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FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN

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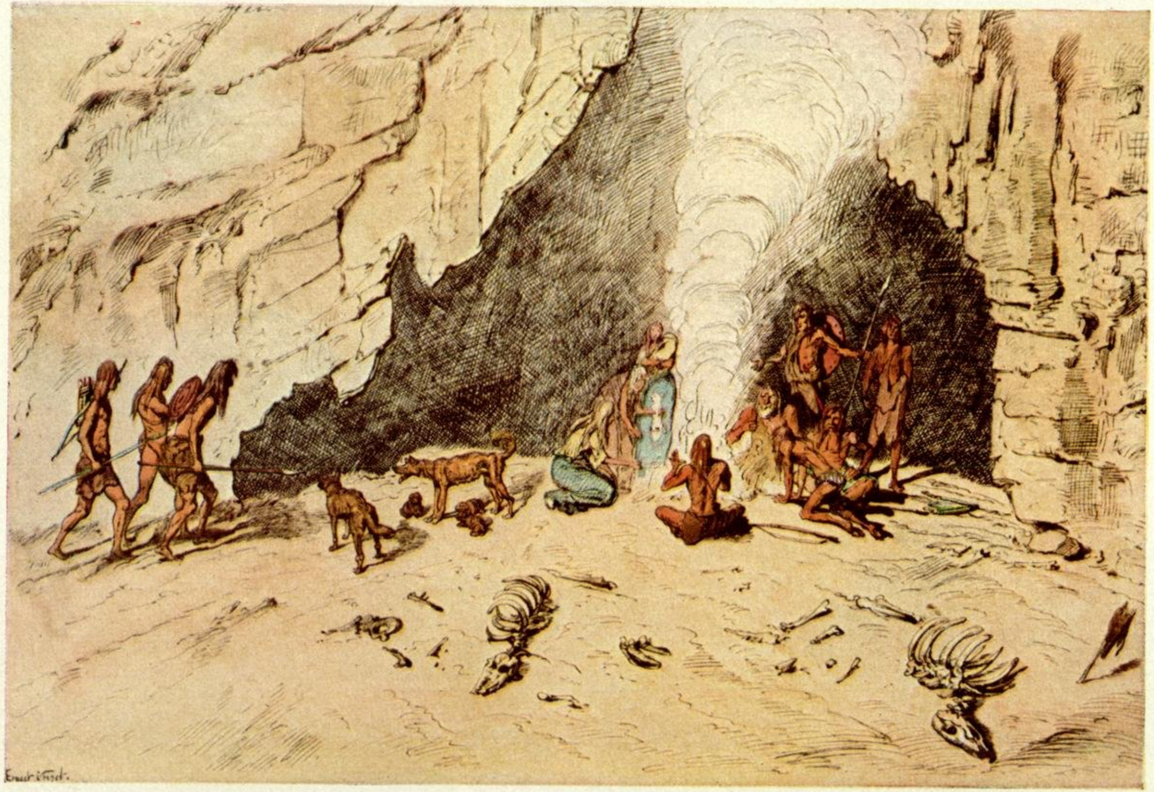

A fanciful sketch of prehistoric man which suggests the rude conditions of his life

MAN FROM THE FARTHEST PAST

By

Carl Whiting Bishop
Associate Curator, Freer Gallery of Art

WITH THE COLLABORATION OF

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AND

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VOLUME SEVEN

OF THE

SMITHSONIAN SCIENTIFIC SERIES

CONTENTS

ILLUSTRATIONS

LIST OF PLATES

LIST OF TEXT FIGURES

PREFACE

THE past history of our race is far too vast and complex a subject to be surveyed adequately by any one individual. Hence this book is the result of cooperative effort on the part of workers in several different fields, all, however, with a direct bearing on the subject.

Dr. Charles G. Abbot, Secretary of the Smithsonian Institution and Editor-in-Chief of the present SERIES, has assumed the task of writing the first three chapters. In the first two of these he has described the setting of the cosmic stage upon which the human race is playing its part; while in the third he has told of the prenatal life of the individual, which so strikingly recapitulates the development of the species in many ways.

The portions of the book dealing with the physical characteristics of prehistoric man have been based very largely upon the work of Dr. Aleš Hrdlička, of the National Museum, Chapters VII and VIII in particular having been taken almost verbatim from a technical monograph specially prepared by him for the Smithsonian Institution.

For the remaining chapters and especially for those dealing with man's cultural progress, the writer is responsible.

In order to avoid confusing the reader, the distinction between man's physical development and his progress in civilization has been carefully maintained. In discussing the former, the plan has been followed of working back from the recent to the more remote past—from familiar types to those less well known. This method enables us to see more clearly how the human race grows ever more primitive, increasingly less like that of today and definitely inferior to it in many ways, the farther back we go in point of time.

The account of man's conquest of material things, however, from his primeval condition to the beginnings of modern civilization, contained in the last nine chapters, has called for the opposite method of treatment. Instead of tracing them backward through the ages, the various discoveries and inventions of major importance have been dealt with in their probable order of occurrence, and their application to an ever-growing range of uses has been described.

Where so many have been drawn on for information, it would be impossible to give due credit by name in each individual instance. Special acknowledgment must be made, however, to Dr. H. N. Russell, Sir James Jeans, and Dr. A. S. Eddington, among astronomers; to Dr. T. C. Chamberlin, Dr. R. D. Salisbury, Dr. Ernst Antevs, Dr. C. W. Gilmore, Dr. R. S. Bassler, the late Dr. C. D. Walcott, and the late Dr. G. P. Merrill, among geologists and paleontologists; to Dr. E. W. MacBride, Dr. C. W. Prentiss, Dr. L. B. Arey, and Dr. Edwin G. Conklin, among cytologists and embryologists; and to Sir Arthur Keith, M. Marcellin Boule, the Abbé H. Breuil, Dr. G. G. MacCurdy, Dr. Hugo Obermaier, and Dr. H. F. Osborn, among prehistorians.

For the various illustrations, due acknowledgment is made in the captions accompanying each. Hearty thanks must be paid to Mr. William H. Gill, of Washington, for the artistic excellence of the drawings, which are almost entirely the result of his painstaking work.

The writer also wishes to express his personal appreciation to Miss Daisy Furscott, of the Freer Gallery Expedition Library, for her aid in reference work and her helpful criticism; and to Miss Christabel E. Hill for her unremitting care in the preparation of the manuscript.

PREFACE

Lastly and in a very special sense are the joint authors under deep obligation to Mr. John R. Ellingston and Miss Rose A. Palmer, of the Editorial Staff, for their cordial and unwearying cooperation, without which this book could not have been completed.

C. W. BISHOP.

Freer Gallery of Art, Smithsonian Institution,
Washington, November 1, 1929.

MAN FROM THE FARTHEST PAST

CHAPTER I

MAN'S THEATER OF ACTION[1]

MAN has his residence upon a world 8,000 miles in diameter. It is fifth in size and third in solar distance of the sun's family of eight principal planets. The sun is an average star, situated about twenty-five trillions of miles from the nearest neighboring star, Alpha Centauri, in the southern heavens. As it would be almost meaningless to name in miles the distances of the other stars, astronomers have devised another expression which is very striking. This is the light-year, the distance which light, moving 186,000 miles each second, covers in a full year. It equals some six trillions of miles. In these terms Alpha Centauri is at about four light-years' distance from our sun and his family of planets. Though expressed in hundreds of millions of miles, the separations of the planets from each other and from the sun become, by comparison to the distance of the nearest star, almost as nothing. Light travels from sun to earth in eight minutes.

Only a few stars are known to lie within 100 light-years of our solar system. The vast majority of them exceed 1,000 and even 10,000 light-years in distance. The stars are not scattered uniformly outwards to infinity. If we could stand armed with a great telescope at a million light-years' distance from the sun, we should see all of our own familiar starry system isolated like a little wheel whose rim,

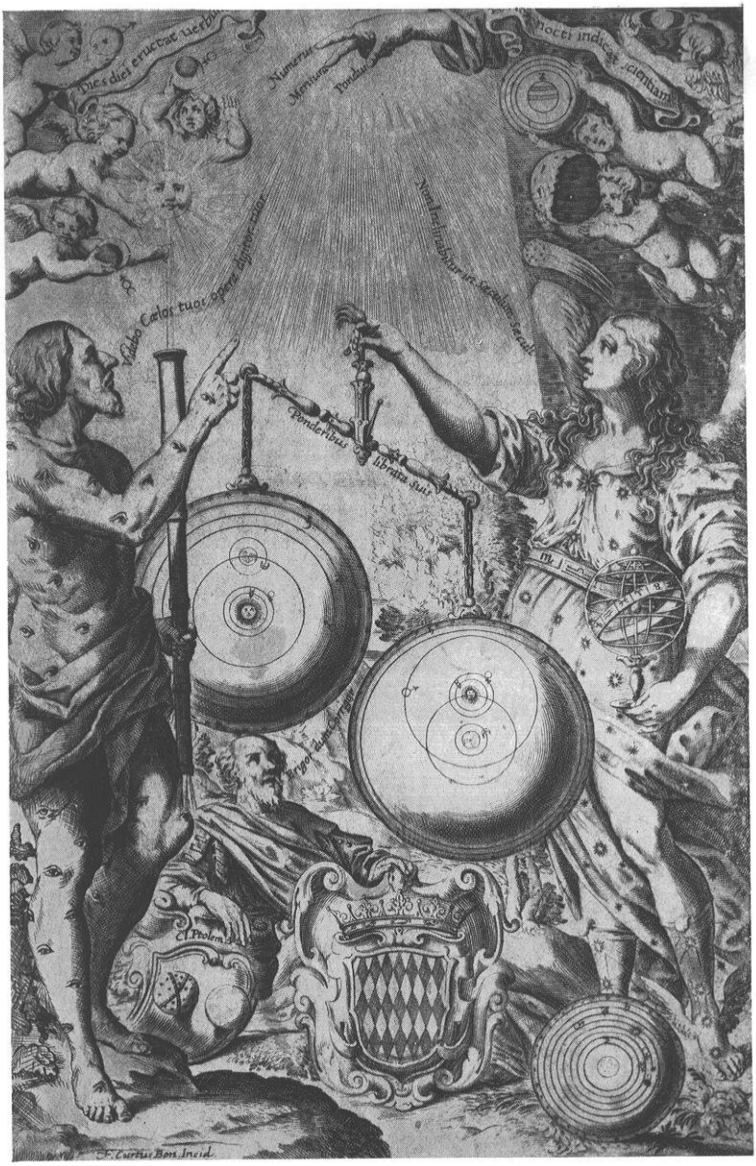
[1] These introductory chapters on man's setting are by Dr. Charles G. Abbot.

extended along the plane of the Milky Way, would appear about five times as wide as its hub. Within this lens-shaped star cluster, which we call our galaxy, the stars, if we could count them all, would probably number some thirty billions.

As we gazed about us from our supposed observing point, a million light-years distant, we should see still other clusters of stars not belonging to our system, for our galaxy is not the only one in space. There are, indeed, hundreds of thousands of other island universes, each of multitudes of stars, besides that one which contains the well-known constellations, the solar system, and the world of man. Do other stars within our own galaxy have planets revolving about them? If so, are these planets inhabited by conscious beings? Do other island universes far outside our galaxy contain still other inhabited worlds? In short, is it reasonable to believe that among the hundreds of thousands of galaxies, each containing its millions or billions of stars, only one world supports creatures equal to man?

So much for the world's setting in regard to space. What of its extension in the domain of time? "The days of our years are threescore years and ten; and if by reason of strength they be fourscore years, yet is their strength labour and sorrow; for it is soon cut off, and we fly away." So writes the Psalmist of the individual. As the history of the ancient world is recovered in written inscriptions on walls and tablets, we are carried back to a time six thousand years ago when men already built great works, marshaled armies, and carried on industries. Dating from many thousands of years before this earliest recorded history, evidences of human skill and fossil human remains in cave dwellings are still preserved. These indications grow less and less evidential of high intelligence in man with increasing antiquity, until at last, at a time estimated at much less than a million years ago, man fades from the scene. Back of that period, animal and vegetable kingdoms persisted for periods estimated at several hundreds

PLATE 1



When man believed earth to be the center of the universe and himself the supreme achievement. From a seventeenth-century edition of the Ptolemaic *Almagest*, depicting victory of the Ptolemaic over the Copernican theory

PLATE 2

What our universe would look like observed from a point a million light-years distant. Earth's position would be about a half inch off center. Photograph of Spiral Nebula Messier 33 from Mt. Wilson Observatory of millions of years. Back farther still the most ancient traces of life itself fade out.

Was this the dawn of time for our earth? We believe not. Nature furnishes a calendar in the minerals which bear the radioactive elements, radium, thorium, uranium, and their degenerated products, lead and helium. Radium, for example, constantly decomposes, yielding helium and a temporary element called radium emanation. The emanation itself decomposes into more helium and a second temporary element. After five similar transformations the end product, besides the gas helium, is the familiar metal lead.

Such are the works of nature's time clock. The time element consists in this, that radium loses half of its weight in 1,700 years, producing helium and lead at rates which are now well known, and which no known agency can either hasten or retard. Basing their estimates on the quantities of helium and of lead in certain of the very oldest rocks which contain such chemical elements as uranium and radium, and on other similar data, students have now come to a general agreement that the primeval earth's crust can not be less than a billion years of age.

Was this, then, the beginning of time? Evidently not, for the chemicals in the stars are all so hot as to be gaseous, whereas the crust of the earth is so cool as to be solid. Immense periods of time must have elapsed before the material which combined to form the solid earth was developed from the gases of which once it formed a part. This brings us to the newest view relating to the length of time, which grows out of the consideration of solar and stellar energy. Our sun and the other stars constitute immense bodies hundreds of thousands of times more massive than the earth. Owing to their tremendous temperatures they constantly give off visible and invisible rays having enormous energy. Even at the earth's immense distance the sun rays contain over a horsepower of energy per square yard. Equally intense are the sun rays in all directions, so that the flow of solar energy is to be estimated in horsepower in terms of the number of square yards on the surface of a sphere ninety-three million miles in radius.

What supplies this copious flood of energy? Probably the annihilation of atoms. This, indeed, so eminent an astronomer as Professor Jeans of England states to be not only a reasonable but a necessary article of scientific belief. Writing on "Astronomy" in the thirteenth edition of the *Encyclopaedia Britannica*, Professor Eddington declares the energy equivalent of the destruction of the entire substance of our sun to be sufficient to sustain its output of radiation through fifteen trillions of years. This is the order of time which the universe is now supposed to represent.

Thus, in brief summary, man's home is in a universe containing some hundreds of thousands of galaxies each composed of millions or billions of stars. Among these there may be many systems of planets such as that which our star, the sun, holds in his train, and among them may be many inhabited worlds. The starry hosts are scattered through a space measured in millions of times the six trillions of miles that light traverses in a year. They seem likely to have been existing through time enduring trillions of years, and likely to continue quite as long in time to come. From the prodigious stores of energy, partly gravitational, partly radiant, which our star, the sun, supplies, man collects the fragment that he needs to carry on his comparatively small concerns. In short, a man, one of nearly two billion living human individuals enduring but for threescore years, does not loom large compared to the universe in which he dwells, to its duration or its energies.

Man's existence on his little earth depends on extraordinary circumstances. As to how life began here, science offers no guess, but how slight are the changes which might destroy life has recently become plain. Water in liquid form is indispensable. It is the only natural liquid independent of life processes[1] which exists in free state and considerable quantity at the earth's usual temperature. A small change of temperature would congeal or vaporize this indispensable liquid. A fall of only ten per cent in the temperature of the globe would drive the higher forms of life to the tropics. Again, miles high above the earth exists that form of oxygen which is called ozone. There is so little of it that if brought to the earth's surface it would make a gaseous layer only a little thicker than the cover of this book. Yet if this trifling constituent of our atmosphere should be destroyed, probably blindness and death to humanity would ensue, owing to the burning chemical action of extreme ultra-violet rays of the sun which ozone cuts off.

The materials of which the universe is composed seem to be common to all parts of it. In the sun and all the stars are found, by observation, only those chemical elements, such as iron, hydrogen, oxygen, and others, which are familiar on our earth, and some of which go to make up man himself. These elements, wherever found, are composed of two constituents, and two only—the protons and the electrons, equal and opposite elementary charges of electricity. On the other hand, harmonious to this unity, there are many examples of progressive gradation. These begin among the very atoms of the chemical elements.

The keen discoverer who laid the groundwork of this knowledge of the atomic gradation was Henry Gwyn-Jeffreys Moseley. Born in 1887, he graduated at Oxford University and became lecturer in physics at the University of Manchester, where he was associated with the eminent British Nobel prize winner, Sir Ernest Rutherford. By a brilliant series of highly delicate and original experiments, Moseley demonstrated the step-by-step relation in the X-ray spectra of the elements, now known as Moseley's law. So epoch-making was this discovery that he was specially invited to lecture upon it in Australia at

[1] Gasoline, the oils, the alcohols, etc., are in nature all products of life processes.

the meeting of the British Association for the Advancement of Science in the year 1914. A volunteer officer in the "Territorials," Moseley hurried from the British Association scientific assembly on the outbreak of the Great War, to be instantly killed by a Turkish bullet at Gallipoli, August 10, 1915. He lived only twenty-eight years, but his name will be remembered forever.

Moseley's law finds its interpretation in the structure of the atoms of the chemical elements. Hydrogen has one orbital electron, helium two, lithium three, beryllium four, and so on, advancing by unit steps, to uranium, the last of the known chemical elements, with ninety-two electrons arranged in a multitude of orbits all focusing about the central nucleus.

Not only in the infinitesimal domain of the atoms, but in the vast spaces of the starry systems, an orderly gradation of qualities prevails. In size, in brightness, in spectrum, in density, in temperature, the nebulae and the stars present an orderly series of great impressiveness. Invisible to the eye, because of tremendous distance, but readily photographed by great telescopes, the heavens contain hundreds of thousands of such objects as are shown in Plate 2. We see there a series of forms ranging from irregular through spherical hazy masses, thence, through gradual elongation, to pronounced spindle shape, and finally to the branched spirals. It is believed that here we see the evolution of a starry galaxy such as our own. At first unformed, gravitation settles the gaseous mass into a sphere; rotation elongates it; still greater motion tends to produce the spindle shapes; which, with increased velocities and tidal forces, produce the two-branched spirals; from which, at length, separate the stars. All of this observedly probable train of events conforms to known laws of fluids.

But the stars also show progression after their birth, of which a striking evidence is given by the group of stellar spectra shown in Plate 78 in Volume 2 of this SERIES. By many years of observation along many lines of attack, knowledge has advanced so far that we may now summarize the evolution of a star. Separating from the parent nebula as an enormously extended gaseous ball, hundreds of millions of miles in diameter and rare as the residual of gas in what we are apt to call a high vacuum, the newly-born star is of low temperature, glows but feebly red, and shows in its spectrum the bands of molecular compounds. Condensing and rising in temperature by the fall inwards of its gaseous matter under its own gravitation, the star glows yellowish red, its spectrum loses its compound bands, because heat dissociates the compounds which produce them, and substitutes for these bands the lines of moderately heated metals. Still enhancing its temperature by internal gravitation, the density of the star becomes yet greater, and its light glows yellowish. Its spectrum lines begin to show the effects of the high temperature involved in the shattering of the atoms from which are stripped off one or more electrons by the violent agitation of the powerful heat within.

This process goes on through the white to the blue stage, when the atoms become so far dissociated as to render the spectrum unfamiliar, for it corresponds to temperatures too exalted to be commanded for any considerable time in our laboratories. If this be the exterior condition, much more is the interior of the star in tremendous exaltations of heat and pressure. It is believed that under these conditions matter is gradually annihilated by the collapse of the atoms, and that the enormous output of radiation is made possible only by the actual passing out of existence of interior matter, with a diminution of the mass of the star. Thus the star grows smaller both by condensation and by annihilation.

With great density the star material, though gaseous, becomes so little transparent that the inner heat is no longer able to force to the exterior a sufficient supply to maintain the radiation outward. The star then visibly cools, and passes in reverse order through the series of colors and of spectrum appearances which we have named. But now, from the rarity of a red star newly born, it grows old and ends as a red star, indeed, but with a density approaching or even exceeding that of the solid metals such as iron. Finally failing altogether to supply glowing heat, the star becomes dark, as indeed many great celestial bodies are known to be. These reveal their presence not by their light but by their gravitation or by cutting off the light of companion stars.

Such, it appears, is the evolution of a galaxy and a star. A solar system presents another operation. Among the multitudes of stars, all of which are in rapid motion in various directions, there will be some pairs, in the course of billions or trillions of years, which will approach so closely together as nearly to collide. Though not actually presenting the tremendous catastrophe of collision, which between two bodies so enormous would indeed be beyond description, a pair of stars passing near each other would raise such great mutual tides that their material would not merely swell out like our ocean tides, but for a time would actually flow away in ropelike streams into space by reason of the adventure. Such material, after the passage of the disturbing star, would collect into planets; and such, we may imagine, is the origin of our solar system.

We are to suppose, then, that our earth was formed by the gathering together of matter which had been caused to flow out from the sun by reason of the close approach, ages ago, of some other star. As the stars often exceed twenty-five miles a second in their mutual approach or recession, and as we have noted that the nearest star, Alpha Centauri, is only some 25,000,000,000,000 miles away, it is conceivable that the near catastrophe which gave birth to our earth might have happened no more than 1,000,000,000,000 seconds, or 30,000 years ago. But as our radium clock has told us that the earth's crust is fully a billion years old, we must conclude that it was not the nearest of the stars but some unknown one, now very distant, which

PLATE 3

Pika Peak massif in Alberta, Canada, illustrating stratification, uplifting, tilting, and erosion, all of which aid the geologist to read the history of the earth. Photograph by C. D. Walcott

by its close approach to the sun founded the solar system.

It used to be supposed, when another hypothesis of its origin prevailed, that the earth cooled from the condition of a glowing hot ball until its crust formed, and that soon after that event it became fit for life. We are now more apt to believe, following Chamberlin and Moulton, who first advocated this view in the early years of the present century, that the earth is the product of gradual accretion of the train of finely divided solid meteoric matter which the supposed close approach of a star to our sun threw out as gases from the sun into space, but which soon cooled to solidification there before combining to form the earth.

Some meteoric matter in individual masses of pounds or tons, and some thousands of minor planets, which are mineral masses of some miles in diameter, still are met with in the solar system. But nearly the whole of the matter which it is supposed escaped from the sun owing to the near approach of another star, is now collected to form the eight great planets and their moons.

In the progress of accretion it is not to be supposed that the earth was at first of regular shape or complete solidity. But as more and more matter accumulated, its growing pressure gradually squeezed out the lighter parts, including the present earth's crust and the water and air. The water settled into depressed regions and, adding to their weight, tended the more to depress them. Also, then as now, the action of the atmosphere in producing decomposition and disintegration, and of the rains and streams in wearing off the elevated parts, tended to remove the heavier portions of the rocks, which on the whole are more soluble. This detritus, finding its way to the incipient oceans, tended the more to emphasize the oceanic depressions and to tilt still higher the land elevations.

Under the enormous weight of the outer part of the earth, its inner portion flows slowly as if it were a viscous fluid. Experiments have shown that the crust to a depth of about sixty miles behaves like a floating island, tilting about and bending under the loads of detritus which the rivers bring down to the plains and the sea, as the winds and waters plane the mountains down. Again and again, as geology teaches us, portions of the continents have been uplifted, planed down, sunk beneath the oceans, covered with mud layers, newly uplifted into mountains, newly planed down, and so on through vicissitude after vicissitude in the great age of the earth. Similar changes are still going on, slowly, but probably no more slowly than they always have done. During many of these changes life existed, the remains of which were sometimes buried by sands and mud that became rock and so have preserved for us the fossil records of the past.

It is impossible to determine accurately in years the length of the periods of geologic time. Moreover, the records are fragmentary, imperfect, depending on the vicissitudes of elevation and depression, aridity, temperature, and other factors. Nowhere is the whole gamut of strata from earliest to latest time exposed. The laying down of strata demands locations such as the shores of a sea or lake, the sea bottom, river basins, or desert valleys. Obviously, these could not in all ages prevail at any one place. Yet the earth's surface yields so many examples of the burial of multitudes of forms of life at successive depths that what is lost in one locality may be supplied from another. Thus it has become possible for paleontologists to estimate the approximate order of succession of life recorded in the fossil remains, and the approximate relative length of time involved in the several periods which these fossil remains suggest. These data are confirmed by many samples from many parts of the earth's surface. Local contradictory evidences, explainable on grounds of earth-folding, noncontemporaneousness of life forms, and otherwise, become no more than the exceptions which prove the rule. The broad features remain surely known.

In this brief survey of present hypotheses and observations relating to the place of man and his abode in time and space, our attention has been drawn to the orderly march of forms, both as regards the infinitesimal atoms and the enormous heavenly bodies. In such developments we find a forecast of the progress of life forms from the simplest to the most complex, not only of every individual being from his conception to his death, but of the animal and vegetable kingdoms themselves. In the next two chapters we shall trace the progressive steps of life development which lead us at length to the consideration of adult man and his achievements.

CHAPTER II

THE CHORUS OF MAN'S STAGE

IN most plays the principal actors are assisted by a large group of minor characters and attendants, whose parts, though less conspicuous, are vital to the drama. It is so in nature. Though man dominates creation, his happiness and even his very existence depend on humbler creatures. Nor are they all his friends or the friends of his friends. Powerful as he is, man requires the full use of all his mental superiority to hold his own against the competition of the insects and microscopic enemies which threaten his life.

Man has not always held the stage. Long before his entrance, race after race of creatures developed, came to the zenith of their power, and gave way in turn to others. Perhaps it will be so with man.

The almost interminable march of life as read in the imperfect record of the rocks has presented six especially interesting eras, which may be designated as, first, the era of the simplest life forms; second, the reign of the invertebrates; third, the period in which vertebrates, exemplified by the fishes, made their appearance; fourth, the heroic age of vegetation; fifth, the age of reptiles; and sixth, the age of mammals, culminating in man.

The first era embraces the dawn of life. Its duration probably is to be reckoned in hundreds of millions of years and is at least equal in length to all succeeding time. Partly by reason of the vicissitudes of the ages which lie between that period and ours, partly because its strata have not been thoroughly explored, and more especially because in its strata the complete records have not been preserved, we have little evidence of the kinds of creatures which then developed.

It is in the rocks of the second great life period, that of the early Paleozoic time, divided in geological nomenclature into the "Cambrian" and "Ordovician," that numerous fossil specimens first become available, abundant, and beautifully preserved. These were the ages solely of the invertebrates, among them many creatures so different from present forms that they can not be said to have descendant representatives in the modern world. There was, for instance, the great family of the trilobites, which resembled superficially the lobster and the crab. The trilobites long ago became totally extinct, but they dominated the earlier part of the periods of which we are now speaking. Some of them, indeed, grew to large size, exceeding eighteen inches in length. The name comes from the shape of the body, which presents a right, a left, and a middle prominent portion. Very beautiful in outline, with numerous delicate side organs almost fernlike in their detail, and provided with eyes and other sense organs, the trilobites seem to have been as complexly organized as many of the foremost of the invertebrates of the present day. They are not by any means primitive creatures. If we accept the theory of the gradual evolution of life forms, they must have had a very long ancestry.

