EXPLANATION OF PLATE SEE PAGE 47.



HISTORY OF TOOLS USED IN SHAPING STONE—CONTINUED.

FOR EXPLANATION OF PLATE SEE PAGE 47.