The trilobites counted among their contemporaries many kinds of shell-protected creatures, including several whose shells resemble greatly some of those of today. Thus we may regard the family of the present-day oyster and those of certain other bivalve mollusks as extremely ancient, though the species have changed from the ancient forms.

Toward the close of the Ordovician period, the class of the cephalopods, now represented by the chambered nautilus, the octopus, squid, and their like, usurped the preeminence so long held by the trilobites, and continued prominently during the Silurian period which followed. Some of these chambered shells were of straight, tapering form, and no less than twelve to fifteen feet in length and one foot in maximum diameter. It is interesting to speculate on their means of locomotion and nutrition.

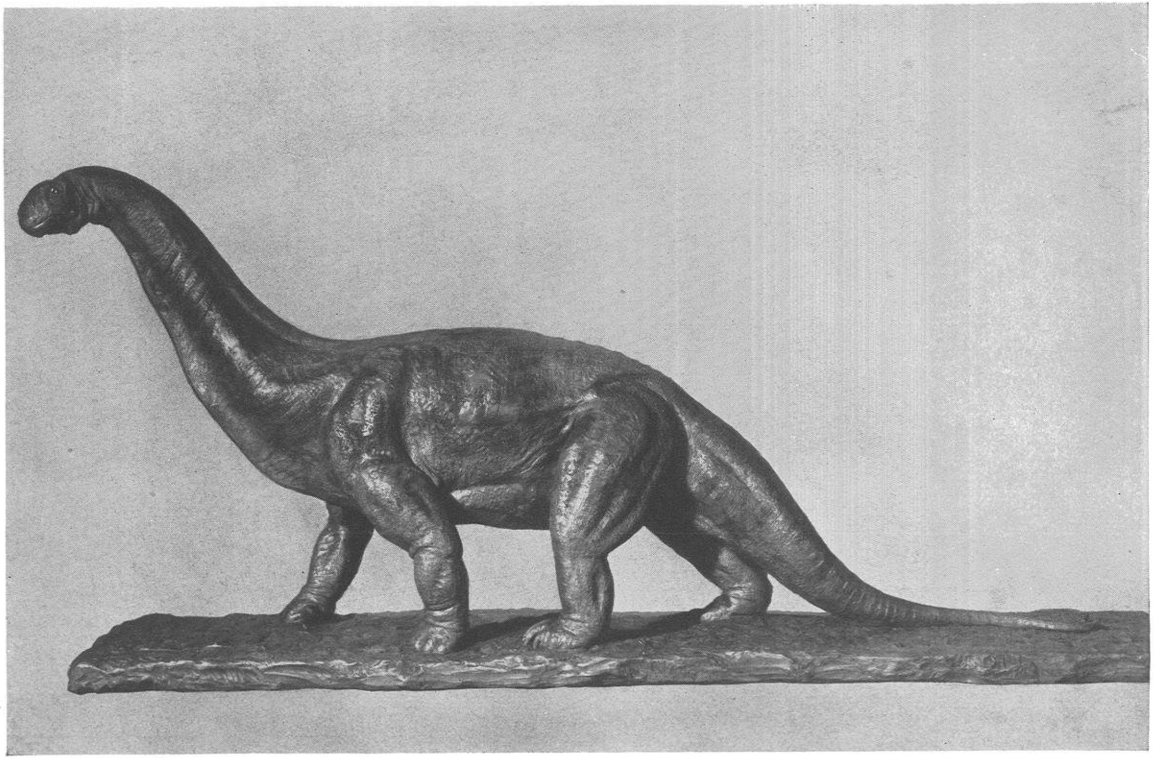
The great period called the Silurian, which followed the Ordovician, is the last one dominated by invertebrate animal life. During the Silurian the trilobites declined, but the cephalopods continued very notable. They shared their prominence, however, with certain remarkable crustaceans, of somewhat scorpionlike appearance, called *Eurypterus* and *Pterygotus*. Among these latter, giants of one and a half to six feet in length appeared. These creatures have never been surpassed among crustaceans of all ages. Many of the other orders and classes of invertebrates flourished notably during the Silurian, as they had done previously, but towards the end of the age the third great life era, that of the vertebrates represented by fishes, began to dawn.

Here we find forms called the ostracoderms, which seem to constitute a connecting link between the crustaceans, as represented by the trilobites, and the true vertebrate fishes that were to come. Their heads and trunks externally bear resemblance to the trilobites, while presenting fishlike fins and tails. They opened their jaws laterally like the crabs, not vertically like the fishes, yet so fishlike were their bodies and tails that till recently students have always classed them with the fishes.

With the Devonian period comes the reign of the true fishes, though the forms differed extensively from most of those in the present seas. Sharks lived in the Devonian both in the open sea and in brackish waters of the shores. Lampreys, lungfishes, and ganoids were also developed. But as yet paleontologists have found no trace of the now dominant bony fishes.

Our fourth era of special interest is the heroic age of vegetation, the Carboniferous. As vegetation is indis-

PLATE 4



Camarasaurus, a typical giant reptile of the Jurassic, restored. It attained a length of sixty feet.
Courtesy of the American Museum of Natural History

pensable to support animal life, it must have coexisted plentifully with the earliest terrestrial animals, though inconspicuous in the fossil record. Fossil evidences of bacteria and marine algae have been found in the rocks laid down in the era of dawning life; but vegetation, though present through all preceding ages, first becomes plentiful, as indicated by the fossil record, in the Devonian. It is represented then, not only by mosses and ferns, but by trees of fernlike form and by some palmlike species. In the Carboniferous period, however, though in forms very strange to our eyes, vegetation became so luxuriant as to form the main source of the coal and to some extent of the oil on which modern industry depends for power. Layers of coal which in some sections reach a thickness of 250 feet are supposed to represent several million years of luxuriant vegetation during the Carboniferous period. Many kinds of trees abounded, but they were very unlike those of the present.

This same period brought forth in the animal kingdom the amphibians, those vertebrate creatures adapted to both land and water. They are thought by some to have developed from certain Devonian types of fishes. Surely this development is a most interesting one. It marks a new era in which for the first time the earth held vertebrate animals able to live on land. Some Carboniferous amphibians, recalling the structure of the crocodile, reached lengths of eight to ten feet. Others resembled snakes, lizards, and salamanders.

Following the Carboniferous period, there ensued an age, evidently of great stress and hardship, called the Permian. It used to be supposed that life was then altogether extinguished and that all subsequent life arose from a new creation. This is an exaggeration. Great diminution in life certainly occurred, and many species were exterminated. It was estimated from such knowledge as was available about the beginning of this century that, with 10,000 known animal species of the Carboniferous period, only 300 remained to represent the Permian. The ratio at present would be more favorable to the Permian, but the decline is startling. Simpler, hardier forms of vegetation took the place of the rich Carboniferous flora. Among vertebrate animals arose a new order, the reptiles. Strange forms they took. There was, for instance, the fin-back lizard, *Dimetrodon*, found six to seven feet in length. Highly interesting is the discovery of reptilian forms which, in the shape of head and skeleton, begin to suggest the mammals.

But before the age of mammals, the earth had yet to see the long ascendency of the gigantic reptiles which ruled at length air, land, and sea. The Triassic period witnessed the rise of the reptilian land dinosaurs, which, although they did not rival the monstrous forms of the two following periods, yet attained a length of fifteen feet. Reptiles of marine habit became lords of the sea, preying upon its previous rulers, the fishes. But the shell-armored invertebrates also attained a new prominence with the rise of the cephalopod ammonites, somewhat similar to the modern nautilus. Their beautifully sculptured spiral shells present hundreds of varieties.

From the Triassic we pass to the Jurassic period, in which the ammonites attained their maximum of luxuriance and beauty. Among the fishes, which during their earlier dominance in the Devonian had been limited to the families related to the lampreys and sharks, the modern bony types now first made their appearance. However, the Jurassic stands for the grand period of the reptiles, both on sea and land. Ichthyosaurs and plesiosaurs reached their highest development. The former took on something of the lines of a fish, though crocodilian of snout, with paddles, fins, and sharklike tails suitable to rapid marine locomotion. The plesiosaurs were ungainly reptiles described by some one as having "the body of a turtle strung on a snake." Like the ichthyosaurs, they were covered by smooth skins unprotected by scales. They ranged from eight to forty feet or more in length.

PLATE 5

A restoration of the extinct woolly rhinoceros in combat with a bison. Both species were contemporaneous with prehistoric man in Europe

On land the dinosaurs attained enormous stature. Here we find *Brontosaurus*, an herb-eating creature balancing its huge horizontal carcass of sixty feet, in combined length of neck and tail, on four stocky legs. Equally grotesque was the great armored *Stegosaurus* with its row of vertical plates over the backbone from head to tip of tail.

Finally, the reptiles, as represented by the pterodactyls and others, invaded even the air. They did not occupy it alone, however, for in the same period the first birdlike animals appear, in the form of the *Archaeopteryx*.

Still antedating the age of mammals, we pass on into the Cretaceous period, in the vegetation of which appear for the first time the angiosperms which form the dominant dynasty of modern plants. The plants had hitherto been represented by the gymnosperms, whose seeds are naked. The angiosperms have true seed vessels. To this class a great variety of trees, shrubs, and herbs of the present day belong.

Among land reptiles, the dinosaurs now attained their most formidable features for attack and defense in *Triceratops*, with his shieldlike crest, sharp beak, and great, pointed horns. Yet Marsh remarks that he had the largest head with the smallest brain of the reptile race. Turtles, lizards, snakes, and crocodiles were among other reptile fauna of the period. The flying reptiles attained great spread of wings, possibly twenty-five feet, and doubtless flew with great power.

At sea, also, the reptiles still ruled. A species of sea turtle reached the enormous size of twelve feet in diameter, with a skull larger than that of a horse. The plesiosaurs and other marine reptiles still continued in giant forms. True sea-diving birds of large size are found, as well as smaller flying species. Among the fishes, a transition had taken place to the prevailing dominance of the modern bony types.

And now, after the long ages of invertebrates, fishes, amphibians, and reptiles, and finally of birds, we arrive at last at the eve of the rapid rise of the mammals, and with them, of the rise of the mind. We find in the Eocene period herbivorous, carnivorous, and insectivorous mammals, among them the ancestors of the cats, dogs, squirrels, rabbits, monkeys, and lemurs, the horse, and the rhinoceros. Ancestral forms of the elephant and mastodon arose in Africa and migrated through Eurasia and America. Some mammals of Eocene time were of elephantine size, though soon extinct. Also, the mammals went down to the sea as the reptiles had done previously, and were represented by whales, dolphins, manatees, seals, and sea lions. Indeed, the name Eocene is given because in this period, for the first time in all the long history of life, the world's fauna and flora contained an appreciable percentage of orders that still exist. Thus the Eocene is the dawn of modern life.

In the Miocene period, which succeeded the Oligocene, the approach toward the present fauna was marked by the advance of the cat and dog families, of the horse, the rhinoceros, the rodents, and by the development of the pigs and the camels, which as yet were confined to America. The deer and ox families migrated extensively. Most interesting, however, is the rise of the primates, nearest of all creatures in their form to man.

The Miocene gave place to the Pliocene period, in which after an intermigration of New and Old World types, similar to that which had taken place in the Eocene and other periods, pointing to the existence of ancient bridges across the ocean depths, there begins the divergence which separation by the oceans has caused. The elephant family were the giants of this period. Mastodons occupied all continents. Among the cats occurred the ferocious saber-toothed tiger, now extinct. The apes developed in southern Europe and other parts of the Old World. Dubois, in 1891, found in Java portions of a skeleton of Pliocene age, about which paleontologists are in doubt as to whether it is more akin to the apes or to man, and so have called it *Pithecanthropus erectus*—the erect apelike man.

To whichever species the Java fossil remains may be assigned, the next period, the Pleistocene, indubitably brings in the dawn of the day of man. His advent is demonstrated by skeletons, tools, drawings, and many other evidences. That he was contemporaneous with extinct

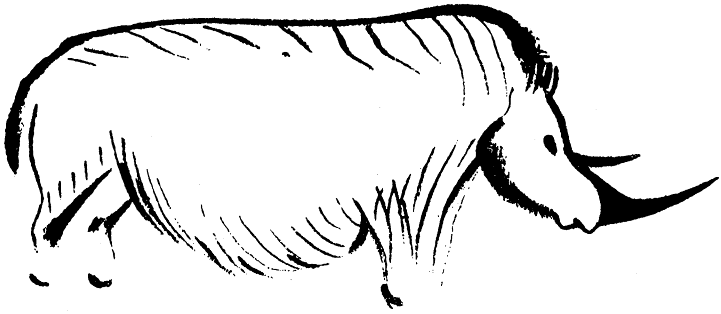


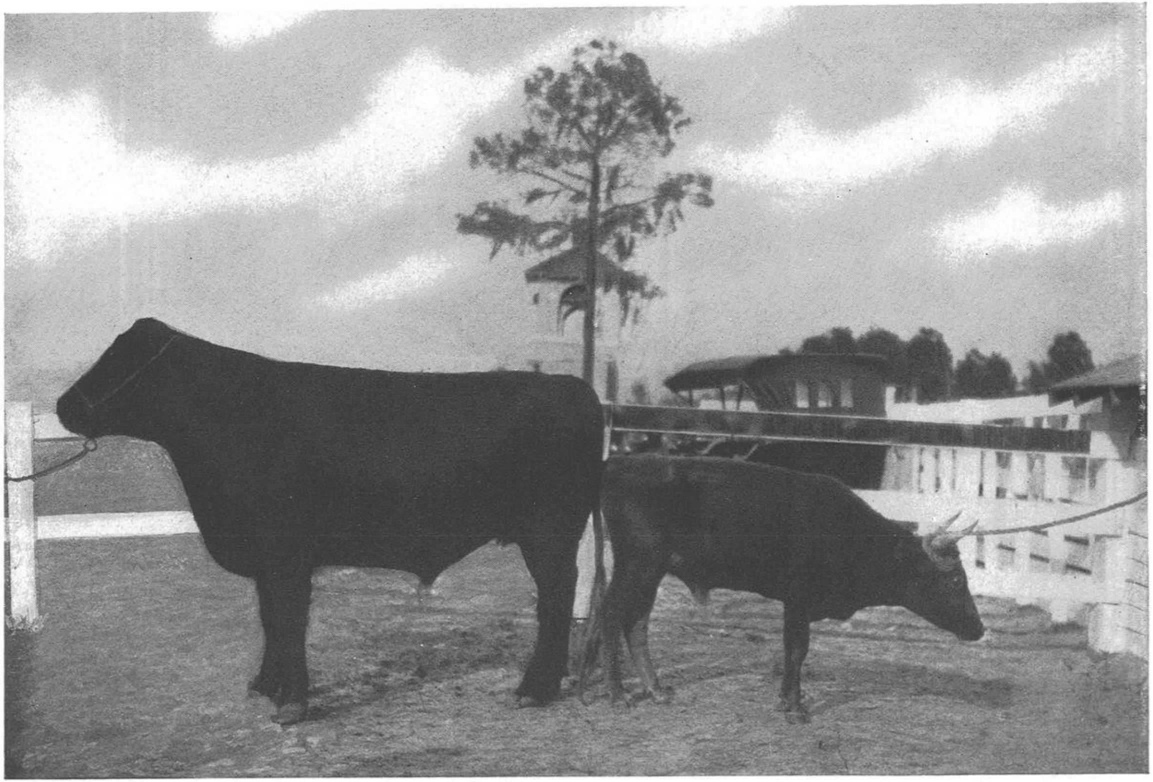
FIG. 1. Woolly rhinoceros of the Pleistocene in Europe. A mural drawing in red in the cavern of Font-de-Gaume, Dordogne, France. After Capitan, Breuil, and Peyrony

Pleistocene animals is proved by his drawings of spirited likenesses of some of these creatures in the caves of southern Europe, as well as by the association in European fossil beds of primitive human skeletons and artifacts with bones of the mammoth, the woolly rhinoceros, and other animals now extinct. The Pleistocene, or Glacial period, was remarkable for the several advances and retreats of arctic and antarctic glaciation. In North America the ice sheets pushed as far south as the junction of the Ohio and Mississippi rivers, while in Europe ice sheets invaded the plains of France. Thus in the infancy of the race, man struggled against odds.

Beginning with the dawn of life, we have surveyed animal and vegetable development through the early Paleozoic, the age of the invertebrates; the Devonian, the age of fishes and of the rise of vertebrates; the Carboniferous, or heroic age of vegetation; the Triassic, Jurassic, and Cretaceous, embracing the long dominance of the giant reptiles of air, land, and sea, and the rise of birds; through the Eocene, Oligocene, Miocene, and Pliocene, which saw the dawn of the age of mammals, and their development to cover and rule the earth; till finally, after the lapse of hundreds of millions of years, man came upon the scene. Within the comparatively brief epoch of a few hundred thousand years at most, he has become master of the world. Other creatures hold their lives at his pleasure; the earth yields her stores of fruits, fuel, and minerals to his machinery; he collects power from the rivers and the sun; he communicates his thoughts around the world almost instantaneously; he explores the universe with his telescope and spectroscope; and he rides on air, land, and water at speeds exceeding that of the swiftest of the birds.

There are at present in the world approximately 600,000 known species of insects, several hundred thousand other invertebrates and nonmammalian vertebrates, and 15,000 mammals. Until comparatively recent times, these were nonexisting, and other species, now extinct, prevailed. Their numbers can not now be estimated, because of the imperfect record which paleontology has thus far disclosed. Nor is the present number complete. Every year adds thousands of newly discovered species to the already hugely swollen list of creatures of the present and the past. It has even been estimated that the unknown insect species are really ten times as numerous as those hitherto described.

The immense numbers of species and the changes therein from epoch to epoch which have marked the past history of the earth, and the tremendous time scale indicated by the study of the slow alterations and great thickness of stratified rocks no less than by the discovery of the transmutation of radium, combine both to accentuate and to answer the question: What is the origin of species? Without other evidences than those just mentioned, the mind would tend to conclude that the species have been formed by gradual divergences of forms exposed to different en-



What breeding will do. The larger animal is a yearling Aberdeen-Angus steer, carefully bred; the smaller is a three-year-old scrub steer. Courtesy of the Bureau of Animal Industry

vironments over ages of time. Such indeed is the almost universally accepted conclusion of scientific men. It is called the theory of organic evolution. As to the relative importance of the parts played by different agencies in promoting the evolutionary process there is as yet no general agreement; but as regarding the general proposition there is nearly unanimous consent.

If the proposition of organic evolution requires further support, it may be found in the experiments of the present day. For example, the little plant, St.-John's-wort, which in America and Europe seldom exceeds a foot in height, was transplanted to New Zealand about eighty years ago. There it has become a tree reaching forty feet in the air. Pigeons which came originally from the wild blue rock pigeon have been developed, under the care of breeders, into the astonishing variety of forms familiar to fanciers. Dogs and horses, too, under the selection of breeders, range through forms almost as various. In laboratory experiments of the past half century, hundreds of what may be accepted as new species of invertebrates and vertebrates have been originated. Man himself is proved to vary. Thus the races of Europe, which have furnished over twenty million emigrants to America within the past century, betray, according to Hrdlička, definite changes of the shape of the skull and other of the most deep-seated skeletal characters in their descendants of only a few generations.

Still more remarkable is the evidence of change which we shall take up in the next chapter, where we follow the human development from conception to old age. It is thought by some to be derogatory to the dignity of man that he should be considered to have ascended from subordinate creatures during the progress of ages. Yet it can not be denied that every human individual goes through an extensive evolution in his own individual development and passes through forms equally repulsive to the squeamish eye. A fact which is often overlooked in this connection is that if the theory of organic evolution is admitted, we are to consider man as ascending from some mammal of the Eocene period, not from any existing form of primate. The date of the parent stem, from which man and the other primates separated as branches, must be set back in time quite a million years.

CHAPTER III

THE DEVELOPMENT OF THE INDIVIDUAL HUMAN BEING

ALTHOUGH in adult life a man is about thirty times as heavy as a fowl, the human egg weighs less than a millionth as much as that of the hen, and is less than a hundredth of an inch in diameter. This great disparity is appropriate to the great difference in the method of nourishing the unborn progeny. The essential nucleus of the living germ-cell in either case makes up but a trifling portion of the total weight of the egg. A great portion of the egg substance in the fowl consists of the yolk which gives nourishment to the forming creature. This egg nourishment must entirely suffice to sustain growth throughout the three-weeks' period of gestation preceding the birth of the chick. The human embryo, on the contrary, almost immediately attaches itself to the wall of the uterus and begins to be nourished at the expense of its mother's circulation.

The nucleus of the human germ-cell within the egg is microscopic in its size and, though it is considerably larger than the male nucleus which unites with it to initiate the new individual, the two contain essentially the same number of chromosomes which constitute the inheritance material. With this in mind, and reflecting that the subsequent office of the mother is mainly to nourish the growing embryo, it will not appear so strange that on the average the influences of father and mother on the character of their offspring are substantially equal.

What at first sight is even more extraordinary is that family resemblances, traits of character, even minute similarities in ways of acting, legion in their number, are clearly transmitted from parents to progeny through the channel of the microscopic germ-cells. One might well marvel that so small an organism could possibly carry the potential impression of so many and such complicated traits. To illustrate this point: A certain gentleman, when signing his name to the roll of members of the Handel and Haydn Society in Boston was accosted by the secretary with the remark, "I should have known to what family you belong had you written only the little letter *b*." Not only do deportment, degree of deliberation of movement, stature, facial and bodily appearance, and quality of voice, but a host of other little peculiarities proving family connection, thus pass from ancestor to descendant.

On the other hand, no two human individuals are alike. In the act of fertilization many thousands of spermatozoa compete for the impregnation of a single ovum, of which but a single spermatozoon is successful. The preferment is in the highest degree accidental, and had any other of the many possible combinations occurred, the child would have differed from him who is born. Also the ova, though far less numerous than the spermatozoa, differ each from each and impart differences to their progeny. Hence by the marriage of two individuals arises almost countless possibilities of varied characters in their offspring. The germ-cells, in short, carry not only the complex imprint of family inheritance, but also the imprint of individuality which stamps each child apart from all others who ever lived. Yet considering the race as a whole, every germ-cell is only one of an almost infinite number, each of which represents still other individualities. Notwithstanding that its potential capacities are thus certainly so highly complex, the tiny organism is, as we have said, so small as to be beyond the unaided vision of the human eye.

We may carry this remarkable consideration still further. It is difficult, though not always impossible, to detect differences microscopically between the germ-cells of man and those of many other creatures of the millions of species representing vertebrate and invertebrate life. These others also have each one their millions of ancestral, living, or potential individuals. By so much the more extraordinary, therefore, is the certainty of determination which stamps uniquely the order, species, race, family, sex, and individuality upon a microscopic human germ-cell.

How is this possible? It is because of the astonishing divisibility of matter. Though so minute, the germ-cells are nevertheless large enough to contain at least billions, perhaps even trillions, of molecules apiece. In a structure containing such an unthinkable number of molecules, the possibilities of dissimilar combinations of chemical differences and of varieties of arrangement are sufficient even to carry all the complexities of inheritance which are wrapped up within a germ-cell.

Let us look more closely upon this mystery. The whole substance of every living creature, plant and animal, is made up of minute cells. In the adult human body, the cells are estimated to number twenty-six quadrillions. Each of them contains a microscopic portion called the nucleus. This latter is the part in which inheritance factors reside. Differences exist in the cells which determine if a fragment of substance is perchance part of a plant, an invertebrate, a mammal, a male or female, a brain, a nerve, a muscle, or skin. Living cells have four properties:

1. Movement.
2. Metabolism, nutrition, etc.
3. Sensitivity.
4. Reproduction.

Movement, by expansion and contraction; metabolism, including the building up of definite substances and the excretion of worn-out or waste substances; sensitivity, comprising the reception and transmission of stimuli, so that what is done to one cell produces some sort of effect in others; and reproduction by cleavage, so that one cell becomes two. Although reproduction by cleavage is the property of all living cells and is necessary for the growth and repair of tissues, certain cells in the higher forms of life are reproductive cells *par excellence*, since they have the function of producing new individuals.

Cells contain, besides the microscopic nucleus, the nourishing and specialized material called cytoplasm, contained within a surrounding membrane. Imbedded in the cytoplasm, the nucleus itself is also inclosed most of the time within an inner membrane, which contains a fluid called nuclear sap and also the all-important chromosomes of the nucleus wherein is the seat of inheritance units. The cell goes through two phases, which may be compared to sleeping and waking. In the dormant state of the cell the chromosomal structure of the nucleus is practically invisible, though undoubtedly this is only an apparent absence, not a real one. In the

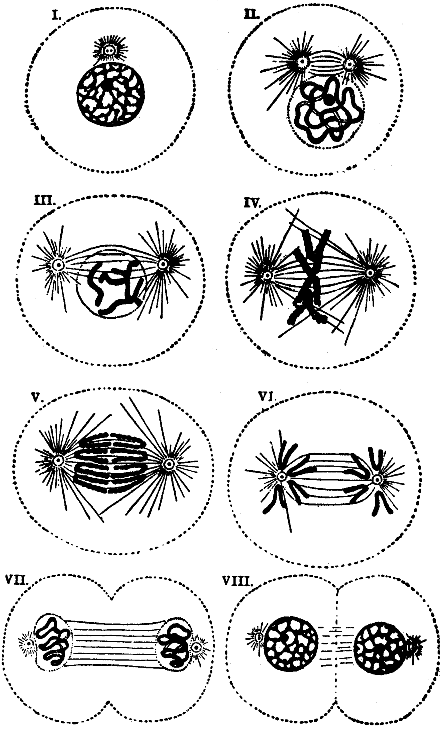


FIG. 2. Phases of mitosis or cell multiplication by division. After Schäfer, from Prentiss and Arey

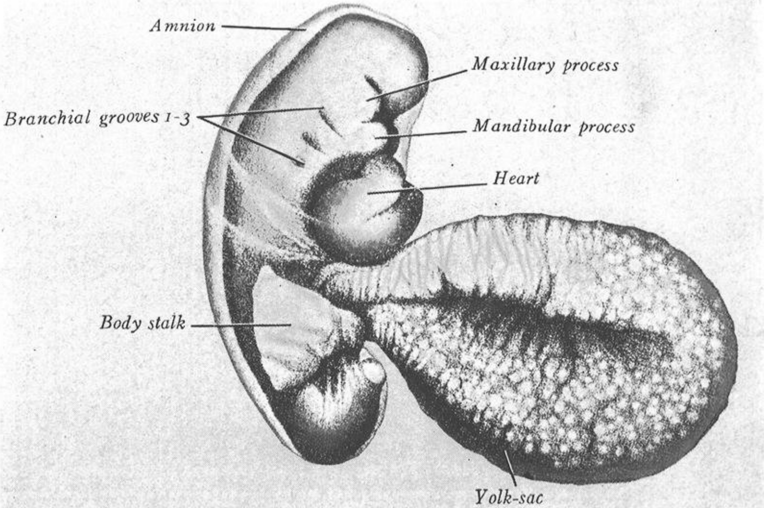
active state occur the extraordinary processes of the division of the nucleus and of the cell (Fig. 2). Within the nucleus at this time the microscope reveals the chromosomes as a certain number of aggregations of granular material. These take various forms, such as loops or chains or single lumps. The number of chromosomes in a cell is characteristic and is constant for each species, but within each species it may differ between the two sexes. In man the count is difficult, but the number is usually regarded as forty-eight.

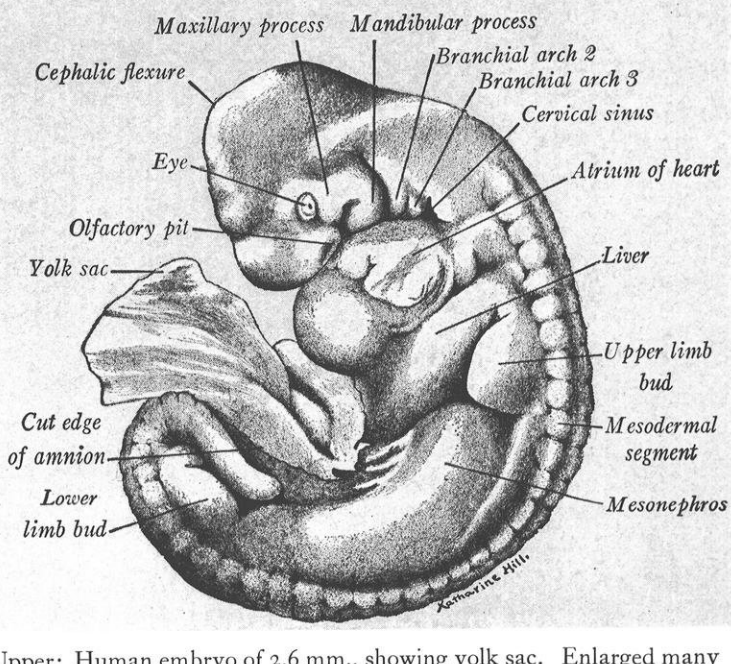
Preparatory to cell division, a pair of centers migrate apart to opposite poles of the nucleus (Fig. 2). The chromosomes range themselves as if upon a central plane with respect to these centers, while from each center rays or fibers go out and fasten upon the chromosomes, thus giving a spindle-shaped appearance to these radiating threads. Thus the whole structure at this time resembles a double cone, with the company of chromosomes at the junction of its bases. Meanwhile the membrane which inclosed the nucleus has dissolved, so that the fluid of the nucleus merges into the cytoplasm of the remainder of the cell. And now all of the chromosomes are dragged into halves, as though drawn toward the two centers by opposing pulls of the connected fibers. These half-chromosomes come together near each of the centers and about them new inclosing membranes are formed. The outer membrane of the cell itself then shows a furrow which deepens into a middle septum, and then the cell divides into two cells, each inclosing one of the daughter nuclei.

Such, in brief, is the general story of all kinds of cells and of their multiplication. But in the formation of the special male and female germ-cells which unite to produce the embryo, each rejects one-half the number of its chromosomes at a certain stage. The act of impregnation completes the structure and unites in a single normal cell the chromosomes of two cells, which were distinctively male and female before impregnation. In every division of cells which occurs thereafter throughout the body of the child, and even in adult life, the daughter cells, being always composed of halves of all chromosomes in the pre-existing parent cells, contain equal shares of male and female elements. Every part of the human body, therefore, is composed of cells which owe half of their chromosomes to each parent.

There is a reservation to be made. In the human species the male germ-cells, or spermatozoa, consist of about equal numbers of two kinds. Each of these germ-cells has one chromosome possessing one or the other of two dissimilar properties. Depending on which of these dissimilar chromosomes is included in the male germ-cell which fortuitously unites with the female, the resulting embryo is male or female. In some animals, as among the birds, for instance, the female holds the pair of unequal chromosomes and is the governing influence which controls the sex of the offspring. In certain animals the disparity between the pair of unequal chromosomes is so great that one chromosome is entirely absent in half the male germ-cells and all cells of the bodies of females contain one more chromosome than those of males.

After the union of the male and female germ-cells the resulting new cell of compound nature soon divides in the manner described above, making two cells, and these in turn divide again, and so on, until soon the ovum contains not one but many cells, each of which includes the male and female chromosomes. Up to this point, so far as microscopic observation shows, the cells have been nearly alike, merely minute sparks of living matter. Yet it is not quite so, for the descendants of certain of them have, it is now proved, capacity for only one sort of further development, although, on the other hand, other cells can subsequently give rise to any organs indiscriminately. But now, as in colonies of bees or of ants, the cells begin to be definitely assigned to different functions, and their descendent cells develop differences from this time for-

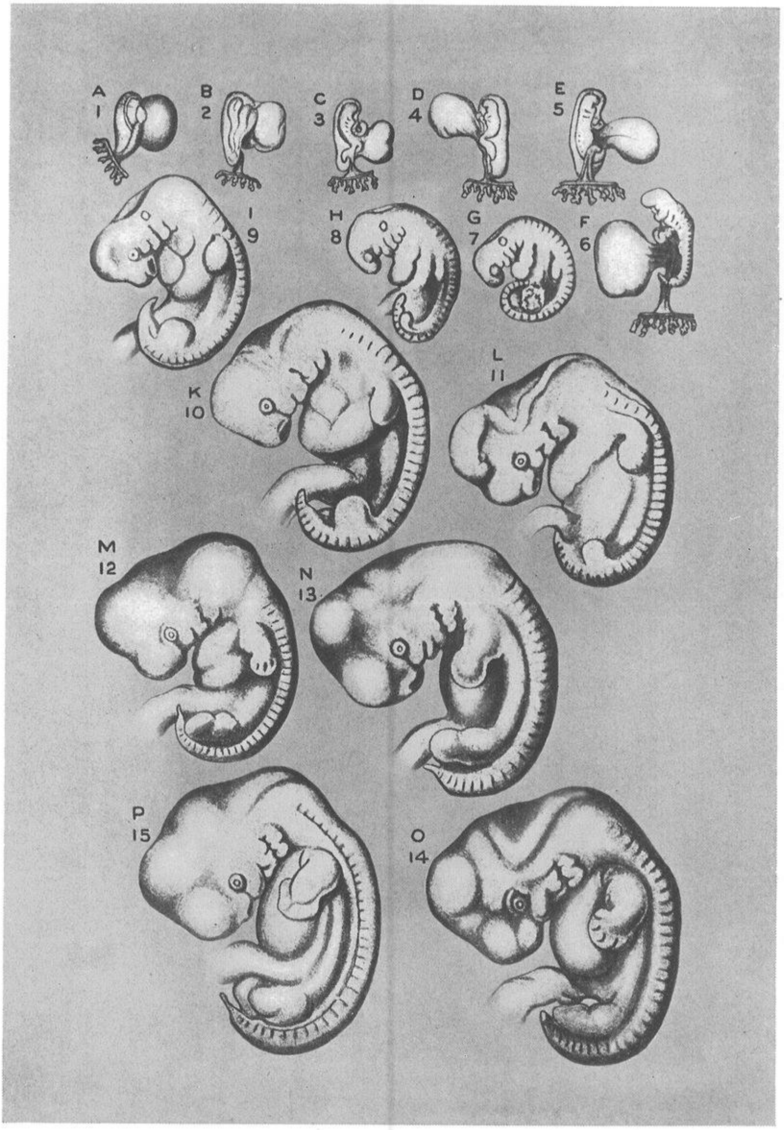




Upper: Human embryo of 2.6 mm., showing yolk sac. Enlarged many times. After His, *Normentafel*

Lower: Pig embryo of 6 mm. Compare with Plates 8 and 9. After Prentiss and Arey

PLATE 8



Human embryo of four to six weeks (2.1 to 11 mm.). After His, *Normentafel* ward. They resolve themselves into three categories, called in the language of embryology, the ectoderm, the entoderm, and the mesoderm (Fig. 3).

Of course, the new creature has not yet given any recognizable visible signs of the wise head, the strong

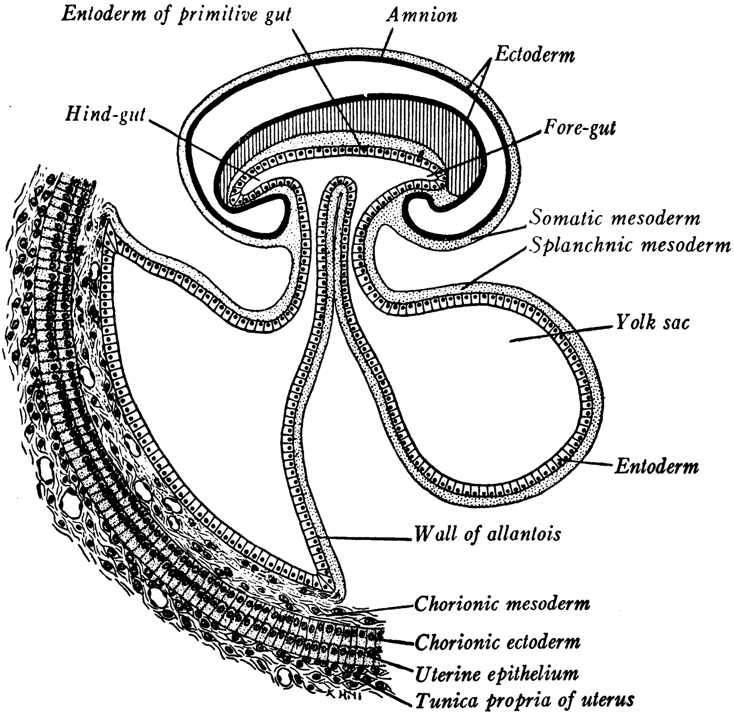


FIG. 3. Diagram of the fetal membranes and allantoic placenta of a pig embryo, showing the three primary germ layers, ectoderm, entoderm, and mesoderm, from which all tissues and organs of the body are derived. After Prentiss and Arey

body, the nimble legs, which later will appear. The three primitive divisions which we now speak of are much simpler; for the ectoderm is merely the original source of that which develops the outer skin, with hair and nails, the lining of the mouth and nose, the nervous system, and the lens of the eye; the entoderm, of the lining of the long canal which is finally to make up the digestive as well as the speaking and breathing organs; and the mesoderm, of the bones, the muscles, the blood and lymph, lining of the body cavity, and the reproductive organs.

In the initial stage, as we have seen, it is difficult if not impossible to recognize microscopically the differences between the nuclei of the germ-cells of different species or even of different orders of animals. But the eggs differ greatly in the quantity of the yolk in which the nuclei are immersed. With birds and reptiles, as we well know, the eggs contain much yolk, whereas with mammals, including man, the yolk is scanty. The development of the embryos associated with much yolk occurs outside the mother's body and they derive all nourishment up to the time of birth from the egg. There naturally develops, as the means of nourishing the growing embryo, a channel of communication leading to the reservoir of food which the egg contains. This channel and reservoir are called the yolk-stalk and the yolk-sac. In the mammals we might well expect the absence of these appendages, for they are useless because the yolk is so scanty and the embryo almost immediately is attached to the parent's circulation. Yet they exist, and persist for a long period, notwithstanding. (Plate 7 A.)

Other curious features in young mammalian embryos are the so-called gill slits. (See Fig. 8 in Plate 8.) These occur in the place corresponding to the gills of fishes. They are most marked in human embryos at the fourth or fifth week, and gradually are closed and modified into the organs of the face, so that they usually disappear before the end of the second month.

Again, the human embryo has a tail or coccyx, very plainly present as an exterior appendage during the second month. (See Plates 8 and 9.) Though the infant generally retains no external vestige thereof at birth, sometimes (though rarely) the tail visibly persists throughout adult life.

We might mention also the soft woolly hair called lanugo which covers the human fetus at a certain age, but is shed prior to or soon after birth. Numerous other transient similarities to other forms of life have been detected in the human embryo. Some of them even persist through adult life. So many and curious are they that they have given rise to what is called the "doctrine of recapitulation." This is the idea that in the development of each human individual from the germ-cell to adult life we see recapitulated in a fragmentary way the organic evolution of man's entire ancestry. Organs which it is suggested were functional in man's remote animal ancestors, but under present conditions are useless, briefly show themselves, and by disuse atrophy and are lost. Some, indeed, like the hair and vermiform appendix, are in process of being lost, although in earlier ancestral forms of life they were valuable functionally.

It is, of course, perfectly obvious that, in the skeleton; the skin; the lungs and their accessories; the heart and the blood circulation; the digestive and reproductive organs; and in many other particulars, man bears a strong resemblance to many of the mammals, and more particularly to the great apes. It is stated by Sir Arthur Keith[1] that only thirty per cent of man's structural details are peculiar to himself and not shared with any others of the primates. Among the remaining seventy per cent there are said to be twenty-six per cent of characters which man shares with the gorilla or the chimpanzee but with no other animal. Going back to other genera of the primates, there are found eight per cent of characters shared by man and the great apes with the gibbons, and indeed a small residue of characters shared with the little monkeys of South America.

Such facts and considerations as these, added to those outlined in Chapter II, have led most anthropologists to admit great probability in the hypothesis that man is not an independent creation but a gradually developed animal

[1] See *Encyclopaedia Britannica*, Ed. 13, vol. ii, p. 779.

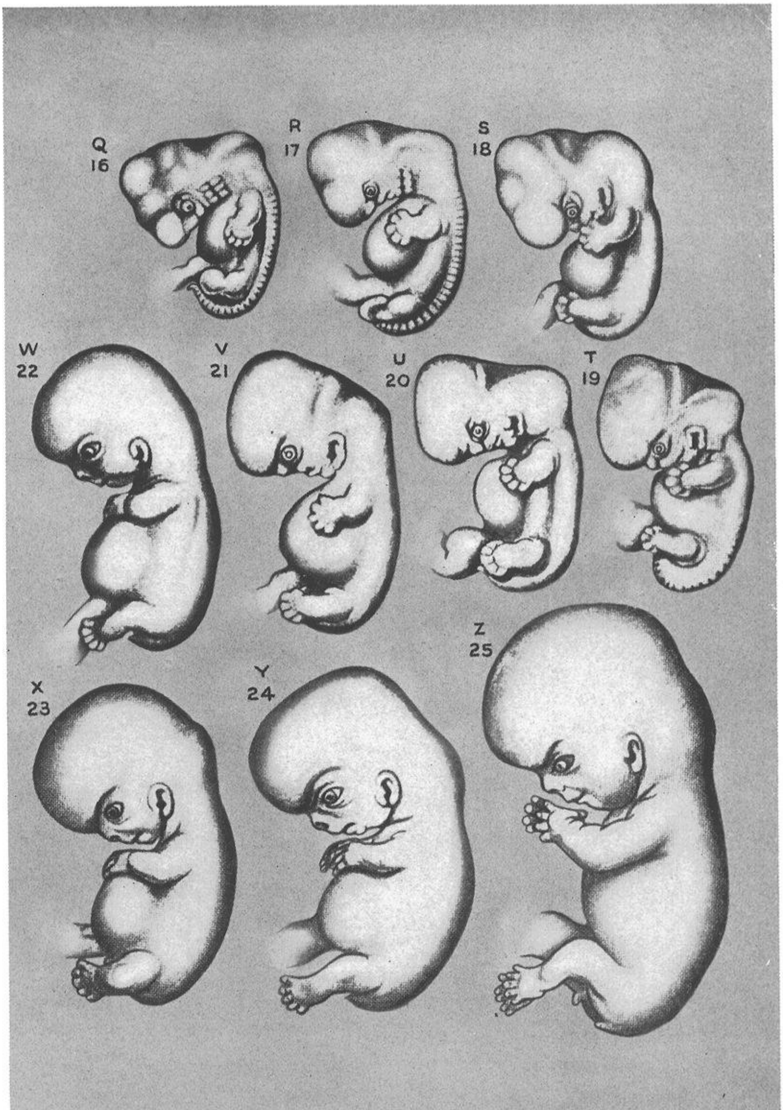
form, whose ancestry and the ancestry of the great apes separated from a common stock at some distant epoch which anthropologists incline to put as far back as the Miocene period. Still further back, in Oligocene or Eocene time, this stock separated, as it is supposed, from those of the gibbons and other Old World monkeys and from the small monkeys of South America. This hypothesis does not imply at all that man's ancestors were like the present great apes. For the line of descent both of man and of the great apes has been subject to great evolutionary changes in these hundreds of thousands of years. We must therefore conceive that the supposed common ancestral stock was quite as different from the great apes of the present as from man.

Speculating still further as to man's descent, it may have come with that of other mammals through the amphibians, and these by way of the fishes from the arthropods, where we lose all paleontological evidence in the long twilight of pre-Cambrian time. But the evidence from analogy found in the development of the human embryo leads us by the doctrine of recapitulation to assign simpler and simpler structures to this prepaleontological human ancestry, until in the beginning of life it originated from the cell itself. There scientific speculation commits the problem to religious faith.

It is of surpassing interest to know what are the influences which change the forms of life. From our knowledge of the structure of the cell, it seems clear that the almost infinitesimal chromosomes are the all-important elements which determine inheritance. Whatever of influence the environment may exert upon a living creature can have no permanent effect on succeeding generations unless it modifies the chromosomes.

Hence students of cytology have made many experiments to endeavor to change in some way the fundamental characters of the chromosomes. Without going far aside to note their work extensively, it will show something of

PLATE 9



Human embryo of six to eight weeks (12.5 to 23 mm.). Stage W (22) marks the transition from embryo to fetus. After His, *Normentafel*

the means employed and the results reached to speak of the X-ray treatment of the sex cells of certain plants, as reported by Goodspeed and Olson. With a Coolidge X-ray tube operated at 50,000 volts, the flower buds of the plant *Nicotiana tabacum*, variety *purpurea*, were treated in January for ten- and twenty-minute intervals. Of over 1,000 plants raised from these seeds more than twenty per cent were variant from the normal. In one lot of 168 plants, 136 were variant. A majority of the variants were decidedly abnormal in such characters as stature, leaf shape, and flower structure. Many of the new forms were completely fertile. In some variants the chromosomes themselves were found by microscopic examinations to be visibly altered.

The development of the individual human being enters a new phase with birth. Ceasing to depend upon the mother's circulation for nourishment and excretion of waste matter, the infant begins to employ its lungs to vitalize the blood with oxygen, and its digestive organs to assimilate food taken for the first time through the mouth. At this epoch of radical change in habit, let us pause to compare the status of the infant with that which has preceded and that which is to follow. As regards age, length, and weight, the average prenatal growth has been summarized as follows:

AGE	LENGTH		WEIGHT	
Months	Centimeters	Inches	Grams	Pounds
0.47	0.015	0.006	....	....
0.63	0.13	0.05	....	....
1.2	0.88	0.35	....	....
1.5	1.6	0.63	....	....
1.8	2.5	1.0	4	0.009
2.5	8	3.1	20	0.045
3.5	14	5.5	120	0.26
4.5	22	8.3	285	0.63
5.5	31	12	635	1.40
6.5	36	14	1220	2.7
7.5	42	17	1700	3.7
8.5	48	19	2240	4.9
9.5	50	20	3250	7.2

Compared to the adult, the length of a newly-born infant may be taken as thirty per cent, and the weight as five per cent. But if the total weight is thus to increase twentyfold between infancy and adult life, the different organs of the body show great differences in this respect. Thus, in average terms, if we take the infant weights in each case as unity, the adult weights of corresponding organs are as follows:

Eye	Brain	Skin	Heart	Stomach and Intestine	Lungs	Skeleton	Muscles
1.7	3.7	12	15	20	20	26	48

It is thus apparent that the eyes and brains of newly-born infants are greatly developed compared to other organs, a fact which is of high importance to a creature whose command over nature rests so much more upon sight and thought than upon size and strength.

The rate of growth of the child decreases very rapidly during the first two or three years, then remains nearly stationary until about the seventh or eighth year, when it again rises rapidly, so that the youth from twelve to fifteen years of age is fairly racing toward adult growth and his food demands are correspondingly increased. From this maximum of growth rate there is a gradual decline, and growth practically ceases at about the twenty-fifth year. In later life the weight, however, often has a marked increase after about the fiftieth year.

The heart-beat of the babe is very rapid, and approximates 135 per minute, falling to 110 in the second year, about ninety in the tenth, and seventy-five in adult life. Considering the very much smaller volume of the infant body, this relatively great rapidity of heart action causes an exceedingly more rapid renewal of the blood in the tissues than occurs in adult life.

Breathing, too, is quicker in the infant life, ranging from thirty-five per minute at birth to twenty-eight in the second year, twenty-six in the fifth, and so onwards. In the early years there is a continual storing up of reserves in the form of complex chemical compounds. Energy is being laid up against the exigencies of life in the form of rapidly increasing masses of flesh. The infant and growing child require pound for pound, over and above the needs of adult man, a larger income of energy corresponding to the imperious demands of growth.

Let us embrace in a single view the long panorama of life and survey the mysterious march of progressive evolution from its marvelous beginning in the individual cell, through the complex organizations of cells making up the many orders and species which have occupied the earth in the past or occupy it now, looking forward towards the undisclosed unfolding of the life of the future. In this far-ranging view, reproduction, not present activity, is by far the most important of all functions. Without it the glory of life is indeed but evanescent. With it the potentialities of the life of the future are beyond estimate.

From this point of view it is wholly fitting that the period of life which is marked by the most outstanding changes in form, activity of growth, behavior, mental outlook, and assertion of individuality should be the period of puberty, when the organs of reproduction become functional. In savage life, the significance of this period is frankly recognized and has led to rites and ceremonies, fasts, vigils, self-torturings, and other curious practices emblematic of the mysterious importance associated with this vital epoch.

It would be superfluous to describe changes of bodily form and habits of thought which accompany the onset of the reproductive period of life, for no one can avoid knowing them. The literature of romance, of motherhood, and of chivalry, which makes up so preponderating a part of the written heritage of the world, expresses the finer influences of this transcendent experience.

We have traced the outline of the history of the forms of life culminating in man, as revealed in the geological record, and the development of the human individual from conception to adult life, as discovered by the sciences of cytology, embryology, and anatomy. We may properly turn now to the story of the upward march of the race of mankind, which begins with primitive man and his implements. These till recently lay buried under the accumulations of ages, but now reveal to us humankind contending for a place in the sun against the brutes and nature.

CHAPTER IV

THE STUDY OF HUMAN PREHISTORY

It was formerly supposed that the great sequences in life forms, like the Age of Fishes, the Age of Reptiles, the Age of Mammals, and so on, came as the result of "cataclysms." There is no evidence, however, that universal catastrophes, of flood, glaciation, or what not, have ever really wiped out all life on the globe so that nature had to start out all over again. The nearest approach to it appears to have come in Permian time, but even then, as noted in Chapter II, many species survived. On the contrary, the same natural forces—rain, wind, frost, ice, earthquake, and volcanic eruptions—which we see about us today, have operated with only moderate fluctuations of effect from the beginning. We shall study the prehistoric past of man as a part of this orderly continuous working of nature.

The decipherment of the records of man's physical type and of the achievements of his intelligence in the far-distant past by the archeologist has required the cooperation of specialists in many different fields—of the geologist, the climatologist, the paleontologist, the zoologist, the botanist, the ethnologist, among others. Thanks to their cooperative work we now know far more than would have seemed possible even a generation ago. Yet the task has been but fairly begun, except perhaps in western Europe and especially France.

In spite of the vast age of human remains in Europe, it is probable that man did not originate on that continent, but came there from other lands, partly over "land-bridges" long since sunk beneath the sea. When Asia and Africa have given up more of the secrets which recent discoveries show are concealed in their soil, we shall know much more about man's origin and earliest history than we do now.

The records of man's prehistoric past fall into several classes, of which two are of leading importance—first, his own actual bodily remains in the shape of his bones; and second, the objects of his handiwork, such as tools and weapons and evidences drawn from the traces of his old camp sites, his burial customs, and his dawning artistic sense.

In addition, the animal life and the vegetation associated with early man can contribute much information. Certain types of plants and animals flourish in tropical climates, while others can exist only under temperate and even cold conditions. Their remains give a clue to climate and other conditions under which early man lived. We can also learn something of prehistoric man from the more backward races of the present day.

But before we describe these methods and their application, let us see how the trained archeologist works. Once he has chosen his site, he digs methodically and with closest attention, sometimes even straining every spadeful of earth through a sieve. He makes exhaustive notes of every bit of evidence that he finds, records each fragment of pottery or bone or worked stone as to its position and condition when found. He takes photographs not only of the objects themselves but also of their surroundings, in some cases even from aeroplanes; draws detailed plans; makes maps; notes fully the geology and climate, the human and animal life and vegetation of the region, both past and present—everything, in short, which might throw light in any way on the mode of life of the men of that time and place. The final study of the finds themselves can be done properly only at some great institution, a museum or university, with the aid of all the resources that modern science can bring to bear.

If it be asked how we can tell the relative age of different kinds of remains found in the soil, how we know that one type of human culture, for instance, is older than another, a simple illustration may answer. Most of us cherish early memories of the "old swimming hole" and its sometimes forbidden delights. Very often, we recall, the creek curved around, with a high bank on the outer edge of the bed, where the water was deep and safe for diving, and with a low, shelving beach on the inner side. The steep outer bank tended always to be undercut by the current, so that portions of it occasionally slipped down into the water, leaving exposed a fresh surface of clay. Near the top of this we should perhaps find sticking out of the earth objects that had been left there in recent times since white people inhabited the country: a rusty piece of iron, some baked bricks, a few fragments of broken chinaware, or a decaying log bearing marks of the pioneer's steel ax. There might, too, be bones of horses or oxen, pigs or sheep—animals which we know the early settlers brought with them from Europe. Lower down in the freshly exposed face of the bank we might find stone arrowheads, fragments of coarse, unglazed pottery, or bones and antlers of deer—animals which shared the country with the Indians..

Sometimes, of course, we should find things mixed up—jumbled together by the plow of the farmer, by burrowing animals, spring freshets, or the caving in of the banks. In general, however, we should see that traces of the later comers in the country lie *above* those of the earlier inhabitants. In a brick wall, the lowest course is bound to be the earliest, while the top one is laid down last. That, in essence, is the principle on which archeology depends (Fig. 4).

As our knowledge accumulates, the easier it is to apply it. If an archeologist from Mars were to come upon a chipped Indian arrowhead of stone sticking out of our clay bank *above* a rusty old iron hoe instead of *below* it, he might be pardoned for thinking that the Stone Age came later than that of Iron. We know, however, thanks to our better information, that it was really the other way around.

It is always easier to work from the known to the unknown. That is the way all riddles are solved. Man's prehistoric past is really a riddle to be solved from certain

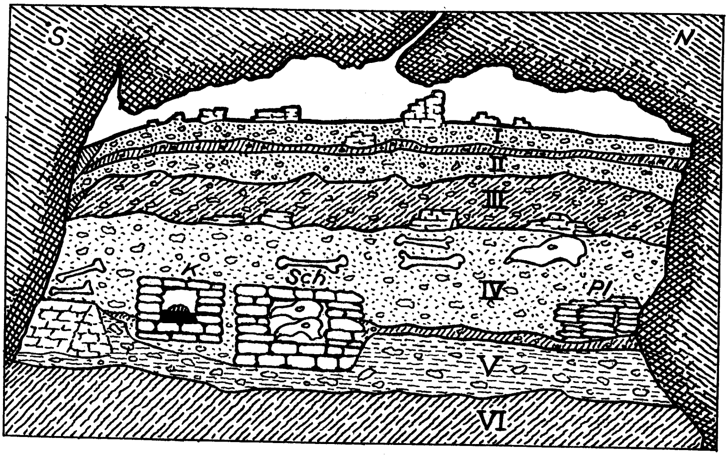


FIG. 4. Cross-section of deposits in cave of Drachenloch, Switzerland, showing how consecutive occupation through the ages is recorded in distinct strata. After Bächler

clues, a skein to be unraveled from the end in hand, which in this case is the present. Let us treat it so, starting from the things we know, and when we reach the things we have not known they will be much less unfamiliar to us. As we go backwards we shall see man's great discoveries—metal working, weaving, pottery making, house building, the domestication of plants and animals, and implement making—fall away from him one by one, until at last we come to a time when he lived among the wild creatures, naked as one of them.

The age we live in is an age of steel. This does not mean, of course, that we never employ other substances

PLATE 10

The Age of Steel
From an etching of the Standard Oil Building, New York City, by Joseph Pennell

Courtesy of the Joseph and Elizabeth Robins Pennell Collection in the Library of Congress

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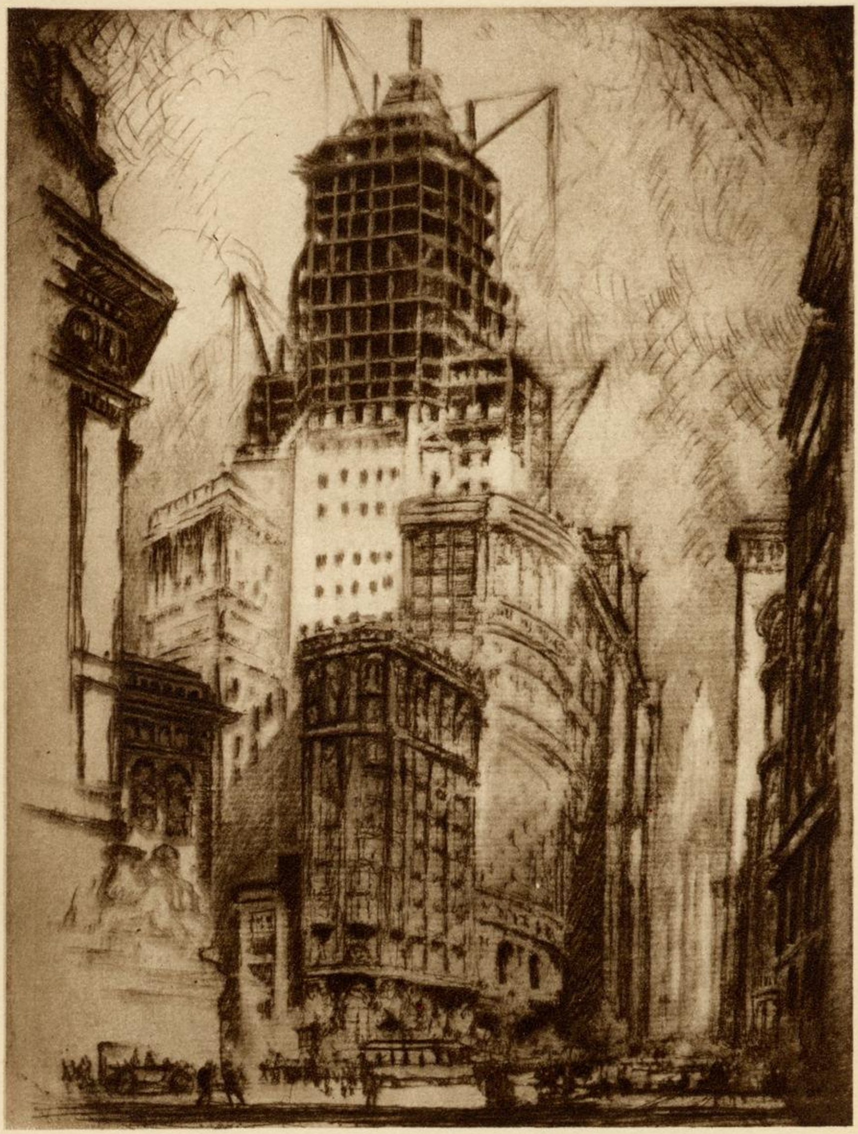


where they prove more suitable or economical. We use copper in many more ways than were ever dreamed of in the Copper Age itself, as we also use stone and wood. But steel is the material most characteristic of our times.

Man has known and employed steel, mainly for making weapons and edged tools, for over 2,000 years; but the true Age of Steel only began something like half a century ago, with its general application to structural uses. Before that, civilized man had long been living in the Iron Age, which began in the real sense about 3,000 years ago, almost certainly in western Asia. Man had known iron earlier still, but only so slightly as to consider it a precious metal. He forged rings and other ornaments from it, and, with the intense superstition which enveloped him, he regarded it as something mysterious and uncanny.

We must not think that the general use of iron sprang up in every part of the globe anything like 3,000 years ago. The entire Western Hemisphere, which long remained to all intents and purposes in the late Stone Age, learned of it only four centuries ago, as did also portions of Asia and Africa and the whole of Australia and the great Pacific area. Even yet remote and isolated tribes, like the New Guinea Papuans, who use stone, bone, horn, or shell for their tools and weapons, are actually living in the Stone Age today. This helps us realize as nothing else can that widely different culture stages may exist at one and the same time in various parts of the world.

As we delve still deeper into the past, we find that before the Iron Age there was a time when, in certain regions of the Old World, people depended on bronze (an alloy of copper mixed, generally, with about ten per cent of tin) as their chief metal. We know this period, therefore, as the Bronze Age, and its earliest traces are to be sought somewhere around 4000 B. C.

But people did not find out all at once how to combine copper and tin to make bronze. Before that they employed copper alone, perhaps as far back as 5000 or

6000 B. C. Along with its use, we meet with many traces surviving from the preceding epoch, that in which weapons and implements were made of stone. In fact, for a very long period men seemed to have looked on the lumps of native copper and the nuggets of gold which they found here and there merely as varieties of tough, malleable stone, and cut, pounded, and polished them into shape long before some prehistoric Edison found out how to melt and cast them. Hence we often speak, not of an Age of Copper, but of a Chalcolithic Period, from two Greek words meaning, respectively, "copper" and "stone."

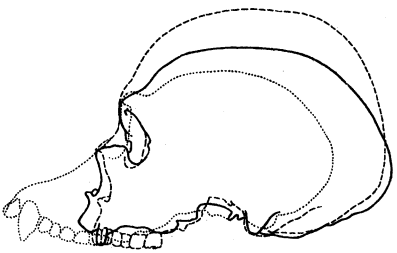
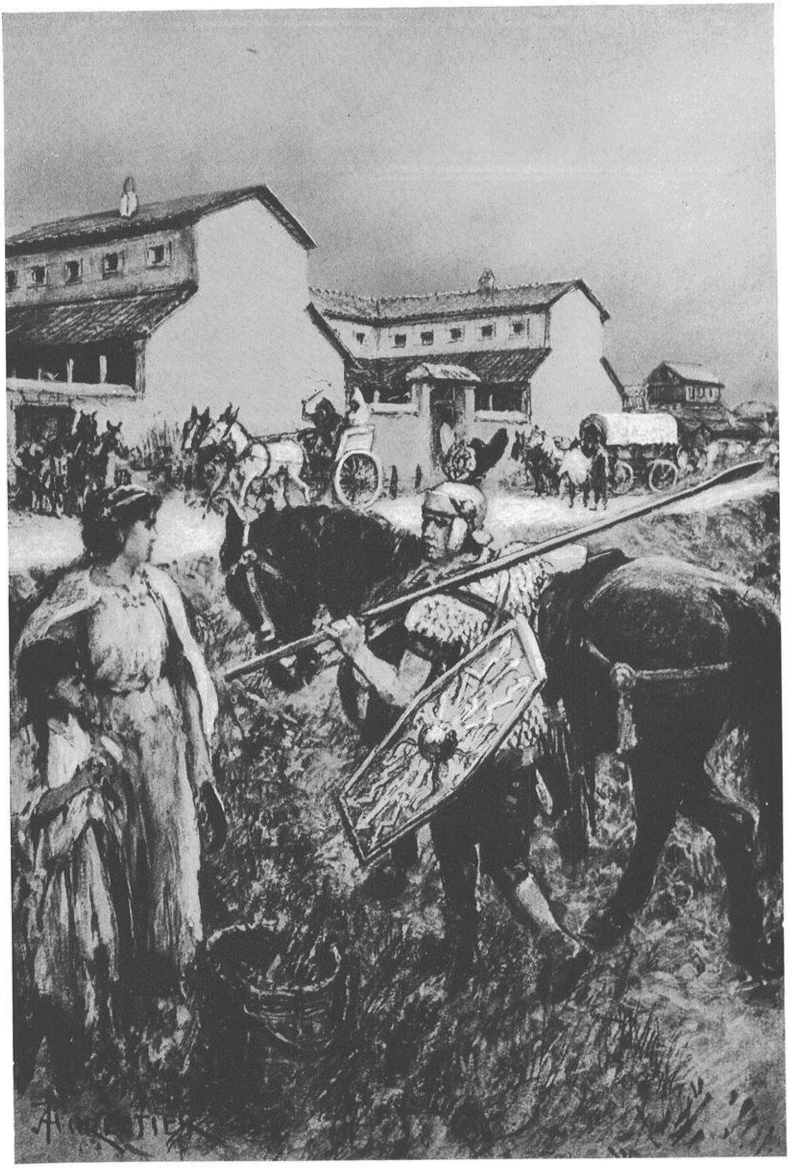


FIG. 5. Outlines of the skulls of a chimpanzee (dotted line), of a Neanderthal man (solid line), and of a modern European (broken line); showing stages in cranial development. After Boule

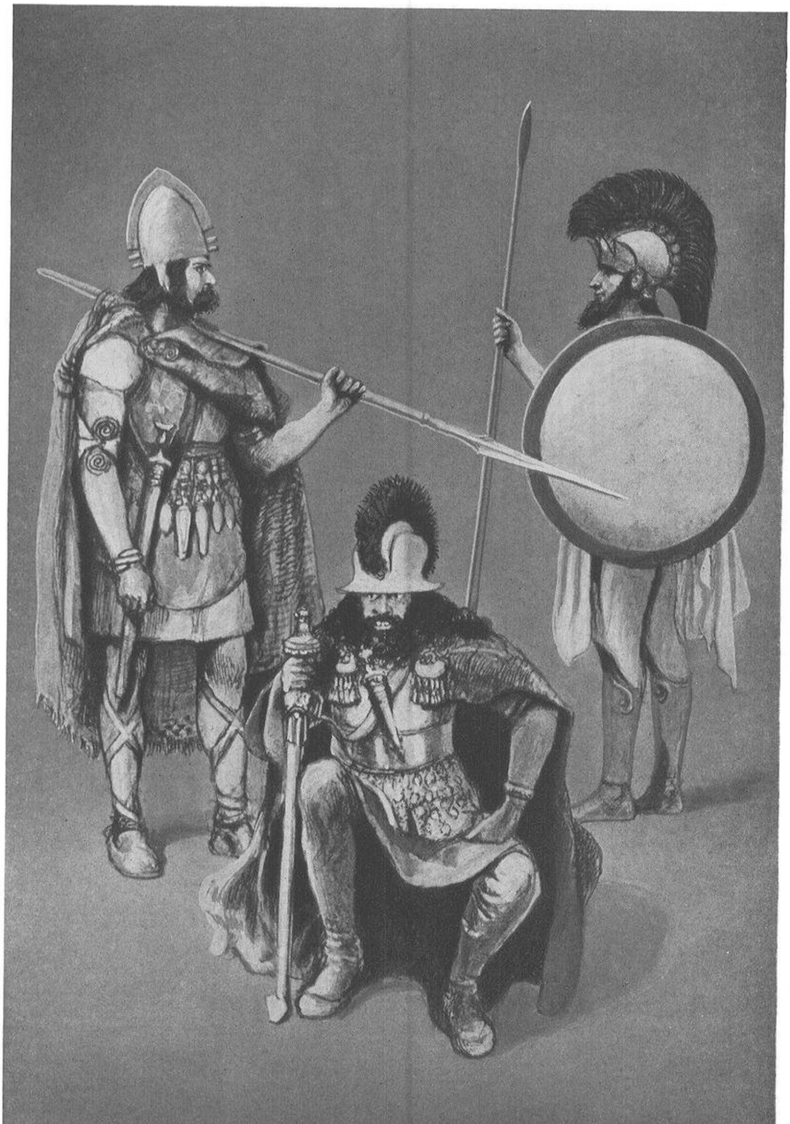
Then, as we push on still further backward into the past, we reach a time when men knew nothing of metals, but depended instead on stone, chipped, ground, and polished, for their most serviceable tools and weapons. This cultural stage is called the Neolithic Period, or New Stone Age. In its long course, man made very many of the basic discoveries upon which all his later progress has depended. The further back we penetrate into bygone ages, the less certain becomes our chronology, because we have less and less to go by. But perhaps we shall be reasonably close to the truth in estimating that in the more advanced parts of the world of that day the New Stone Age was beginning something like 10,000 to 15,000 years ago.

As our knowledge of the past steadily increases, we realize more and more that there are few breaks in progress. Successive stages always grow quite naturally out of those that have gone just before. Thus instead of a

PLATE 11



The Age of Iron. Scene at a posthouse on one of the great Roman roads. In the foreground a cavalryman. After Forestier, *The Roman Soldier*



The Bronze Age. Right, a Greek like those who fought at Troy; left, a western European chieftain; center, one from the Danube region. After Forestier, *The Roman Soldier* complete gap or hiatus between the New and the Old Stone Ages in Europe, such as students once thought existed, there was an intermediate period when men were slowly, and no doubt often with great difficulty, adjusting themselves to changed conditions and new discoveries. This stage has been given a name of its own, *viz.*, the Mesolithic or Middle Stone Age. It was clearly an age of transition. Some of the peoples and cultures which then appeared in Europe undoubtedly arrived there from other lands; but there also existed some survivors from earlier times in that continent itself.

But we have not yet reached the earliest evidences of man's presence in Europe. Before the Middle Stone Age, as we might infer from the name itself, there was an Old Stone Age—the Paleolithic Period, as it is called by prehistorians, who have subjected it, especially in France, to intensive study. They have discovered in it numerous subdivisions which they have named after places in France where typical sites have been found. At the very close of the Old Stone Age—merging, in fact, with the Mesolithic that followed—is the Azilian, named for the cave of Mas d'Azil in the northern spurs of the Pyrenees; before that comes the Magdalenian, so called after the rock shelter of La Madeleine, in the same region; then the Solutrean, from the great open camp of prehistoric man found at Solutré, farther east; the Aurignacian, from the sepulchral grotto of Aurignac, and the Mousterian, from the cave of Le Moustier, both in the same region as Mas d'Azil; the Acheulian, from St. Acheul, and the Chellean, from Chelles, two places in northern France; and lastly, the Pre-Chellean, oldest of all.

These successive stages overlap the entire vast span of the Old Stone Age. They comprise certain periods when the climate was warmer than it is now, and others when it was far colder and a sheet of ice buried much of Europe, as Greenland today. Throughout this epoch, as we travel further and further back into the past, we find on the whole an increasing rudeness of culture associated with older and older types of animals, many of

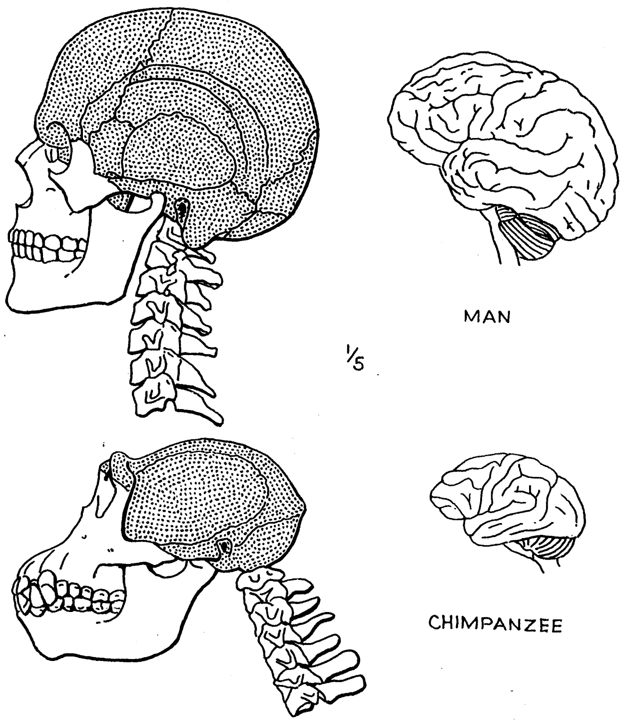
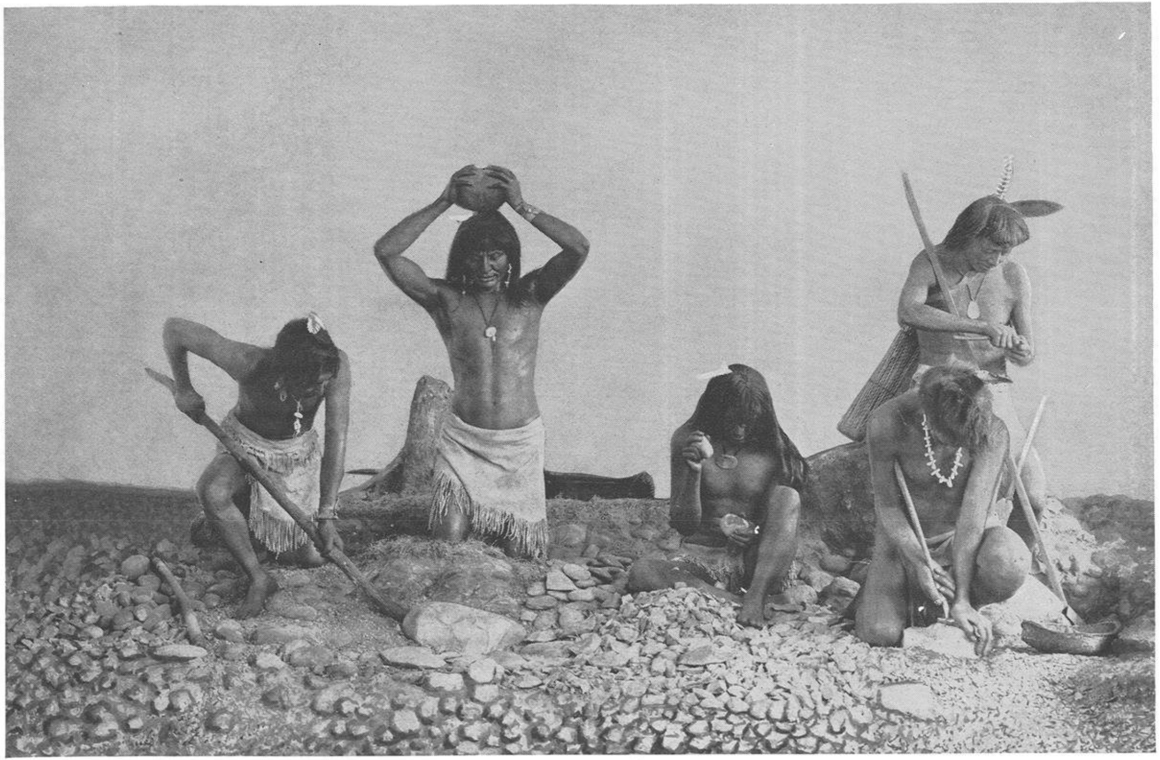


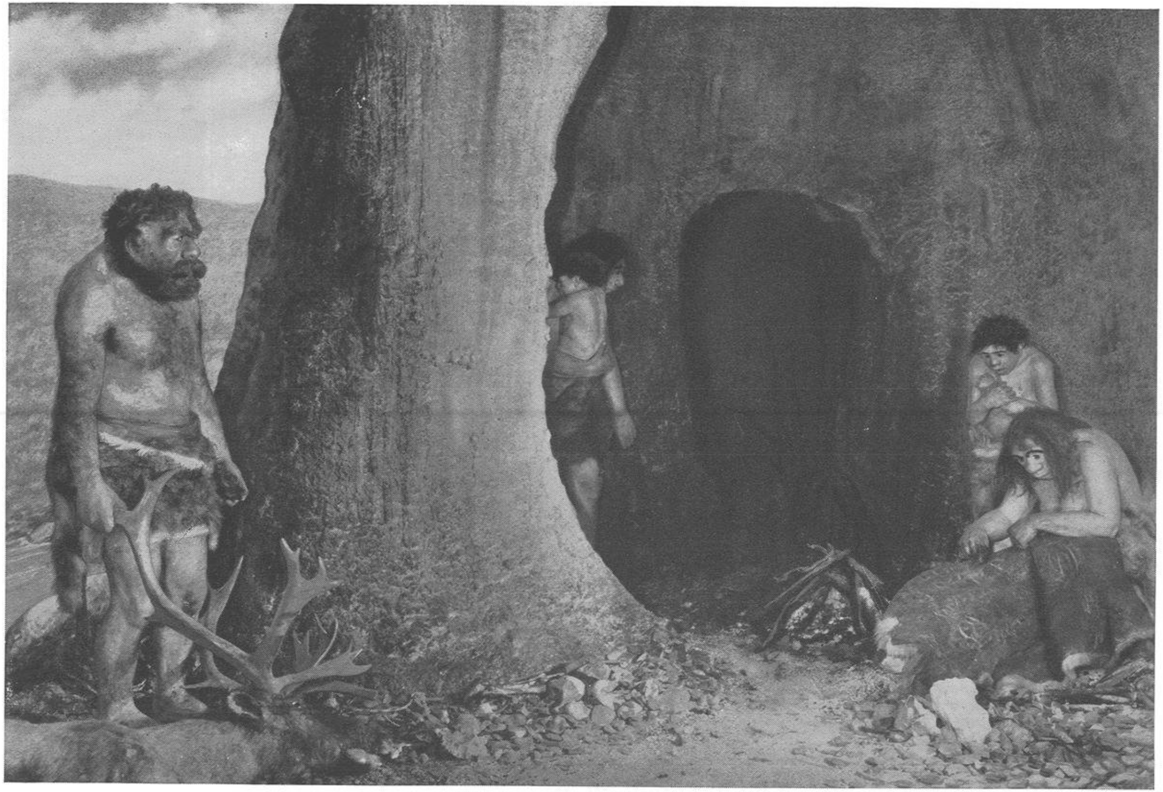
FIG. 6. Side view of the skulls and brains of modern man and chimpanzee. Note the difference in the manner of carrying the head. After Boule

them extinct ages ago. This is no mere guesswork, but is clearly proved by the actual remains themselves.

The bones of men and animals, unlike the rest of the body, may, under favorable circumstances, be preserved almost indefinitely. Careful study of them can tell us much about the looks and habits and the relationships of the creatures, human or animal, to which they once



The New Stone Age. The American Indians, before the advent of Europeans, possessed a New Stone Age culture and are shown here manufacturing stone implements. Group in the National Museum



The Old Stone Age. A restoration of a Neanderthal family. Courtesy of the Field Museum of Natural History belonged. Fortunately, also, the very part of the skeleton most apt to be preserved is the one which reveals to us more about the living creature than any other, namely, the skull, which in life contains the brain, the seat of man's intelligence—precisely what we are studying. The size of this organ, as shown by that of the brain-case

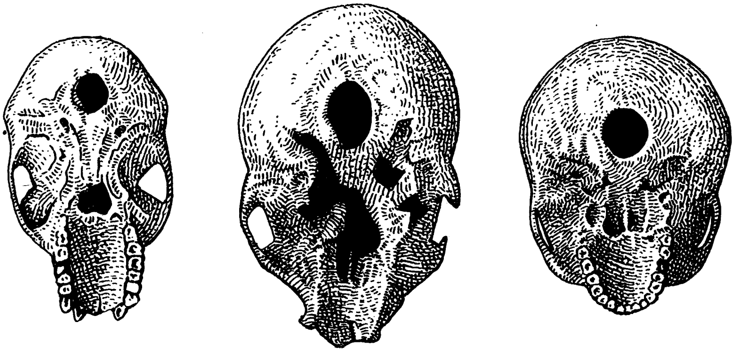


FIG. 7. The lower surfaces of the skulls of a chimpanzee, a Neanderthal man, and a modern European; showing progressive shifting of the opening for the spinal cord toward the center of the skull. After Boule

itself, provides us with many clues of the highest importance. Among normal white male adults the size of the brain averages around 1,550 cubic centimeters, although in different individuals this figure may vary as much as 200 cubic centimeters either way. The skulls of certain less cultured modern peoples, however, as well as those of some prehistoric races, fall decidedly below this capacity. In the three higher apes, the gorilla, the chimpanzee, and the orang-utan, the average sizes of the brain rarely if ever exceed 600, 400, and 400 cubic centimeters, respectively.

Hence, speaking very generally, the lower we go in the scale of intelligence the smaller and lighter in weight do we find the brain. More than that, it is simpler and less convoluted, so that in creatures like some of the South American monkeys, for example, the surface of the brain presents a very smooth structure showing comparatively few of those folds which seem so closely linked with intelligence. Again, by good fortune, the number and shape of these convolutions is indicated on the inner surface of the skull, which nature molds to fit them exactly (Plate 15). Hence, in a well-preserved prehistoric skull we can tell by the impressions on its inner surface whether the individual to which it once belonged had a brain of higher or of lower grade. And where, as in the case of Neanderthal man, we have found several skulls belonging to the same type, we can begin to draw conclusions regarding that race as a whole.

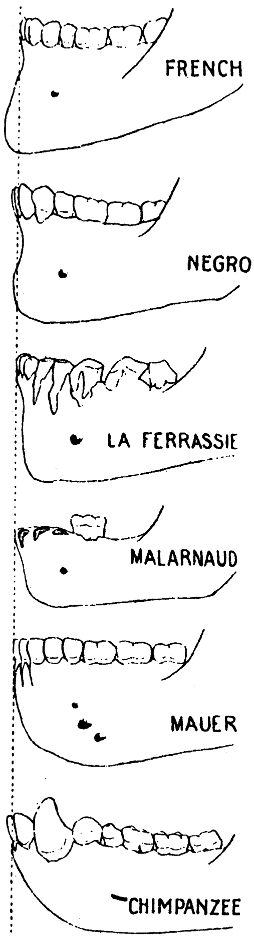


FIG. 8. A series of lower jaws showing progressive development of chin. After Boule

Scarcely less significant are the base of the skull and the manner of its attachment to the neck. These help to reveal the posture habitually assumed by man and by the most manlike animals, the great apes. As none of the latter ever habitually go about erect, their heads are set on their necks very differently from ours. The face is pushed forward (Fig. 6), and the muscles of the neck are attached to the skull in a way calculated to support the latter in this position. Moreover, the opening through which the spinal cord passes into the brain is situated much nearer the back of the head (Fig. 7). From these data we could deduce, if we had never seen a live gorilla, that he normally assumes a stooping posture, with the head and especially the jaws carried far forward, more nearly approaching that of four-legged creatures on the one hand and of very early man on the other.

The characters of the lower jaw or mandible, though too numerous and often too technical for us to describe in detail, contain much information for the anthropologist. The hinge, or articulation, by which the lower jaw is attached to the skull differs widely both in individuals and in races, so that this single character can tell us a great deal regarding the shape of the head of which it once formed a part. The presence or absence of a chin also means very much. All modern and recent races of men have a chin, while the apes have none, their lower jaws sloping right backward from the front teeth. Here again, the further back we go into man's remote past, the less do we find his chin developed, until in some of the most ancient human skulls it is practically absent (Fig. 8).

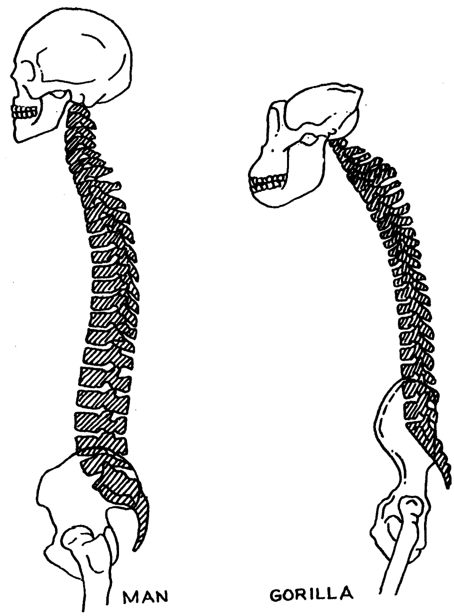


FIG. 9. The skull, spinal column, and pelvis of man and gorilla compared. After Boule

Just inside the point of the human chin, back of and below the roots of the front teeth, occurs a small projection bearing two points to which the main muscles controlling the tongue are attached. Instead of a projection, the lower jaws of apes actually have a small *depression* at this point; and in the older prehistoric human skulls, we find a condition intermediate between modern man and the ape.

The teeth, in their size and shape, including that of their roots, in the way they are set in the jaw, and in many other features, likewise contain evidence of great significance to the anatomist and the prehistorian.

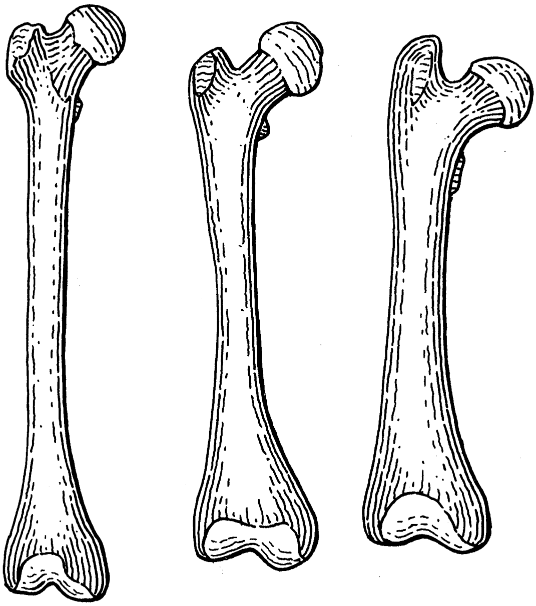
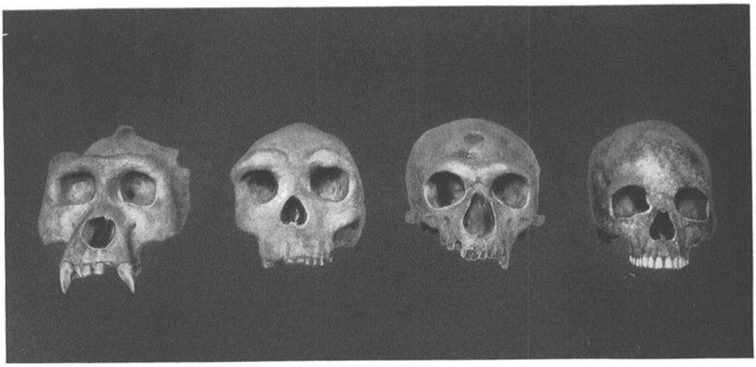
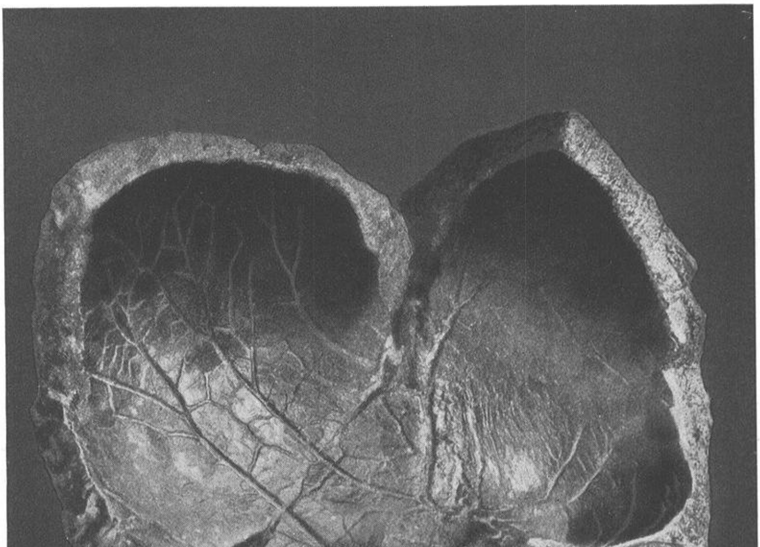


FIG. 10. Thigh bone of modern man (left), of Neanderthal man (center), and of gorilla (right). After Keith

As our far-distant ancestors gradually attained a more upright posture, their fossil skeletons reveal that further anatomical and structural changes took place in their bodies. The head began to be balanced on the spinal column, instead of being thrust far forward (Fig. 9). To accomplish this balancing, the back of the head, or occiput, grew out backward, the jaws were drawn in and became less massive, the forehead became higher, and the whole face more nearly vertical. At the same time equal or even greater changes went on in the rest of the skeleton, notably in the pelvic bones. In a creature going on all fours, the weight of the internal

PLATE 15

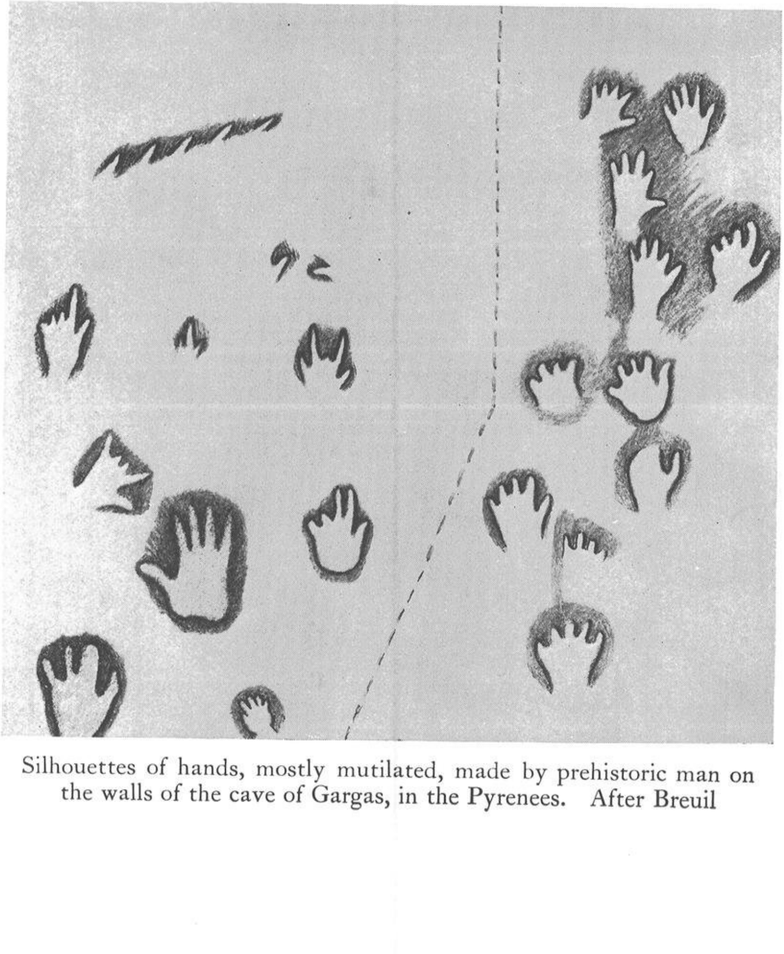




Upper: Progressive series of skulls—gorilla, Rhodesian man, Neanderthal man, and modern Kafir. In the National Museum

Lower: Fragment of the Piltdown skull. Note its great thickness and the impression left by the brain on its inner surface. After Smith Woodward

PLATE 16



Silhouettes of hands, mostly mutilated, made by prehistoric man on the walls of the cave of Gargas, in the Pyrenees. After Breuil organs, chest, and head is partly supported by the fore-legs; in man, on the contrary, this duty is thrown on the pelvis. Alterations took place also in the curvature of the backbone and in the structure of the individual vertebrae.

Finally, the bones and joints of the legs and feet likewise bear witness to many facts about primitive man. For example, a fairly constant relation exists between the length of the thigh bone, or femur, and the total height of the individual in different races; and the femur is precisely one of the parts of fossil skeletons most apt to be preserved (Fig. 10). The shape of the knee joint, again, shows whether the leg could be straightened, which is to say, whether its owner walked upright or stooping over.

A striking recent instance will suffice to show how the trained modern specialist works with the often very fragmentary evidence that keeps coming to light. About a score of years ago some pieces of a skull found at Piltdown, in southern England, were recognized at once as one of the very earliest specimens yet discovered. It was in the highest degree desirable to restore it as nearly as possible to its original shape. As some question existed as to whether the fragments found were sufficient to allow of this being done, the eminent anatomist, Sir Arthur Keith, submitted to the following test. With his permission we here quote part of his narrative in his own words:

. . . The question is often asked: Are four fragments of a skull, such as those found at Piltdown, sufficient to give us a definite clue to the original form of skull? . . . To test the matter, Professor F. G. Parsons of St. Thomas's Hospital Medical School, London, made a proposal to me, namely, that he and some of his fellow-anatomists should select a skull, cut fragments from it corresponding to those found at Piltdown, and that I should attempt to reconstruct the entire skull from these fragments. I gladly accepted the proposal, and resolved, however the result should turn out, to make the experiment the subject of an address I had promised to the fellows of the Royal Anthropological Institute.

On the 16th January, 1914, a fortnight before this lecture was due, the four pieces of a skull shown in [Fig. 11] came to me from Dr. Douglas Derry, of University College, London. They were representatives of the Piltdown fragments, and the task of reconstruction offered the same difficulties. Only on one piece—the occipital fragment—could any certain sign of the middle line of the skull be detected.

. . . .

How near a true reconstruction of the original form can be obtained by the use of such a method is apparent in [Fig. 12]. As regards the width and height, the reconstruction was in close agreement with the original skull from which the fragments given to me had been cut. The general form was rightly reproduced. There were certain minor errors which could have been eliminated had there been sufficient time at my disposal. It is obvious in [Fig. 12] that the right parietal fragment is placed too low, and that the occipital bone is too high. But as regards general outline and chief diameters the result of this experiment was reassuring.

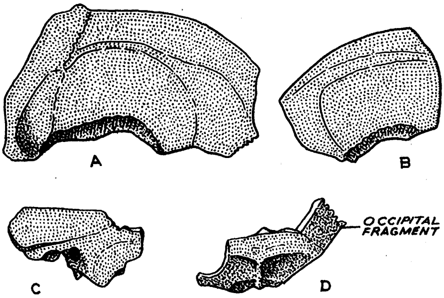


FIG. 11. Fragments of skull used in Sir Arthur Keith's test; cut from the cranium of an ancient Egyptian woman. After Keith

. . . .

The actual reconstruction of the experimental skull occupied me

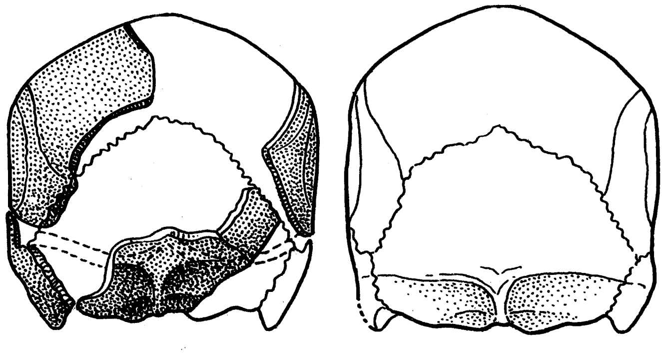


FIG. 12. Skull of ancient Egyptian woman as reconstructed by Sir Arthur Keith, and cast of the original

the better part of two days. Having made exact drawings of it, I handed the skull and drawings to Dr. Derry at University College. He then showed me the cast of the original—the skull of an ancient Egyptian—a woman, with a peculiar form of head and a brain capacity of 1,395 c. c. The estimate I returned of the brain capacity, namely 1,415 c. c., was not very wide of the truth, and as regards general form and actual dimensions I was relieved to find the method I had followed had given—except in one respect—a fairly accurate reproduction of the original.

Nothing could be more conclusive regarding the painstaking methods employed by modern anatomists in the study of ancient skeletal remains. And only rarely, we may add, do prehistoric skulls present so many difficulties as that of Piltdown.

The comparison of ancient man's customs and practices, so far as we know them, with parallel traits among modern savages has its dangers, for often the ethnologist finds that closely similar practices among modern tribes may arise in totally different ways and be governed by entirely different ideas. Yet this method in the hands of experts can be made very useful, even if rarely in itself decisive. A concrete example will show how it helps to throw light on the far-distant past.

There have been found painted on the walls of caves in France and Spain many silhouettes of human hands, with one, two, three, or even four fingers showing only as stumps (Plate 16). An experience with American Indians reported by George Bird Grinnell suggests the key to this mystery. Once when he was present at Camp Lewis, Montana, the body of a Crow Indian chief killed in battle was brought in, whereupon the mother and a male relative each cut off the little finger of the left hand in sign of their grief. And a Cheyenne Indian once explained to Grinnell how he had sacrificed three of his fingers to the Higher Powers, to induce them to aid him in taking vengeance on an enemy.

Again we find in the reasoning of certain primitive peoples of our day who depict animals and enemies on their weapons and elsewhere, for the purpose of exerting over them magical influences, an explanation of why some of the prehistoric peoples of Europe executed wonderfully lifelike paintings and engravings of animals on the almost inaccessible and ordinarily invisible walls of caves. They

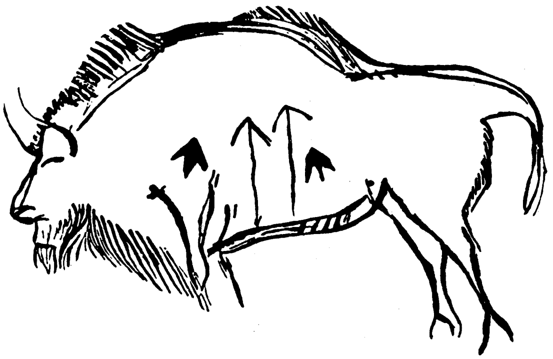


FIG. 13. Cave painting of a bison, with darts (or possibly arrows) piercing its sides; undoubtedly of magical significance. From the cavern of Niaux, southwestern France. After Breuil

did this not to give expression to their artistic impulses but for magical motives.

It may help to make clear the manner in which the science of archeology reveals the story of man's ancient past if we consider three typical prehistoric sites where lived generations of men far apart in time.

There is a cavern near the village of Mas d'Azil, in southwestern France, forming a natural tunnel some 500 yards long through which flows the Arize, a tributary of the Garonne. Repairs in the road along the stream in the year 1887 brought to the notice of M. Edouard Piette a section of the earth with which the cavern had become filled through the ages. A surface layer of black clay five feet thick contained many traces of the latest occupants. These dated from Roman times back to the Neolothic Period, which in this part of France merged into the subsequent Bronze Age somewhere around 2500 B. C. Just beneath this, and therefore next older, was a stratum one and one-half feet in thickness, of various colored clays, containing objects of early Neolithic date. Lower still came the Azilian layer, also about one and one-half feet thick, with implements of that transitional period which in fact has received its name from this very site. Below the Azilian again, a succession of strata, amounting in all to seventeen feet, contained various hearths with remains of Magdalenian type, including a thick barren layer which showed that there had been a long interval when the cave was unoccupied by man. Bones of reindeer and other arctic animals, some of the latter belonging to extinct species, were found in the lower deposits, but not in the Azilian.

Passing over now to Solutré, where M. Arcelin carried on excavations from 1866 until his death in 1904, we find a site of another kind. It is two and one-half acres in extent, sloping upward from the river Saône toward a rocky bluff 300 feet high, and consisting largely of the débris left behind by the ancient occupants. In some places this great mass of material was found to reach a depth of thirty-three feet. Its upper portions contained bones of various wild animals, including the mammoth, the cave bear, the wild bull, the horse, and especially the reindeer; also quantities of tools and weapons of reindeer horn, bone, and stone; minerals for colors; carved figures; and perforated animal teeth. The weapons included many of the so-called "laurel-leaf" points of flint, so characteristic of the Solutrean culture phase named for this very site.

Beneath the Solutrean remains and belonging apparently to the preceding Aurignacian epoch, at a depth of about ten feet, occurred a uniform layer of horse bones, charred, cut, and broken; mingled with these were flint implements. This huge deposit covered an area of well over 4,200 square yards, or more than seven-eighths of an acre, and represented the remains of at least 100,000 horses that had been killed and eaten by the prehistoric hunters during their long occupancy of this site. Below the horse bones, again, the excavators came upon one and in some places two layers of Aurignacian débris; while finally, in the deepest portions of their trench, they uncovered the Mousterian culture with its characteristic coarser artifacts. These were buried under nearly forty feet of accumulations. In 1923, the son of the elder M. Arcelin, in company with MM. Depéret and Mayet, discovered in the Aurignacian stratum, under all those of Solutrean and Neolithic and more recent times and well below that of the horse bones, the skeletons of two men and one woman. Near the latter lay the remains of two babies. The bodies of the adults had evidently been regularly buried, for their graves were marked by slabs of limestone which, though destined in the course of ages to be so deeply covered, probably had projected above the ground when the prehistoric mourners placed them in position.

The last of our three typical sites is that of Chelles, on the river Marne, eight miles east of Paris. Here the ancient sands and river gravels form a terrace about twenty-six feet thick between the present bed of the stream and the surrounding level. First comes a Mousterian stratum; just below that, an Acheulian one; then, earliest of all, about thirteen feet above the river, the Chellean, to which this site has given its name. Characteristic types of stone implements and bones of different species of animals mark each of these layers. For the Chellean and earlier Acheulian epochs were associated with creatures belonging to a warm climate, like the straight-tusked elephant, the hippopotamus, and Merck's rhinoceros. On the other hand, the upper or later Acheulian and the Mousterian, later still, show, by the presence of animals like the mammoth, the reindeer, and the woolly rhinoceros, the existence of arctic conditions.

These three typical sites—Mas d'Azil, Solutré, and

Chelles—show how successive culture layers have come to light one after the other, from the Neolithic, at the top, clear back to the Chellean, far below. They reveal, too, that the further back we go into the past the cruder are the implements which we find man using and the more primitive his manner of life.

CHAPTER V

THE ICE AGE

GEOLOGICAL research has revealed traces of more than one ice age, or glacial period, in both the Northern and Southern Hemispheres, far back in the earth's remote past, countless ages before the appearance of man. However, the one which we generally have in mind when we speak of the Ice Age, and with which we are here concerned, occurred but yesterday, geologically speaking, and profoundly influenced the development of man. There is no doubt whatever that man existed long before it began, but the vicissitudes and hardships to which he was then exposed had a great deal to do with the shaping of his later destinies and therefore the Glacial Period deserves our attention here.

Many explanations have been suggested of the causes that produce an ice age or lead to its disappearance. One surmise pictures the solar system, in its journey through space, as having passed through a "cold region" which lowered the temperature of our earth enough to cause enormous expansion of the polar ice caps. But this theory lacks the support of any real evidence.

Again, the English astronomer, Croll, argued for variations in the shape of the earth's orbit as the cause of an ice age. We all know that the path of our planet around the sun does not form a true circle but an ellipse. This changes its shape through the ages at a rate that can be calculated astronomically. Croll suggested that the Ice Age corresponded to the last period of great eccentricity of the orbit of the earth, when the latter attained its

PLATE 17

The Victor Glacier, Alberta, Canada, showing terminal and lateral moraines, erratic blocks, and the hollowing action of glaciers on the sides of valleys. Photograph by C. D. Walcott

Granite rock in the Sierra Nevada, California. The striations and polish record the former passage of a glacier over it, moving from left to right. Photograph by Gilbert. Courtesy of the Geological Survey maximum distance from the sun and therefore received correspondingly less of its heat. This would have made the Glacial Period begin 240,000 years ago and last for 160,000 years, thus coming to an end 80,000 years ago.

This theory at one time found wide acceptance. But growth of knowledge has developed serious objections to it, and prehistorians have come to feel convinced that the maximum severity of the Ice Age occurred much less than 80,000 years ago.

Still others have tried to explain the great expansion of the ice caps as due to causes arising on our earth itself, such as changes in the shape of the continents, produced by the elevation or sinking of the land. It has also been claimed that an ice age has followed every great period of mountain upheaval. Such earth movements have no doubt played a part, perhaps an important one, but they do not explain everything.

Another hypothesis, in some ways more promising than any of those outlined above, ascribes the advance and retreat of the great ice fields to fluctuations in solar radiation; for our sun appears to be what astronomers call a variable star, giving out less heat at certain times than at others.

But whatever the cause or causes, they led to a lowering of the temperature, although not necessarily a great one. In fact, meteorologists believe that even under present atmospheric conditions a fall in the average yearly temperature of only seven to nine degrees Fahrenheit would bring on another glacial period in Europe.

The formation of glaciers requires that two conditions be met: First, an annual heavy fall of snow, so that it lies in great drifts; and second, summers either too cool or too short to melt all the snow that falls. The snow thus keeps on growing deeper and deeper, until the lower and older layers, subjected to great pressure by the superstructures, gradually turn into solid ice. When this takes place on level ground, immense ice sheets form in time, to remain for ages until another slow change in climate causes them gradually to melt. In rugged country, however, these vast accumulations of ice tend to move downhill, seeking ever lower levels (Plate 17). In this way the valleys are occupied by slowly moving rivers of ice, partly carried along by their own weight and partly pushed on by that of the ever-growing masses behind them. Usually glaciers move down the valleys very slowly, although in the polar regions they may advance as much as fifty feet per day. The rate depends on the temperature, the slope of the ground, and the volume of ice involved. It is a little greater by day than by night and in summer than in winter.

Now the passage of millions of tons of ice over the surface of the earth produces many interesting effects. For one thing, it naturally exerts a tremendous grinding and scouring force which steadily wears away the sides and bottoms of the glacier-filled valleys. Their cross-sections thus become changed in time from the typical **V** shape, produced by ordinary stream erosion, into one resembling a capital letter **U**. Where valleys of this type occur, we may be sure that glaciers have once passed.

Much as the current of a river often undermines its banks and causes them to cave in, so a glacier, in spite of its vastly slower movement, produces in the same way falls of rock, gravel, and earth. These lie on its surface and gradually form long lines of débris, known as lateral moraines, which, sinking slowly to the bottom of the glacier, become frozen solidly in the ice; being thus dragged along irresistibly over the underlying rock surface, they score parallel grooves running in the same direction as that of the moving glacier (Plate 18). After the latter has disappeared with the return of a warmer climate, these marks remain to afford unmistakable proof that the region was once ice covered.

In time the bowlders carried along at the bottom of the glacier are worn by their contact with the ground into characteristic rounded or prismatic shapes. Ultimately many of them are reduced to dust. All this material, both coarse and fine, together with the earth that falls from the sides of the glacial valleys, combines to form what is known as "till," or "bowlder clay." The occurrence of this substance is another evidence of the former presence of a glacier.

Often, too, after the ice has melted away, it leaves behind it bowlders of all sizes, usually with rounded contours, called "erratic blocks." When these are composed of rock unlike that of the country around them, they can often be traced back, sometimes for vast distances, to the region whence they originally came.

The glacier, as it slowly travels downhill, eventually reaches a level where it melts and forms a "glacial stream," which carries along with it bowlders, gravel, and sand, automatically sorting them out, as it goes, according to size. This material forms heaps called terminal moraines, often of crescent shape, with the hollow side toward the glacier. Wherever, owing to stability of climate, the melting end of a glacier has remained stationary for centuries, these appear as huge mounds quite unmistakable to the trained eye.

Through the careful study of these and other traces of former glaciation, particularly in western Europe, geologists have been able to learn a great deal about the nature and history of the last great Ice Age. They have found that the latter, far from being confined to western Europe, extended over the world, with glaciers forming in both the Southern and Northern Hemispheres apparently about the same time, and through their gradual extension enveloping large portions of the globe. In this way much of North America, of northern Europe, and of southernmost South America was buried under enormous fields of ice during untold thousands of years. Asia, owing to a drier climate, seems largely to have escaped such visitations. For we must remember that to bring on an ice age an increase of cold alone is not enough; there has to be at the same time a fairly heavy annual fall of snow. Northern Siberia, at least in part, lay under a vast stationary field of ice; and some of the great Asiatic mountain masses formed important centers of glaciation. But, speaking generally, in Asia the Glacial Period appears to have been far more local in character than it was either in Europe or in North America. The same, too, may be said of South Africa, of Australia, and of New Zealand.

Geologists have found further that the Glacial Period consisted not of a single intensely cold epoch, but of several, alternating with epochs of mild or even decidedly warm climate. In most of western Europe the great ice sheets underwent no less than three or four successive epochs of expansion and retreat, known as glacial and interglacial stages respectively, even the shortest of which lasted for many thousands of years. There is, moreover, reason to believe that the interglacial epochs were much longer than the glacial ones.

As a glacial stage approached, the winters must have grown imperceptibly more and more severe, through not merely hundreds but many thousands of years. The glaciers far in the north crept further south, those in high mountain masses further down the valleys, until they overspread the northern portions of Europe and North America with enormous ice sheets, in some places thousands of feet thick. Conditions then must have resembled those of today in Greenland and in the Antarctic Continent.

Further, the glaciers transformed the covering of the neighboring ice-free regions from forest and meadowland and swamp into tundras—treeless plains of black mucky soil, with a permanently frozen subsoil overgrown with moss, lichens, and dwarf shrubs, as in northern Alaska and Siberia today. The animals living on them were quite typical, and included forms like the hairy mammoth, the woolly rhinoceros, and the reindeer. The terrible storms of winter often killed multitudes of these and other wild creatures, whose skeletons, buried in the earth, still remain and reveal many facts concerning the climatic and other conditions which prevailed in those days.

Again, while the glacial stages were drawing on or disappearing, the nearness of the ice fields set up atmospheric effects of the most far-reaching sort, such as the winds known as anticyclones. These blew over the adjoining ice-free areas, carrying vast clouds of dust composed largely of the finer material from the moraines. The fact that this dust settled equally on the tops of the hills as well as down in the valleys shows that it was carried there by the wind and not by the action of water. As the process went on, the dust accumulated in thick beds of a special kind of soil known as loess, which occurs in many parts of the world, in both the Eastern and the Western Hemispheres. Loess is no longer being formed in Europe, but it is in northern China, where it covers vast areas with a mantle many feet in thickness (Plate 19). There the people hollow their dwellings out of it, and the roads in time become worn down so deep that not only they but even the vehicles passing along them are often quite invisible from the surface.

Along with the formation of the loess, the aspect of the country gradually assumed a steppe condition, like the seemingly limitless plains of southern Russia and central Asia. These have an extreme range of temperature, with short hot summers, when they are covered with grass and shrubs, and long bitterly cold winters, when the snow lies deep, blizzards rage, and animals perish by the thousands.

To the latter peculiarity of a "steppe" phase of climate we owe much of our knowledge about the animal life of the time, including such plains-loving forms as the bison and the horse. For the blizzards killed many creatures whose bones, left after the snow melted away in spring, were buried by the dust storms of the following summer.

The same is true of human remains, though in far less degree; for man even then was able to afford himself and his kind protection from the frightful snowstorms.

Other phenomena attending the Glacial Period were the recurrent elevation and sinking of the land. We do not know definitely just what occasioned this, but the very weight of the enormous ice sheets seems to have caused the ground beneath them to sink slowly, while the regions where they were absent were pressed as gradually upward, in a sort of slow seesawing motion.

Still another contributory cause seems to have been the actual lowering of sea level during the glacial stages. In order to form the enormous ice fields, water had to come from some source. Normally that drawn up out of the ocean by evaporation is returned to it, either directly as rain and snow falling on its surface, or indirectly through rivers, streams, and melting icebergs. But during the recurring glacial epochs this balance was upset. Then the snow which fell over vast areas, instead of melting the following summer to flow eventually back into the ocean, slowly, year after year, turned into ice. While the glaciers were thus growing in size during tens of thousands of years, more water was being withdrawn from the ocean than was going back into it. Dr. Ernst Antevs, of the University of Stockholm, a very high authority, has made some interesting calculations based upon this fact. He says:

The volume of ice during the climax of the last glaciation in excess of the existing quantity, according to the estimates made in the foregoing chapter, was as follows:

	Cubic Kilometers of Ice
North American ice sheet	27,050,000
European ice sheet	5,000,000
Other Pleistocene glaciers in Eurasia	350,000
Greenlandic ice sheet	400,000
Northern Hemisphere	32,800,000

This total volume of ice corresponds to 30,800,000 cubic km. of water. Taking the area of the ocean as 361,000,000 square km., this water quantity represents a layer over that area 83 m. (272 feet) thick.

The ice sheets and glaciers on the Northern Hemisphere are thought to have reached their greatest extent at practically the same time. On the other hand the climaxes of the glaciations were perhaps not entirely synchronous on the different hemispheres, though alternation is out of question. The volume of the ice on the Southern Hemisphere in *excess* of the present quantity is estimated to have been some 4,100,000 cubic km., which corresponds to 3,760,000 cubic km. of water and represents a layer over the area of the oceans 10 m. (33 feet) thick. Therefore, if the glaciations reached their climax simultaneously on both sides of the equator the sea level was lowered by some 93 m. (305 feet). If the contemporaneity was only partial the sea level may at most have been lowered 88 m. (290 feet).

This process steadily, although very slowly, caused a lowering of the sea level and exposed to the air thousands of square miles of the earth's surface that had hitherto formed part of the bed of the sea.

There is scarcely a part of the globe where the effects of this rising and sinking of the land are not manifest. Thus in many regions we find one or more "raised beaches," old strands on which the sea once broke for long periods, but which are now raised far above the reach of the highest waves (Plate 20).

The opposite sort of earth movement, that of slow subsidence, left traces in "sunken rivers." The taking of accurate soundings has traced the former courses of many of the present-day rivers sometimes for long distances along the sea bottom. The latter, that is to say, was once elevated above sea level, so that existing rivers flowed across it far beyond their present mouths.

Thus both England and Ireland have in the past been joined to the mainland, as was the case even after the close of the Ice Age, not so very many thousand years ago. And Europe was connected with Africa both across the Strait of Gibraltar and by way of Italy and the present islands of Sicily and Malta, thus dividing the Mediterranean Sea into two landlocked basins. The "land-bridge" at Gibraltar probably sank beneath the waves somewhat before that of which Sicily still forms a remnant. But traces of the invasion of Spain by cultures from

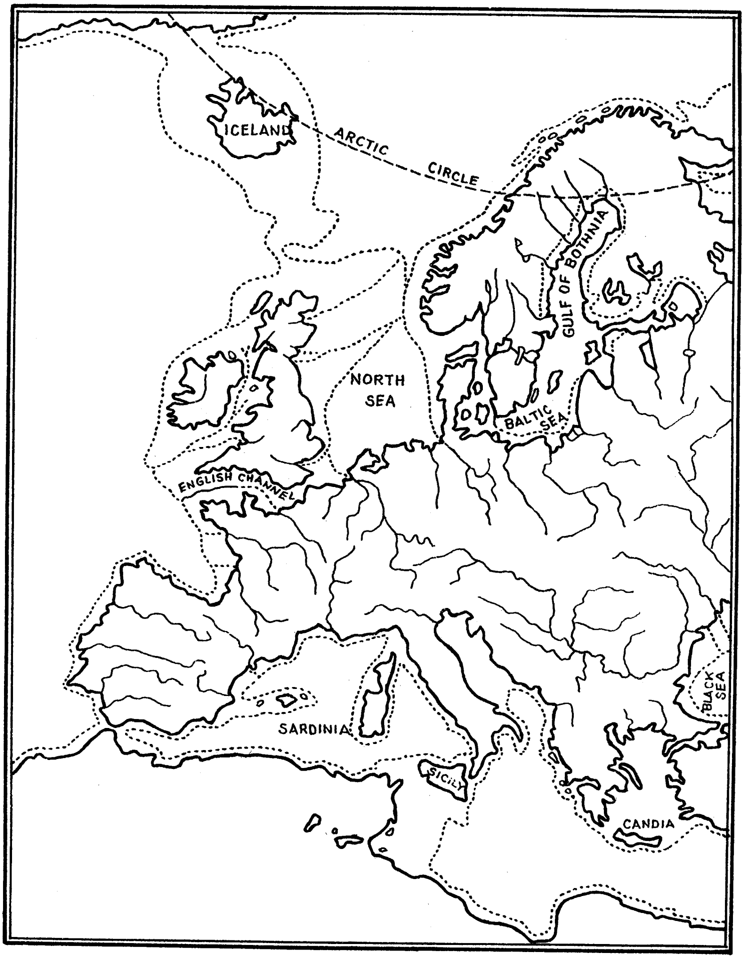


FIG. 14. Map of western Europe, to illustrate the former greater elevation of the land. The dotted lines indicate the ancient coast lines and the courses of "sunken rivers." Note the land connections between Europe and North Africa across the Strait of Gibraltar and by way of Sicily

Loess country, northwestern China. This covering of fine dust, transported by wind action from the Gobi desert, reaches in places a thickness of hundreds of feet

PLATE 20

The terrace along the hillside in the distance is a raised beach representing the shore line of old Lake Bonneville, Utah. Photograph by Gilbert. Courtesy of the Geological Survey

Africa seem to show that during at least part of the Pleistocene or Glacial Period the two regions were connected. It is unlikely that man during the Old Stone Age had learned how to build canoes or rafts, so wherever he spread, he probably did so by walking.

On the other hand, during a portion of the Ice Age, great gulfs stretched down across what is now dry land from the Arctic Ocean to the Caspian and Aral seas (then probably united) and to Lake Baikal in eastern Siberia. One proof of this is that in all three of these now quite landlocked bodies of water occur seals, which could only have reached them when they were connected by sea with the waters of the Arctic regions.

A final characteristic result of the Ice Age to be mentioned is the "river terraces" it formed. As the climate grew warmer with the approach of an interglacial stage, the melting of the ice sheets set free vast quantities of water, which caused great floods and freshets. These carried with them much of the débris brought down by the glaciers from the uplands, and spread it over the river bottoms as sand or gravel. With the disappearance of the ice, the rivers, deprived of most of their supply of water, of course shrank in size, and began to cut for themselves channels in the great beds of sand and gravel that they had brought down in the preceding glacial stage. Thus terraces formed, and sometimes we find more than one, the highest in each case being the most ancient. In the gravel and sand of certain of these river terraces, we find some of the earliest remains of man's handiwork, in the form of rough stone implements. These include the Pre-Chellean, the Chellean, and the Acheulian culture stages, when man had not yet been forced to become a cave dweller, but lived in open camps or at most on the sunny side of overhanging bluffs.

The sequence of the warm and cold epochs which together composed the Glacial Period has been well worked out in the region of the Alps by Penck and Brückner.

They found in those mountains and their surrounding foothills evidence of four glacial stages, which they called the Günz, Mindel, Riss, and Würm.

Of these the first or Günz stage, although it lasted for many thousands of years, seems to have been the least extensive. Its traces, for example, appear to be lacking in parts of Germany and perhaps in England. At all events, no evidence exists of any very severe or widespread refrigeration, although the snow line in the Alps dropped 4,000 feet lower than the present 8,800 feet above sea level.

After the Günz glaciation had reached its maximum, the climate of Europe grew slowly milder again. The first interglacial stage was relatively short and its temperature seems to have been slightly warmer than that of the present, as indicated, for example, by the fossil remains of the hippopotamus.

The second or Mindel stage ushered in the first really great period of glaciation, at least in Europe. Great ice sheets, spreading out from the Alps, from Scandinavia, and from Scotland, gradually overflowed those regions, in addition to the greater part of England and Holland, nearly the whole of northern Germany, and two-thirds of Russia. Ice packs covered the northern seas the year round, and glaciers, forming in the mountains of Scotland and Scandinavia, united in a solid mass of ice clear across the North Sea.

There followed in turn another interglacial stage, which appears to have been the longest of all. Penck, indeed, believes that its duration was greater than all the time that has elapsed since. The remains of the vegetation indicate a climate not so very much warmer then than now.

The third or Riss glaciation seems to have been more severe than the first, but less so than the second, and was followed by a warm interval of particular interest to us because in it many authorities place the beginning of the Old Stone Age—the Pre-Chellean, the Chellean, and the Acheulian epochs of human culture, mentioned in the previous chapter.

Up to the end of this third interglacial stage the animal life of Europe had been one suited to a tropical or sub-tropical climate. It included various forms of the elephant and the rhinoceros, the hippopotamus, the monkeys, the lion, the hyena, and the saber-toothed tiger. These creatures probably came from southern Asia and northern Africa, in part at least by the "land-bridges" which then spanned the Mediterranean. More northern forms, like the musk ox, do occur during the colder stages, but not in the south of Europe.

After the close of this interglacial stage, however, as the fourth or Würm glacial stage drew near, this warm-temperate animal life of Europe died out entirely, to be replaced by species belonging to northern regions with a cold environment. A like change also occurred in the vegetation.

During this fourth glacial stage the climate seems to have been colder than at any previous period, though the areas actually covered by ice sheets did not, at least in Europe, equal those covered in the second stage, so that man managed to exist in spite of the cold damp climate.

The type of human culture in Europe and the adjoining portions of Asia and Africa during most, if not all, of this glacial stage was the Mousterian, which is always associated with remains of the Neanderthal race, a species of mankind differing from that of the present day. For the Neanderthalers life in the fourth glaciation must have been hard and rough to a degree beyond anything that we can conceive of now. In its appalling danger and discomfort it has been likened by one recent author to a winter in the trenches under the conditions of modern warfare. Although man had progressed somewhat in his mastery over nature, he was still pitifully ill equipped for his struggle with ferocious beasts and a bitter climate (Plate 21).

After the maximum of the fourth glacial stage the climate did not at once turn warmer. Instead, there followed a period of oscillation, with at least three minor returns of the ice, during which the mammoth, the woolly rhinoceros, the reindeer, and other cold-weather animals continued to live in Europe, although many other creatures found there during the earlier periods had died out.

Gradually the slow changes of temperature characterizing the Postglacial Period became less and less marked, and toward the beginning of the Neolithic or New Stone Age, the climate became pretty much what it is today.

It is interesting to note, in this connection, that the Ice Age still exists in the north and south polar regions. These, however, were not always covered with ice, as they are today. The fossil remains of plants found there prove that they have in times past enjoyed a mild and genial climate. Perhaps some day they will do so again. On the other hand the present may be simply an interglacial stage, with another return of the ice sheet awaiting us in the far distant future.

Various attempts have been made to determine how long the Ice Age lasted, and definite light has recently been thrown on the length of time since the last or Würm glacial stage attained its maximum. So far, however, we do not know how long it had taken to reach that point; nor how long the preceding periods lasted. Some have put the beginning of the Pleistocene period, or Ice Age, as far back as 1,000,000 years ago; others at half that figure; Penck estimated it at 525,000 years, and Sir Arthur Keith at 200,000 years ago.

Geologists practically agree, however, that the Ice Age closed both in North America and in Europe something like 10,000 years ago, a little more in the southern portions of those continents and a little less further north. Thus Scandinavia, lying considerably nearer the

PLATE 21

A mammoth hunt in the Old Stone Age. Owing to the inadequacy of their weapons these prehistoric hunters must often have killed their prey by driving it over a cliff as shown

North Pole, remained in the grip of the ice sheet for over two thousand years longer than France.

Baron Gerard de Geer of Sweden has made the most promising attempt at measuring the time that has elapsed since the height of the last great glacial stage. In his article in *Antiquity* of September, 1928, he says:

> In 1891 I had noticed, in several places [in America] laminated clays, similar to the late glacial melting sediments in Sweden; these I had found, by long continued investigations, to represent the annual deposit from the melting water on the border of the retreating ice edge. . . . I had succeeded in identifying such varves from one point to another, and ultimately worked out a systematic plan for the elaboration of a continuous time scale.

These varves, or annual bands, as Baron de Geer satisfied himself, corresponded to the yearly fluctuation of the glaciers, due to the oncoming heat of summer (Plate 22). If carefully measured over some section of country which represents the whole retreat of the ice since the end of the last glaciation, they will indicate pretty closely the number of years that have elapsed since that retreat began. They will also tell us, by their inequalities, which were the warmer and which the cooler periods of years. If we find that such warmer and cooler periods occurred at the same time in different parts of the earth, we shall know that the major cause of all these successive glaciations must have been of cosmic character. Such a discovery would also probably throw much new light on the variability of the sun's radiation, to which these world-wide, contemporaneous glacial changes would in all probability be due.

Aided by a band of enthusiastic university students, Baron de Geer actually carried through the laborious undertaking of counting and measuring the varves in Sweden. He found that in that country approximately 8,700 years have elapsed since the latest glacial stage finally closed. His pupil, Doctor Antevs, made extensive counts and measurements in the United States and

Canada and found nearly corresponding results. Going still further back, these investigators have shown that certain well-defined pulsations of ice advance and retreat occurred both in America and in Europe. Summing up all the evidence, Doctor Antevs concludes as follows:

> Thus there was correspondence between the ice retreat in North America and in Europe in several of the larger features, but topographic and climatic differences seem to have limited the agreement. Since the correspondence was not perfect even in the larger features, agreement in the smaller features in details, such as relative summer temperature and varve graphs, cannot be expected.
>
> Our present knowledge of the geologic history of the two areas does not permit any other correlation. If the one outlined is correct and the estimates of the time represented by zones in which the ice retreat is not chronologically determined are fair, the last ice sheets had their greatest extent and began to wane about 40,000 years ago. This figure may be less than 10,000 years too large or too small—a fact of importance because of the interest that has recently sprung up in the absolute Quaternary chronology.

Thus for the first time we have before us, in results attained since 1920, an actual chronology in years covering the period since the peak of the last glaciation, and we can say with some confidence that it reached its greatest intensity about 40,000 years ago and, after a long and fluctuating period of retreat, finally ended, in western Europe at least, about 8000 or 10000 B. C. This much is fairly definite.

PLATE 22

Varves in glacial clay, Sandy Falls, Ontario. Markings such as these enabled Baron de Geer to give the first reliable estimate of the time elapsed since the last maximum of glaciation. Courtesy of the Geological Survey of Canada

CHAPTER VI

MAN THE CAVE DWELLER

NOT until the final great glacial stage, that of the Würm, did man, in Europe at least, begin definitely to live in caves, forced thereto no doubt by the increasing cold. We often speak of "cave men" as though they were, from first to last, of one and the same species. But we err in doing so, for it was precisely during this cave-dwelling period that there occurred the most fundamental change in mankind so far known in human history.

At first, as we move backward in time, through the Ages of Iron, of Bronze, and of Polished Stone, we meet with men of essentially modern type, differing in no very marked way from the races found today in all parts of the globe. The same thing applies in almost equal degree to the Mesolithic, or Middle Stone Age, and to the last of the three subdivisions of the Old Stone Age proper, that usually called the Upper Paleolithic. For even then, during and just after the close of the last glacial stage, we find living in Europe men of large brains, well developed foreheads and chins, and sometimes almost gigantic height. It is just here that the change occurs. Before the last-mentioned peoples, and differing from them far more than does any one modern race from another, lived the lowly Neanderthal man, short of stature and slightly stooping of posture, with a large head, thick neck, enormous projecting brows, retreating forehead and chin, and powerful frame.

Back to this point, the beginning of the Middle Paleolithic or Mousterian epoch, our knowledge of the different physical types of the Old Stone Age is fairly extensive, because while people lived and died in caves their bones stood a much better chance of being preserved than when left lying in the open. Moreover we have definite proof that even the lowly Neanderthal race had come to reverence its dead enough to lay their bodies away in graves, where they would be covered with earth at once and thus protected from destructive agencies.

But earlier still, during the Lower Paleolithic, that extremely long period embracing the Acheulian, the Chellean, and the Pre-Chellean epochs, there were men who made from stone roughly chipped implements of ever-increasing crudeness the further we penetrate back into the past. Finally we reach the Eolithic or "Dawn Stone" Age, characterized by implements so rough as to be barely, if at all, recognizable as the work of human hands and brains. Throughout these long earlier ages men seem to have lived mainly in the open, often on the "glacial terraces" described in the last chapter. Hence when they died their skeletons stood but little chance of preservation, especially as they appear not to have done much, if anything, in the way of burying their dead.

An account of the human types of the later periods, when man had already become much what he is today, forms no part of the plan of the present volume. In the present chapter we shall confine ourselves to a discussion of the cave-dwelling races of the Old Stone Age, and more particularly to some of the finds of human skeletal remains from the three epochs of the Upper Paleolithic, *viz.*, the Magdalenian, nearest our own times; the Solutrean, next earlier; and the Aurignacian, earliest of the three. A description of the various industries and above all the remarkable art of this time belongs more properly in the last section of this book, devoted to man's cultural development.

MAN THE CAVE DWELLER

The Magdalenian Epoch

Excellent authorities are inclined to put the beginning of the Magdalenian epoch at from 15,000 to 18,000 years ago, and it appears to have lasted at least 3,000 or 4,000 years. Researches indicate that it occurred during the first two of the three minor advances of the ice fields which took place in Postglacial time, together with the drier interval between. During the greater part of this long period one race of men dominated western Europe, almost though not quite to the exclusion of all others. This race is named after the little hamlet of Cro-Magnon in southwestern France, where, in 1868, five typical skeletons came to light in a grotto.

The men of the Cro-Magnon race, when it first appears, were of almost gigantic height, although its women were much shorter, a disproportion which seems to have been a special characteristic of the race. But by the Magdalenian epoch, with which we are now dealing, it had for some reason degenerated considerably in this respect, although still of high mental type and strong bodily development. In fact, with this one exception of stature, it presents much the same traits during the entire Upper Paleolithic, from the beginning of the Aurignacian down to the very end of the Magdalenian. Some of its characteristics seem to have survived into much later times and perhaps even to the present day.

The shape of the Cro-Magnon skull is quite unmistakable, and in itself serves to identify skeletons of this race wherever found. Anthropologists call it "disharmonic," because the shape of the face does not harmonize with that of the brain-case, as it normally does in most races. When looked at from above, the Cro-Magnon skull is seen to be long and narrow; but the face, instead of having a somewhat similar outline, is short and broad.

Even the women of the Cro-Magnon race actually had larger brains than the average modern American or western European, a condition due perhaps in part to the fact that with bigger bodies go larger brains. But another explanation suggests itself. The intensely hard conditions of life during the Old Stone Age must constantly have weeded out the less intelligent individuals, particularly during their younger years. Probably only the very fittest, both in mind and in body, survived to become the fathers and mothers of the next generation.

The human remains assigned to the Magdalenian epoch include the parts of two skeletons found near La Madeleine (Dordogne), the site which gave the culture its name, and a single skeleton, that of an adult male, found at Laugerie-Basse, a great rock-shelter on the Vézère, by Massénat in 1872, under nearly ten feet of deposits containing Paleolithic hearths.

In the rock-shelter of Raymonden, in the commune of Chancelade (Dordogne), MM. Hardy and Féaux, in 1888, found a nearly complete skeleton of a man between fifty and sixty years of age, and about five feet in height. It lay doubled tightly up, and had probably been buried in that position, perhaps swathed about with bandages. This Magdalenian man of Chancelade had a large brain quite of modern size, a high and rather narrow skull, a long straight nose, broad face, powerful jaw, and strong chin. Except for his short stature we should find him a well-built man with strong features. Both this and the preceding example, that from Laugerie-Basse, differ from the typical Cro-Magnon in displaying greater height of face. In this trait, they have been thought to resemble some of the eastern Eskimo of today.

Again, two well-preserved skeletons of a man and a woman were found in 1914 by workmen at Obercassel, near Bonn, on the Rhine. They lay at a depth of about twenty-five feet, protected by large, flat stones. Here, as elsewhere, the bones were stained with red ocher and were associated with bone implements bearing the incised decorations characteristic of Magdalenian art. This has

PLATE 23

Restoration of Cro-Magnon man; represented clad in furs and carving a piece of bone. Modeled by Mascré under the direction of Rutot

definitely proved the Cro-Magnon race to be responsible for the remarkable artistic development of the Upper Paleolithic Period. The man's height was estimated at five feet three inches, the woman's at two inches less.

The Solutrean Epoch

The Solutrean epoch was shorter by probably 1,000 years than the Magdalenian, which it immediately preceded in parts of western and central Europe. The geographical distribution of its peculiar culture suggests that the latter came from the east, perhaps from the plains of Russia and western Siberia. The forms of its art and its implements, rather than the skeletal remains of man himself, distinguish the period. Among the very few skeletons which may be attributed with some certainty to the Solutrean epoch are the following:

At Crot-du-Charnier, in the commune of Solutré itself, Ducrost found, at a depth of some five feet, an oval hearth measuring about fifteen by ten feet, bounded by flagstones. Within this inclosure he discerned the skeleton of a male, under the bones of whose right hand were two fine "laurel-leaf" points, the special flint implements which characterize the Solutrean. Near by lay several carvings and outside the flagstones great quantities of cold-period animal bones. Numerous other sepultures have been found near this site, but many of them seem to belong to later times.

At Klause, near Neu-Essing, in Bavaria, Obermaier found many Solutrean artifacts and, amid a mass of breccia composed of fragments of mammoth tusks, a human skeleton of a male about thirty years old, attributed to that stage. A mass of powdered ocher completely surrounded it.

Among other skeletal remains usually attributed to the Solutrean epoch are those from Brüx, in Bohemia, and from Brünn, in Moravia. These indicate the existence in central Europe of a narrow-headed race which, however, differed from the very broad-faced Cro-Magnons in having a harmonic form of head; that is, the face was narrow, like the brain-case.

Thus it would seem that during this period two distinct races occupied Europe, the Cro-Magnon in the west and that of Brünn more to the east, particularly in the valley of the Danube. This would harmonize with the belief that the Solutrean culture came originally from that direction. It has been suggested, moreover, that in the Brünn race we have the remote ancestors of the type of northern European, tall, fair, and narrow skulled, which we know as the Nordic race; but whether this be true or not only time and further research can tell.

The Aurignacian Epoch

The Aurignacian epoch, the earliest of the three included within the Upper Paleolithic, endured for perhaps 7,000 or 8,000 years. Its culture appears to have reached Europe toward the close of the fourth great glacial stage, that known as the Würm, somewhere around 25,000 or 30,000 years ago, finding a climate much colder than that of the present and quite severe enough to compel man to seek refuge in rock-shelters and the mouths of caves.

The splendid Cro-Magnon race first appears in Europe at the beginning of the Aurignacian. At this time, in addition to its other fine attributes, it enjoyed that of exceptionally great stature, which it later lost. The men seem actually to have averaged over six feet in height, and individuals have been found who stood over six feet four inches. In addition to this splendid height, the men had deep chests and broad shoulders, and the proportions of their leg bones show that they were capable of great speed and physical activity. The Cro-Magnon race stands, in fact, among the finest that has ever existed anywhere in the world.

It has been suggested that the race originated somewhere in Asia and moved slowly westward, along the northern shores of Africa, until it reached the ancient land-bridge extending across the Mediterranean Sea by way of Sicily to Italy, which it crossed to enter Europe.

In connection with the skeletal remains of Aurignacian man, the name of Lartet will ever be remembered. Edouard Lartet, in early life a lawyer, when almost sixty years of age became keenly interested in the exploration of caves. These are numerous in the departments of Haute Garonne and Ariège, in southern France. Near the village of Aurignac there existed a small cave, now wholly quarried away, which New Stone Age man had used as a sepulcher and then walled up with a slab of stone. Falls of débris from the hill above had hidden its mouth, but it was accidentally discovered in 1852. Within were found the remains of seventeen persons, which by order of the mayor received Christian burial.

In 1860, Lartet visited this cave and explored the undisturbed strata, two or three feet thick, which still covered its floor. These abounded in charred and broken bones of extinct animals—the cave bear, cave lion, cave hyena, woolly rhinoceros, giant deer, mammoth, and others—broken for their marrow by the men who formerly lived there. In the terrace in front of the cave he found charcoal and other traces of ancient hearths, in which were embedded objects of the type we now call Aurignacian, including flint implements, carvings in ivory, shell necklaces, pendants of perforated teeth, and weapons of bone and reindeer horn.

Eight years later, Louis Lartet, the son of Edouard, while excavating a grotto or rock-shelter at Cro-Magnon, near Les Eyzies (Dordogne), made the discovery of five skeletons lying amid hearths and implements similar to those found at Aurignac. The skeletons belonged to men averaging nearly six feet in height and were, on the whole, hardly to be distinguished from those of tall men of the present day. This site gave the race the name which it bears among prehistorians today.

In the Crot-du-Charnier at Solutré, MM. Mayet, Depéret, and Arcelin found in 1923 three Aurignacian burials beneath the celebrated deposit of horse bones already mentioned. These included the remains of two tall males and one short female, the former resembling the tall old man found at Cro-Magnon.

We can mention but one more of the many discoveries of Aurignacian remains, that made by the late Prince Albert of Monaco. In the year 1895, the Prince undertook the investigation of the caves of Grimaldi, sixty or seventy feet above sea level in the red rocks which rise from the sea a little east of Mentone. For his researches Prince Albert secured the help of the best talent of France, including such eminent men as Boule, Cartailhac, Verneau, and Villeneuve. They investigated no less than seven caves, one of which, the famous Grotte des Enfants, proved a veritable treasure house of Aurignacian remains. In excavating thirty-three feet of deposits, they revealed ten ancient floors of habitation. From the top down to the ninth level all were Aurignacian, yet evidently separated from one another by long intervals of nonoccupancy, which suggests the long duration of the Aurignacian epoch.

The upper strata disclosed the reindeer, but no mammoth or woolly rhinoceros, such as were found at more northerly sites of the same period. Various extinct forms common in those ancient times, like the cave bear, cave lion, and cave hyena, were discovered. Toward the bottom, tropical animals—Merck's rhinoceros, the hippopotamus and the straight-tusked or "ancient" elephant—proved the existence in the early Aurignacian of an interlude of warm climate. In the lowest layer of all, some implements gave evidence of the Mousterian culture of Neanderthal man.

The investigators found human remains in the second, third, eighth, and ninth levels, all probably interred in shallow graves under the floors of their dwelling sites, according to the custom of the time. Ornaments and artifacts, evidently intended by their friends as provision for the future life, accompanied the skeletons, and some of the bones found were stained with red ocher.

At the base of the Aurignacian deposits of Grimaldi, and dating apparently from the very beginning of that

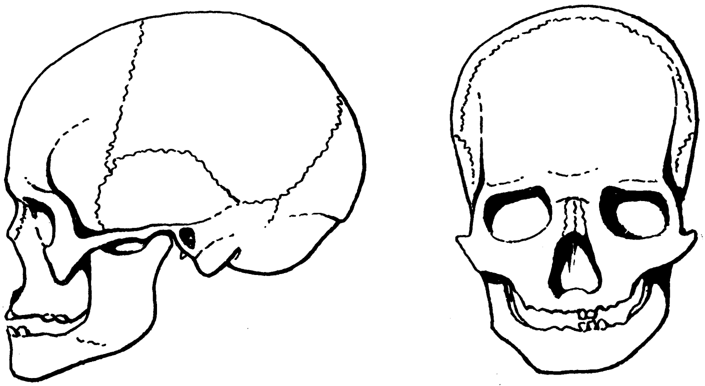


FIG. 15. Profile and full-face views of the skull of the Grimaldi woman. After Keith

epoch, were found two skeletons which have aroused great interest among prehistorians. For they have been held to indicate the existence at that time in this part of Europe of representatives of a race which was neither that of Neanderthal nor that of Cro-Magnon. The skeletons belonged to a youth and a woman, both of rather short stature (Plate 25), and they present traits which have been interpreted as Negroid in character. It will be remembered that the Cro-Magnon race, with its Aurignacian culture, is supposed to have entered Europe from Asia by way of northern Africa and the old land-bridges across to Italy. Now in recent years there are coming to light all over Africa remains of a type of art, consisting mainly of engravings and paintings of animals, which in many ways recall the remarkable cave art of the Upper Paleolithic in Europe.

In South Africa works of this character are attributed in part to those dwarfish, yellow-skinned, woolly-haired little hunters, the Bushmen, themselves undoubtedly a very ancient race, now nearly extinct. Moreover, certain of the physical peculiarities of the latter people are

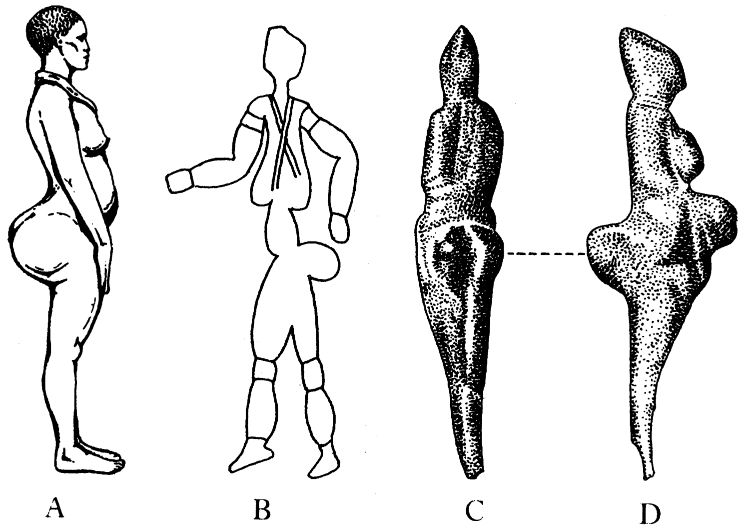


FIG. 16. Aurignacian and modern Bushman comparisons. A, Bushman woman; B, Bushman drawing of same; C and D, statuettes in steatite from the Grimaldi caves

shown clearly in the figures of very stout nude women, carved from ivory or soft stone, which have been found here and there in the Upper Paleolithic of Europe (Fig. 16). These facts, taken in conjunction with the Negroid traits ascribed to the two Grimaldi skeletons just mentioned, seem to hint at some African influence on Aurignacian art. Any more definite conclusion than this, however, we should hardly be justified in drawing as yet.

At all events we have now reached the point, in our backward journey through time, when Aurignacian man first appears in Europe and takes the place till then occupied by the low-grade race of Neanderthal. As far as

The caves at Grimaldi, near Mentone, on the Mediterranean coast of France, once inhabited by prehistoric man. After Boule

The Grimaldi skeletons of a woman and a youth with negroid characteristics. After Verneau western Europe is concerned, Neanderthal man disappears completely from the scene never to return. Whether he was in part absorbed and in part exterminated by the far superior Cro-Magnon race, or whether he died out from other causes, we can not as yet say with certainty.[1]

Beyond doubt contact, with intermarriage between the two races, did occur. The spread of civilized man over so much of the globe at the expense of less advanced races during the past few centuries shows us what usually happens in such cases. The lower culture, even though destined in the long run to be entirely destroyed by the higher, yet borrows from the latter many of its features, particularly in the domain of warfare.

In like manner the unmistakable Aurignacian influence visible in certain classes of Mousterian artifacts may very probably be traced to the time when the Cro-Magnon race was spreading over western Europe, absorbing, driving out, or killing off Neanderthal man as it advanced. Perhaps, too, the undoubted resemblance in the burial customs of the two races is due, in part at least, to this cause. In central Europe the Mousterian epoch is immediately followed, not by the Aurignacian, but by the Solutrean, which would indicate that the Cro-Magnons for some reason did not penetrate that far. But even here the Neanderthal race finally disappears and is succeeded by the bearers of the Solutrean culture, who appear to have been the race of Brünn or Předmost. That the latter, notwithstanding their high skulls and their faces of modern type, should display certain traits recalling the Neanderthalers may perhaps be due to contacts at this time.

It is possible that Neanderthal man may have survived for a while longer in a few other regions. At one time or another he inhabited not only Europe but also parts of

[1] On this subject the author accepts the views of many eminent prehistorians, notwithstanding that Dr. Hrdlička, as will appear in the following chapter, inclines to think the Cro-Magnon the lineal descendant of Neanderthal man.

Asia and Africa. But until the prehistory of the two latter continents is much better known than it is today, we shall not be able to say where he originated or where he made his last hopeless stand against men of the modern species.

This much seems agreed upon by most prehistorians—that the Mousterian culture appears in Europe at the close of the third interglacial period; that it was in part, though by no means entirely, a development from the previous Acheulian; and that it extended over much of the last great glacial stage, that known as the Würm. Some time after the first and more important climax of the latter, the career of Neanderthal man came to an end, and that of the Cro-Magnon race began.

CHAPTER VII

NEANDERTHAL MAN[1]

NEANDERTHAL Gorge and the valley north of it constitute one of the most interesting natural formations in western Germany. Here one comes unexpectedly upon a piece of romantic scenery lying beneath the level of the cultivated plain surrounding it. Eroded by the small stream, Düssel, and its branches, out of the limestone formations that underlie the surface, for generations the gorge and valley have been favorite resorts. The former is named for Joachim Neander, a poet and song composer of the German Reformed Church, who lived in the seventeenth century, and for whom the gorge was a favorite retreat. Doubtless he sometimes entered the cave in which two centuries later was found the famous skeleton which has become the type of a special race of men.

The gorge is bounded by high, rugged cliffs of Devonian limestone which have been extensively quarried since the middle of the nineteenth century. In the year 1856 the excavations had reached the so-called Feldhofen Grotto, a somewhat extensive cave located in the right-hand cliff not far from Ravenstein, a high, isolated rock still standing. The mouth of the cave lay about 110 feet from the right bank of the stream and 60 feet above its level.

According to local accounts the cave had two parts. In August, 1856, two laborers, clearing out the loam from the smaller section, uncovered a human skeleton. Not

[1] This and the following chapter are quoted with slight alterations from, and Chapter IX is based on, a monograph by Doctor Hrdlička, now being published by the Smithsonian Institution, entitled "The Skeletal Remains of Early Man."

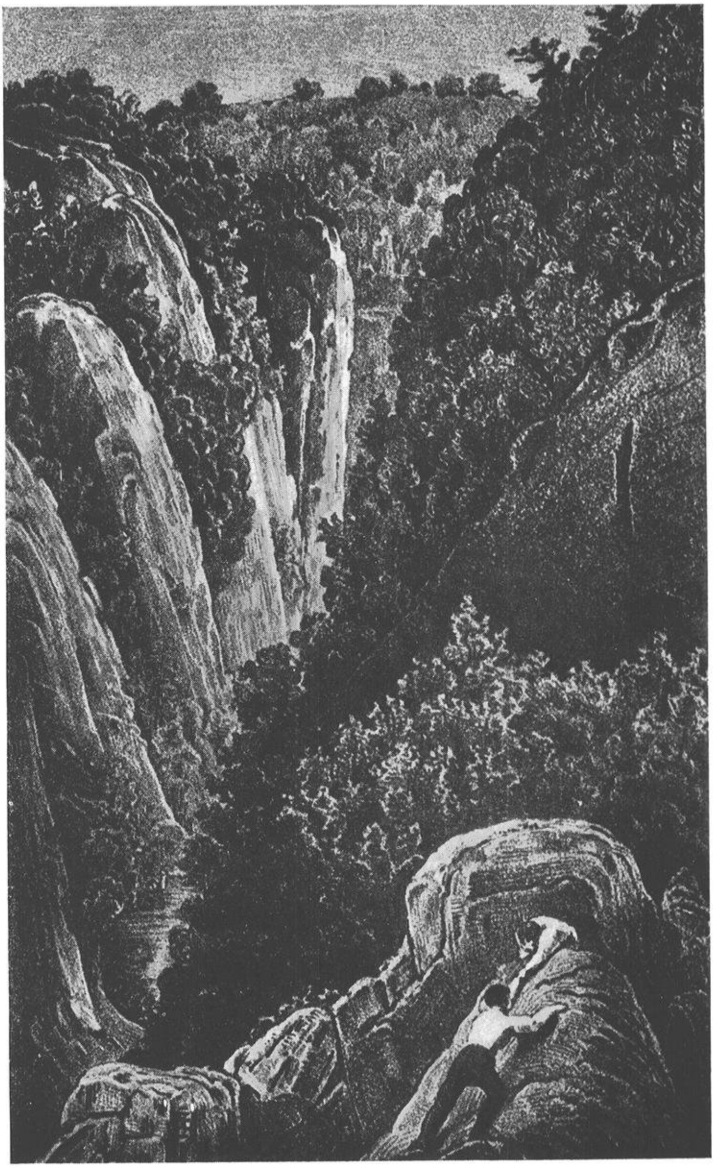
recognizing its importance they threw it out with the earth; but the owner of the quarry on being told of the find urged the workmen to collect the fragments of the skeleton. Fourteen pieces were gathered and these were given soon after into the hands of Doctor Fuhlrott, of Elberfeld.

They comprised the skullcap, the femora, humeri, ulnae, right radius, a portion of the left pelvic bone, part of the right scapula, a piece of the right clavicle, and five pieces of ribs.

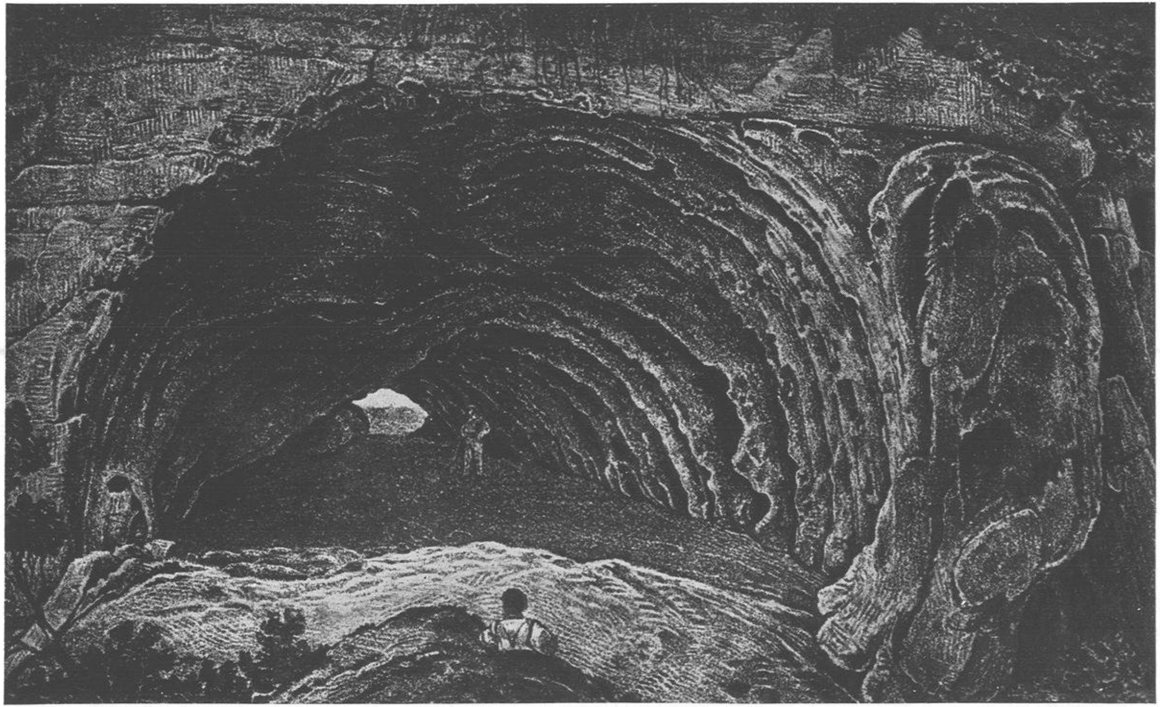
At the general meeting of the Natural History Society of the Prussian Rhineland and Westphalia, at Bonn, on June 2, 1857, Doctor Fuhlrott gave a full account of the locality of the find and of the circumstances under which the discovery was made. The principal details of his report were as follows:

> A small cave or grotto, high enough to admit a man and about 15 feet deep from the entrance, which is 7 or 8 feet wide, exists in the southern wall of the gorge of the Neanderthal, as it is termed, at a distance of about 100 feet from the Düssel and about 60 feet above the bottom of the valley. In its earlier and uninjured condition this cavern opened upon a narrow plateau lying in front of it and from which the rocky wall descended almost perpendicularly to the river. It could be reached, though with difficulty, from above. The uneven floor was covered to a thickness of 4 or 5 feet with a deposit of mud, sparingly intermixed with rounded fragments of chert. In moving this deposit the bones were discovered. The skull was first noticed, placed nearest to the entrance of the cavern; and further in were the other bones lying in the same horizontal plane. Of this I was assured in the most positive terms by the two laborers who were employed to clear out the grotto and who were questioned by me on the spot. At first no idea was entertained of the bones being human; and it was not till several weeks after their discovery that they were recognized as such by me and placed in security. But, as the importance of the discovery was not at the time perceived, the laborers were very careless in the collecting and secured chiefly only the larger bones; and to this circumstance it may be attributed that fragments merely of the probably perfect skeleton came into my possession.

Soon afterwards, in 1860, Sir Charles Lyell, the celebrated English geologist and paleontologist, visited the



The Gorge of Neanderthal as it was about 1840, before the rocks were blasted away. From an old woodcut



The Neanderthal cave as it still existed about 1840. From an old woodcut locality, in company with Doctor Fuhlrott, and made a sketch thereof.

Following the early notices concerning the Neanderthal cranium and before other specimens of similar nature, such as those of Spy and Gibraltar, became known, an extensive controversy arose as to the real significance of the find. Virchow, and after him others, were at first inclined to look upon the skull as pathological; to Barnard Davis its sutures appeared to show premature synostosis; while Blake and his followers regarded the specimen as probably proceeding from an idiot. But there were also those, such as Schaaffhausen, Broca, and others, who from the beginning saw in the cranium (the other bones received at first but little attention) not a pathological or accidental monstrosity, but a peculiar, theretofore unknown type of ancient humanity. From time to time new examples of this same early type appeared in different parts of Europe, under circumstances which steadily strengthened the claim of the whole class to geological antiquity. Finally, after a thorough comparative study of the Neanderthal remains had been carried out by modern methods and in the light of new knowledge, the cranium and bones were definitely recognized as representing in a normal and characteristic way a most interesting earlier phase or variety of mankind, our Mid-Quaternary predecessor or close relative, *Homo neanderthalensis*. The credit for deserving work in this field is due especially to Prof. G. Schwalbe, of Strassburg, whose numerous publications on the early forms of human remains in Europe are well known to every anthropologist.

The remains of the Neanderthal skeleton are preserved in the Provincial Museum at Bonn, where, through the courtesy of the director, Prof. Hans Lehner, Doctor Hrdlička was enabled to examine the originals and later have them photographed. For the explanation of the terms used in the description of this and other skulls, the reader is referred to the diagram of the human skull (Fig. 17).

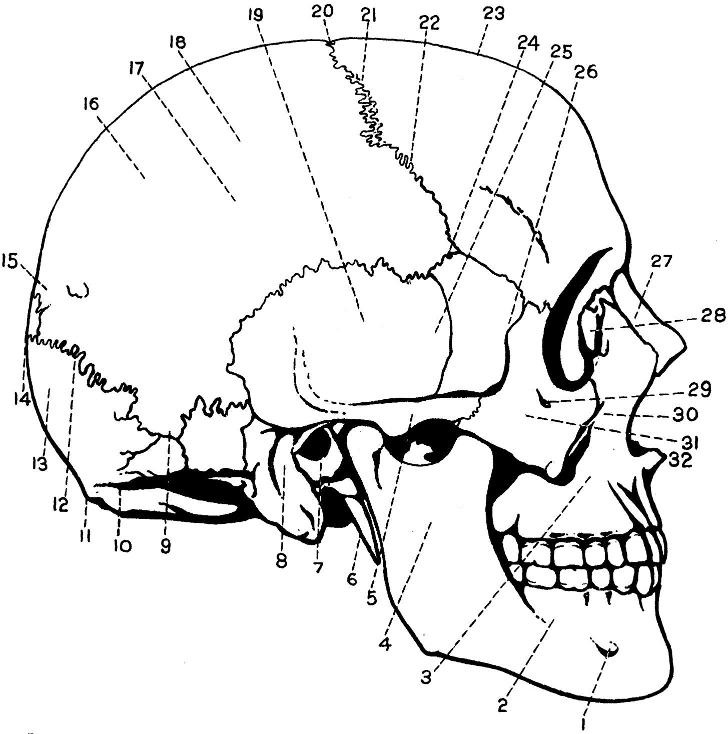
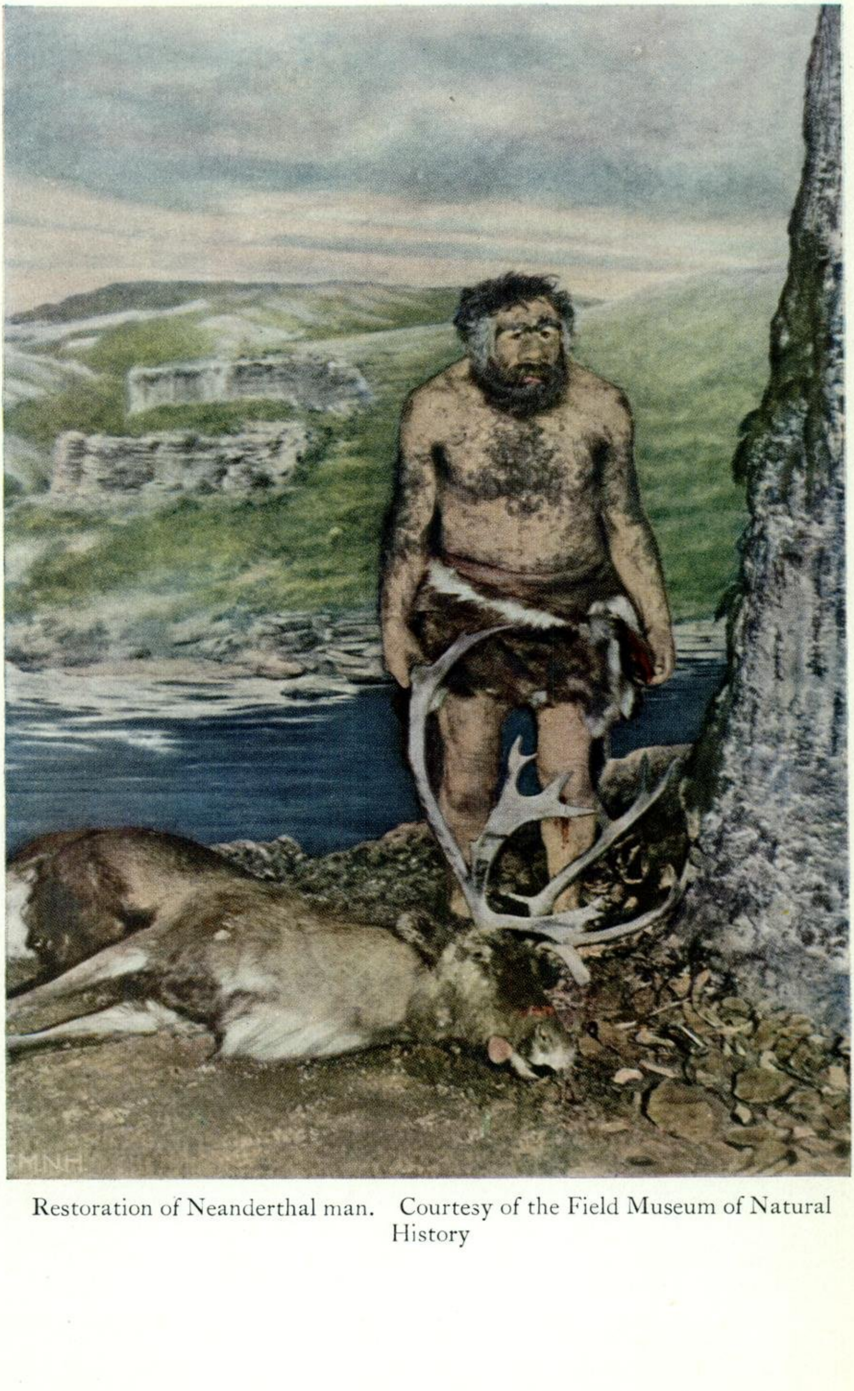


FIG. 17. Diagram of skull showing principal characters referred to in the text

1. Mental foramen
2. Body of lower jaw
3. Superior maxilla
4. Ramus of lower jaw
5. Zygomatic arch
6. Styloid process
7. External auditory meatus
8. Mastoid process
9. Asterion
10. Superior curved line of occipital bone
11. External occipital protuberance
12. Lambdoid suture
13. Occipital bone
14. Lambda
15. Obelion placed between the two parietal foramina
16. Parietal bone
17. Lower temporal ridge
18. Upper temporal ridge
19. Squamous part of temporal bone
20. Bregma
21. Coronal suture
22. Stephanion
23. Frontal bone
24. Pterion
25. Temporal fossa
26. Great wing of sphenoid
27. Nasal bone
28. Lachrymal bone
29. Malar canal
30. Infraorbital canal
31. Malar bone
32. Anterior nasal aperture

PLATE 28



Restoration of Neanderthal man. Courtesy of the Field Museum of Natural History

The skull (Plate 29) is gray in color, with large mud-brownish or gray-sepia patches, on the outside, and whitish gray to whitish brown on the inside. It is decidedly heavy and much mineralized. It is plainly non-pathological. The sagittal suture has evidently closed earlier than it ordinarily does in civilized modern man, but this must have taken place after the brain ceased to influence the cranial vault, for it resulted in no perceptible deformation. The coronal suture is obliterated up to the temporal ridges, while the lambdoid is still patent. Similar conditions to these are sometimes met with in the skulls of persons beyond the fiftieth year of life, and if not attended by scaphocephaly or other consequent deformation can not be regarded as abnormal. The serration of the lambdoid suture is decidedly simpler than in modern human skulls.

The facial and basal parts are lacking. The vault shows very good dimensions in length and breadth, but is strikingly low, and the bones are considerably thicker than in the white man of today, so that the brain cavity was only moderate.

Besides its lowness the vault is characterized by a very decided protrusion of the whole supraorbital region. The supraorbital torus, or arch, formed through this protrusion is heavier than in any other known example of *Homo neanderthalensis*. The line from the glabella to the naso-frontal articulation is relatively extensive and passes considerably backward and downward, indicating a very marked depression at the root of the nose, not unlike that which is present in the adult gorilla. Likewise owing to the forward extension of the supraorbital arch, the upper parts of the planes of the orbits face very perceptibly downward, while in modern man they face somewhat upward or approach the vertical.

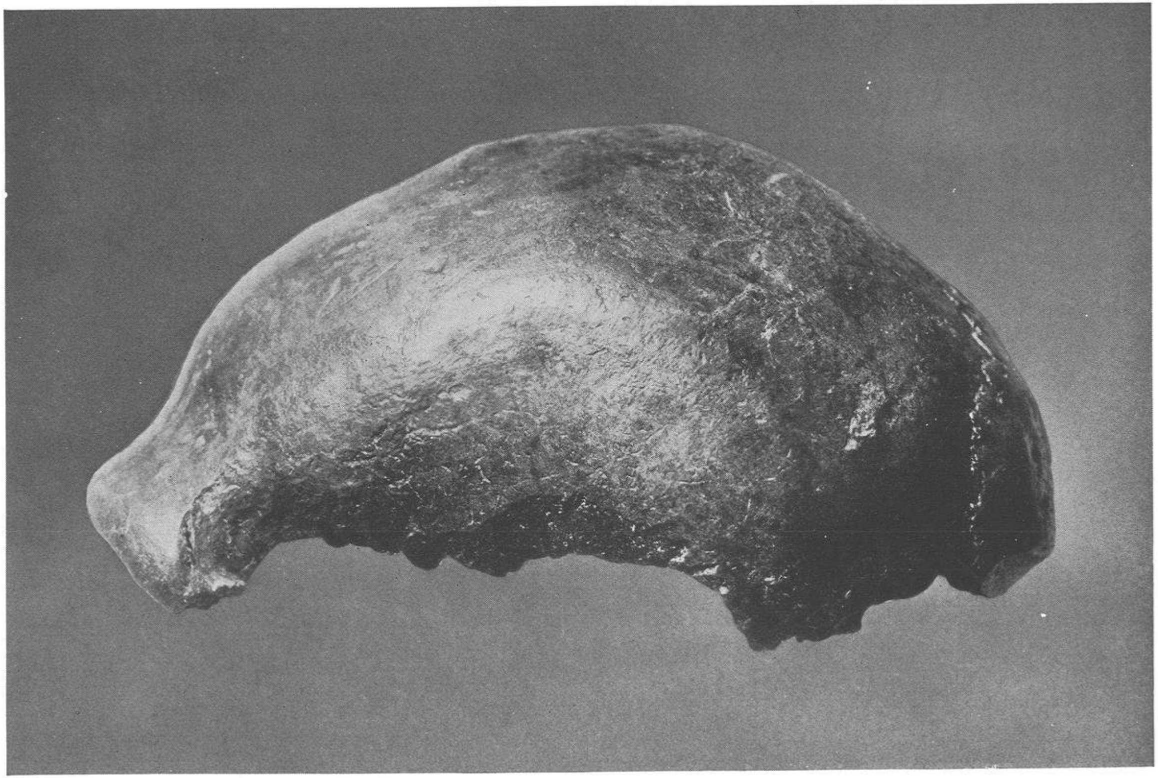
The forehead is low and slopes markedly backward; nevertheless it presents a moderately well-defined convexity. The sagittal region is oval from side to side, much like that in man of today; the occiput, however, is marked by a relatively high situation of the crest and other peculiarities. The outline of the vault, as looked at from above, is a long ovoid. The thickness of the frontal bone at the eminences is 8.5 mm.; of the left parietal, along a line 1 cm. above the squamous suture, 6 to 8 mm. These measurements are about one-third greater than those of the skull of an average modern European.

The lowness of the skull vault is very marked. In modern crania the vault is almost invariably much higher. Neanderthal skull measurements gave a height, according to Schwalbe, of 8.05 cm. with "calotte-index" of 40.4. In contrast thereto, 107 recent adult human skulls, of various derivation, gave heights of from 8.40 to 11.70 cm. and indices from 52 to 68. The cephalic index is 78.5, almost exactly medium between long and short heads of modern times.

The internal capacity of the skull has been estimated by Schaaffhausen at 1,033 c.c., by Huxley at 1,230 c.c., and by Schwalbe at 1,234 c.c.

The brain which filled the skull was lower and narrower and slightly more pointed than the human brain of today, approaching in these features more nearly the anthropoid form. The right frontal lobe was slightly larger and longer than the left, and the whole right hemisphere was slightly longer than that of the opposite side. In modern man it is generally the left hemisphere which is the longer, but this exception in the Neanderthal man is not necessarily of any special significance.

The long bones and others of the skeleton, so far as preserved, show many features of anthropological inferiority, demonstrating plainly that not merely the skull, but the whole body of Neanderthal man occupied a somewhat lower evolutionary stage than that of any normal human being of historic times. Yet there is much, also, that connects the type closely with later and present-day man.



Side view of the Neanderthal cranium found in 1856

The Gibraltar skull belonging to a woman of the Neanderthal race, found in the Forbes Quarry in 1848.
Photograph from the Royal College of Surgeons, London

The bones of the arm, the pelvis, and the femur, or long bone of the leg, differ markedly from those of the average present-day man. Certain distinctive features of the femur, indeed, could not be duplicated today collectively; in some instances, not even individually. Thus, among other differences: The head is larger and more globular than in modern man; the neck is stout and rather short, and the angle it forms with the shaft is less oblique than in most recent femora; the connecting bridge of bone between the great trochanter and the neck is stouter than in most recent bones; and the trochanteric fossa is larger than in modern man. These are but a few of the many differences too technical for this discussion.

Some of these may be observed in Figure 10, in which the Neanderthaloid femur is compared with those of a modern Frenchman and of a gorilla.

The bones of the Neanderthal skeleton in general indicate a powerful musculature and a broad and strong chest, combined with a somewhat submedium stature.

As years have gone by since the discovery of the skeleton at Neanderthal, many other remains of similar men, with retreating chins, low, beetling brows, and powerful frames, have been found in various parts of Europe and Asia. Almost a score of important recoveries of this nature have already (1929) come to light. The principal ones found thus far are dealt with by Hrdlička in the order which follows.

The Gibraltar Skull

The celebrated Gibraltar skull was discovered as early as 1848, therefore eight years before the Neanderthal cranium made its appearance, in the Forbes Quarry situated on the north front of the Rock of Gibraltar. It was dug out of a terrace on the north face of the rock from a formation of solidified breccia consisting of weathering of the limestone cliff and fine wind-blown sand.

The part of the terrace where the cranium lay was possibly in former times the floor of a cave. A section of a cave still exists behind the site of the discovery and was explored in 1911 by Duckworth, but without results. It is certain that the skull showed, and to some extent presents to this day, a hard stony matrix adhering to its surface and filling its cavities. Broca, to whom we owe the first descriptive account of the specimen, says that it was taken out from a "very compact and adherent gangue" from which it was disengaged with much difficulty. The photographs published with Broca's account show very noticeable remnants of the stony matrix.

The skull was presented to the Gibraltar Scientific Society by the then secretary, Lieutenant Flint, but for many years received no scientific attention. In 1862 it came to England, with the collections from the Gibraltar caves, and was studied to some extent by Busk and Falconer. The latter, perceiving how much it differed from recent human skulls, proposed to refer it to a distinct variety of man, the *Homo calpicus*, after Calpe, the Roman name of Gibraltar. Finally, in 1868, Busk presented the cranium to the Museum of the British Royal College of Surgeons, where it is still preserved.

The first descriptive account of the specimen was published, as mentioned above, by Broca, but the adhering stony matrix prevented at that time any attempt at accurate measurement. Subsequently it received attention from Huxley, de Quatrefages, and Hamy, and later from Macnamara, Klaatsch, Schwalbe, Sollas, Sera, and Keith, as well as Hrdlička. It is a very remarkable specimen, which, even though the geological and paleontological evidence relating to its antiquity is imperfect, does not allow for one moment any doubt as to its representing an early form of human being; and its characteristics are such that it is now universally regarded as a representative, possibly a very early one, of *Homo neanderthalensis*.

The cranium is gray-whitish to yellowish in color. It is considerably mineralized and heavier than normal. The stony matrix has been so far removed that such important determinations and measurements as the defective state of the bones permit may now be made. Fortunately the facial region, the frontal bone, and most of the right side of the skull, including the back, are relatively well preserved; the top of the vault, on the other hand, shows a large defect, and the left parietal, temporal, and sphenoid parts, together with much of the base, are lost. With all these defects, a sufficient number of parts remain to permit of valuable determinations on the skull and inferences as to the brain, and also a fairly correct reconstruction.

The aspect of the face is semihuman, apish. The midportion, from the glabella downward, protrudes more than in normal skulls, as a result of which the planes of the orbits, as well as the planes of the malars, slope more outward and backward than they do in modern crania. Other very striking features of the face are: The relatively (for a female) huge supraorbital arch; the very large orbits; the stoutness of the medial process of the frontal bone; the complete absence of the supraorbital (canine) fossae; the broad nose; and the dental arch with long teeth. The supraorbital arch does not greatly protrude as it does in the male Neanderthal skulls; nevertheless it represents a true and rather huge torus, such as is wholly unknown in recent crania. A remarkable feature which gives the face its characteristic appearance is the fullness, to mild convexity, of the suborbital (canine) fossae and of the nasal processes of the maxilla. All these parts look as if inflated from behind.

The teeth, though considerably worn off, appear very long. A very interesting condition is the absence of the two median incisors. As there is no sign of decay, and as the alveolar process shows a characteristic absorption notch at this place, it would seem that the two teeth must have been lost long before the death of the individual, and that presumably through some violence. The whole recalls forcibly the ceremonial knocking out of these incisors (and sometimes also other teeth) in the Negro, Australian, and other primitive peoples.

Another facial peculiarity of the skull is its low and sloping forehead, the ensemble presenting a picture of phylogenetic inferiority which, taking into consideration that this is unquestionably the skull of a female, is not quite equaled by any other specimens of Neanderthal origin thus far discovered, though it is true that the facial features are preserved in only a few of the specimens belonging to this great period.

The vault of the skull is especially noteworthy on account of its lowness and a peculiar formation of the occiput that gives the impression of breadth with submedium height. Much the same characteristic is found also in other Neanderthal skulls.

Endocranially, the skull shows a number of interesting features. There is throughout a marked paucity of impressions of brain convolutions and also of those of the blood vessels. Even the sinuses have left but shallow grooves. The brain itself was not particularly small for a female skull; and it was of an already rather advanced human type.

There are other details and dimensions about the specimen which are of more or less interest to the anthropologist, but which need not be dealt with in this account. It will suffice to say that both the visual and the instrumental examination of the specimen lead to the conclusion that the Gibraltar skull represents highly valuable remains of an early human being and that its principal characteristics justify its classification with *Homo neanderthalensis*.

The cephalic index is approximately 77 as measured by Hrdlička, 80 according to Sollas; the cranial capacity 1,200 c.c. according to the estimate of Keith, 1,250 to 1,260 c.c. according to Sollas.

A view of Rock-Gun, Gibraltar, with the Devil's Tower cave marked by a black cross. After Miss Garrod

PLATE 32

Restoration of a Neanderthal boy. Courtesy of the Field Museum of Natural History

NEANDERTHAL MAN

Later Work at Gibraltar

In 1910 and again in 1911, W. L. H. Duckworth, of Cambridge University, visited Gibraltar for the purpose of obtaining, if possible, additional information about the old skulls and of making further exploration.

He found that the Forbes Quarry still existed, though, having been worked at intervals since 1848, its boundaries were now larger. The quarry, as originally noted, is under the north front of the Rock of Gibraltar. The rock at this point still contains a remnant of a cave, which is not more than about thirty feet above sea level and "is probably the result of marine erosion at a remote epoch; and at a remote epoch also, the mouth of this cave must have been closed, until it was reopened by the quarrymen." It was in all probability in this cave that the skull was discovered. A partial exploration of the cave and the neighboring talus was barren of results so far as remains of man were concerned.

A second cave in the rock explored by Doctor Duckworth gave remains of the Neolithic Period. Another cavern (Sewell's Cave) yielded, with others, some Mousterian, Aurignacian, Solutrean, and even Magdalenian stone implements.

In 1917, parts of the Rock of Gibraltar and its neighborhood were investigated by the Abbé Breuil. During this work the Abbé discovered near the "Devil's Tower" a rough rock-shelter which gave indications of Paleolithic man. This site, in 1926, was explored in detail by Dr. Dorothy A. E. Garrod; and it was here that in June, 1926, Miss Garrod found, inclosed in rock, the skull of a child, proceeding evidently from the Mousterian period.

The specimen was found in some Mousterian deposits fronting a small cave opposite the ruin of Devil's Tower, in the eastern face of the north front of the Rock, not very far from the Forbes Quarry, in which in 1848 was discovered the adult Neanderthaloid skull of Gibraltar.

The details of the find are given by Miss Garrod; the main points are as follows:

> The Mousterian site at Devil's Tower was discovered in 1917 by the Abbé Breuil, then acting as diplomatic courier between Gibraltar and the French Naval Bureau at Madrid. In the course of a visit to the North Front of the Rock he noticed fragments of fossil bone in the talus of a small cave or rock-shelter at the foot of the immense vertical peak of Rock-Gun, immediately opposite a ruin known as the Devil's Tower. M. Breuil was unable to follow up this discovery at the time, but in 1919 he returned to Gibraltar and with the help of the late Colonel Willoughby Verner dug a trial trench a little way down the talus of the shelter, unearthing a number of animal bones and four stone implements of definite Mousterian type. My own work on the shelter, undertaken at M. Breuil's suggestion, occupied seven months, between November, 1925, and January, 1927, and was carried out by means of a grant from the Percy Sladen Memorial Fund.
>
> The Devil's Tower cave is a narrow fissure running obliquely into the Rock of Gibraltar at the eastern end of the North Front, 350 m. from Forbes Quarry. It has a maximum height of 12 m. and a maximum width of 1.20 m., and 4 m. from the entrance it narrows to a mere crack. The rocky floor at the cave mouth lies 9 m. above sea level, and 5 m. above the average level.
>
> The work carried out consisted in emptying the cave down to the rock floor and removing the talus or terrace deposits over an area extending from the rock wall which bounded them on the west to a line 4.50 m. to the east of the cave mouth. Seven layers of deposit were revealed in this way, the succession from above downwards being as follows:
>
> 1. Fine sand, filling the fissure to the roof.
> 2. Calcareous tufa, 1–4 m.
> 3. Fine sand, 20 cm.—1 m.
> 4. Travertine, 10–80 cm.
> 5. Fine sand, 40 cm.—1.40 m.
> 6. Travertine, 50–75 cm.
> 7. Raised beach, with its surface at 8.50–9 m. above sea level.
>
> Layers 1–5 contained archeological material, the industry from top to bottom being Mousterian.

The total number of implements and flakes recovered was small—less than 500—the majority in quartzite, the rest in flint, chert, and jasper. There were also two fragments of bone compressors. The industry of layers 1 and 2, and the implements found in the "wash" have a well-marked Upper Mousterian character.

The fauna found by Miss Garrod was much the same at all levels and represented about twenty-five species, many of them now extinct. They include the wolf, bear, hyena, lynx, deer, horse, and elephant, and indicate a cold-temperate climate as then prevailing in southern Spain.

In June, 1926, after firing a heavy blast of explosive gelatin in the hard rock, Miss Garrod uncovered with difficulty part of a human skull embedded in layer 4 and filled in with travertine. It had been cracked by the blast into several fragments. In October, other parts of the skull were found in layer 4, about eighteen feet distant and nearer the mouth of the cave.

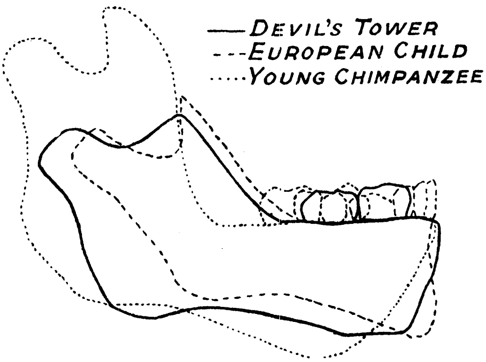


FIG. 18. Lower jaw of the Neanderthal child from the Devil's Tower, Gibraltar, compared with those of a modern European child and a young chimpanzee. After Buxton

Miss Garrod remarks:

It seems clear from the position of the bones that the skull originally lay in the mouth of the cave, but as it belonged to a very young individual it fell apart along the sutures, and the frontal and left parietal, together with those parts which are missing, were washed forward on to the terrace by the waters of the spring which converted the original sandy layer into travertine. The missing parts were probably carried further forward than the others, and so rolled down the slope and were lost.

It is probable that the skull was already separated from the body when it lay in the cave, for if the whole skeleton had been present, some at least, of the bones must have been found. On the other hand, the fact that the lower jaw (Fig. 18) lay quite close to the temporal and maxilla suggests either that decomposition was not complete at the time of deposition or that the jaw was fastened to the skull by a thong or string. In either case it seems impossible to avoid the conclusion that the skull was intentionally preserved, either as a trophy or in fulfilment of a pious rite.

The human skull is described most carefully and with much detail by Professor Buxton. The main results of his study are:

The Devil's Tower bones are the remains of a single individual skull belonging to a child of five years old, probably of the male sex. . . . The form of the face and jaws is essentially that which we associate with Neanderthal man. Many of these features can be shown, however, to owe their characteristic appearance partly to the great size of the teeth and partly to functional activities, but the general massiveness, not only of the jaws but also of such features as the tympanic plate, is remarkable.

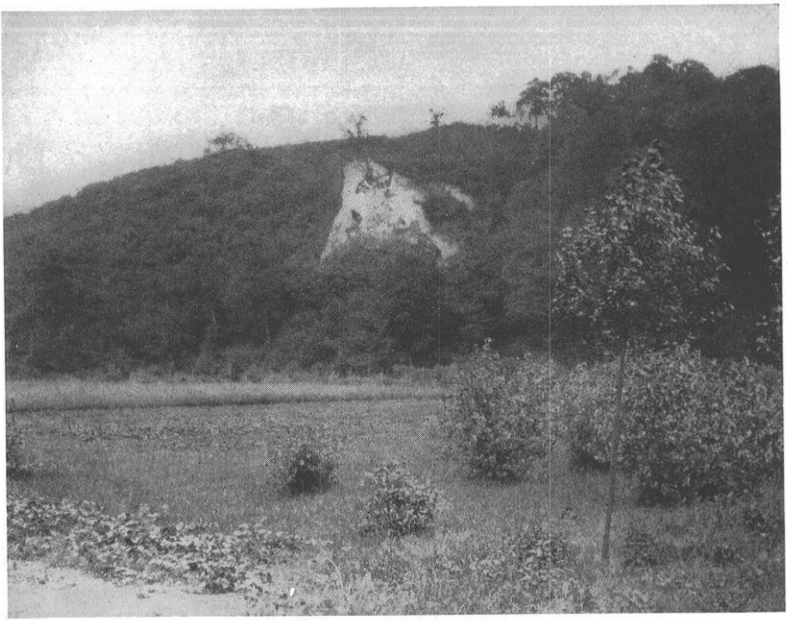
. . . The dimensions and form of the brain-case, especially the expansion of the frontal area, are beyond the range of Neanderthal man, as hitherto discovered, if we make the same allowance for age that we should do in the case of a modern child. These conditions suggest a brain-case built more after the fashion of modern than of Neanderthal man. . . . The teeth of our specimen closely resemble in size and shape those usually associated with Neanderthal man. The face and jaws must therefore necessarily be close to the typical Neanderthal form. The brain-case is, however, different from the type form, because the underlying structure, the brain, was larger.

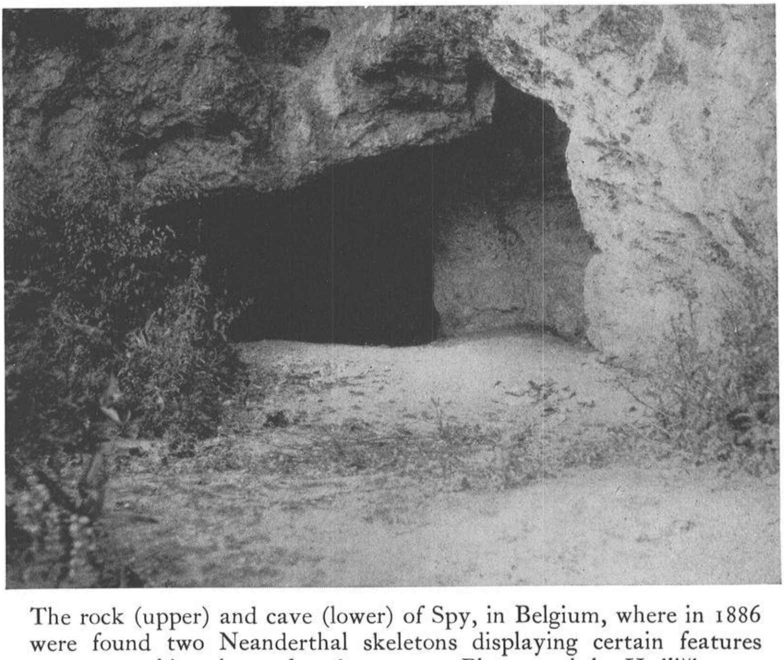
The Spy Skeletons

In the province of Namur, in Belgium, there is a steep wooded mountainside in the district of Spy, which is skirted by the little river Orneau. A great rock standing sentinel-like has at its base, sixty feet above the stream, a cave now called the cave of Spy, which opens toward the south. Several times during the last century the accumulations within the cave were searched by antiquarians and yielded worked flints and bones dating from Late Stone Age cultures.

In 1885 MM. Marcel de Puydt and Maximin Lohest, archeologist and geologist, respectively, examined the region of the cave more systematically. A terrace at its

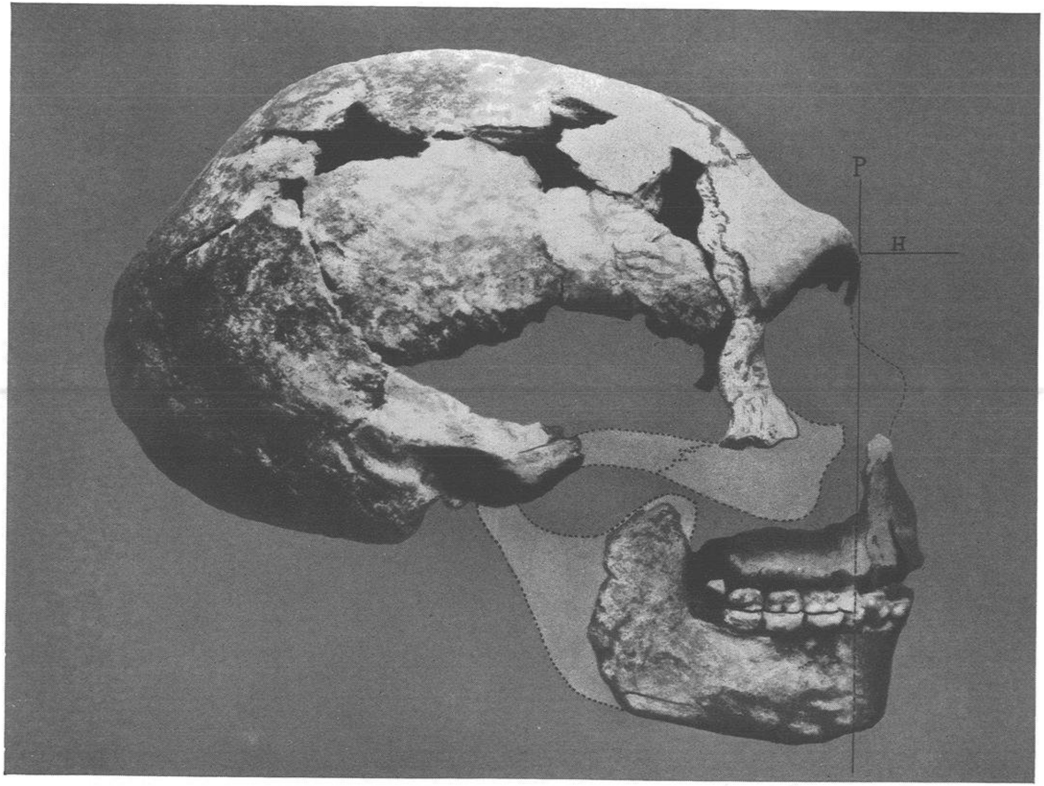
PLATE 33





The rock (upper) and cave (lower) of Spy, in Belgium, where in 1886 were found two Neanderthal skeletons displaying certain features approaching those of modern man. Photograph by Hrdlička

PLATE 34



Spy skull No. 1, side view. The jaws and teeth are nearer the modern type than is usual in the Neanderthal race. After Fraipont front showed no signs of having been disturbed, and here they concentrated their efforts. Sinking a trench in a thick layer of brown earth mixed with numerous fragments of limestone, they came at a depth of four feet to a layer some twelve to sixteen inches thick containing fragments of bones and flints, débris of pottery, and several thousand implements of wood and stone, ornaments, and the like. The stone implements, of rather high-class workmanship, seemed of the Mousterian cultural type.

Returning to their excavations in 1886, de Puydt and Lohest found in June two human skeletons, besides large quantities of bones of animals and flints and other artifacts of the Mousterian type. Professor Fraipont, of the University of Liège, joined in the examination of the discovery and in its announcement in *Bulletins* of the Royal Academy of Belgium. According to this announcement the human bones were found at a depth of thirteen feet below the surface, which here rose considerably higher than the floor of the cave. There was no evidence of previous disturbance of the superincumbent layers. The accumulation contained fallen rocks, earth, many traces of man's early occupation, and numerous remains of fossil animals.

The skeletons, called Spy No. 1 and Spy No. 2, lay, respectively, twenty-eight and twenty feet to the south of the cave entrance. They were inclosed by an undisturbed layer of argillaceous tufa, from which they were removed only with great difficulty and some damage.

More in detail, a section of the deposits showed them to consist of:

A. Brown earth and fallen rocks; thickness approximately 2.90 m. (over 9 ft.). No paleontological or human remains.

B. Yellow argillaceous tufa, inclosing limestone blocks, 0.80 m. (2½ ft.) in thickness. This layer could be broken only with difficulty by the pick. It gave some bones of the mammoth and deer, and also some worked flints.

C. A stratum 15 cm. (6 in.) thick, strongly colored red and containing many flint implements, rejects of stone industry, angular fragments of limestone, bits of charcoal, and débris of mammoth tusks. This layer formed a hard crust resistant to the hammer and covered the human skeletons.

The animal remains found in the hard layer C that overlay the two human skeletons were:

Woolly rhinoceros	Mammoth
Horse	Hare
Wild boar	Cave bear
Stag	Badger
Wapiti (?)	Marten (Weasel?)
Giant deer	Fox
Reindeer	Wolf (Dog)
Sheep	Cave hyena
Wild bull	Cave lion
Extinct bison	Wild cat

D. Yellow calcareous clay and rubbish, passing to a tufa of the same nature as that in layer B. Thickness 15 cm. (6 in.), uneven. At base a streak of charcoal.

E. The human skeletons and the worked flints.

F. Brown clay, in places black, inclosing angular pebbles of limestone, numerous animal bones, and worked flints.

The animal remains encountered at the level of the skeletons, or lower than these, comprised the following:

Woolly rhinoceros (abundant)	Wild bull (rather abundant)
Horse (very abundant)	Mammoth (common)
Stag (rare)	Cave bear (rare)
Reindeer (very rare)	Badger (rare)

Cave hyena (abundant)

There were, therefore, distinguishable, aside from the surface material, three distinct fossil-bearing layers, namely:

B. This contained bones of the mammoth and deer; also some Mousterianlike flint implements of refined and rather peculiar type.

C. This stratum, with the underlying few inches of earth, covered the human skeletons. Contents: Bones of many Quaternary animals; abundance of flint blades, Mousterian points, and other flint implements, in general of less refined make than those of layer B; also implements of bone and ivory. Among the bones were needles, awls, beads, and pendants, and a number of bones were decorated with linear designs. Some of the bone pendants evidently had once been colored red.

D-F. The stratum of the two human skeletons. This gave also some bones of Quaternary animals, and some stone implements of Mousterian type but inferior in workmanship to those from the layers above.

The human remains, the authors thought, were not burials but incidental inclusions. As the middle, hardened stratum was found undisturbed, the skeletons could not have been more recent than this stratum.

Considering the animal and archeological remains associated with the human skeletons, together with the absence of disturbance in the superimposed and more recent layers, Lohest believed himself justified in referring Spy remains to the Mousterian period. The deductions of Fraipont, based on the study of the skeletal remains themselves, were that they belonged to Neanderthal man. Since then the Spy remains have received more or less careful consideration by every student of early man, and the above classification was found to need no radical revision.

What remained of the Spy skeletons was preserved, up to the German invasion in 1914, in the collections of the University of Liège, where thanks to the courtesy of MM. M. Lohest, Charles Fraipont, and J. Servais, Doctor Hrdlička was enabled to examine the originals for the first time (1912). During the invasion, the remains, the property of M. Lohest, were secreted by the latter in his home, at the bottom of an old chest, and, though searched for, remained safe. Here, in the presence of the regretted owner, Hrdlička studied the remains the second time (1923); and finally in 1927, thanks to the courtesy of the sons of Lohest, he was enabled to examine the originals, still in their house, for the third time. At the time of his second visit, in 1923, Prof. A. Rutot and his assistant made it possible for him also to visit the cave.

The skeletons are currently known as No. 1 and No. 2. To No. 1 (Plate 34) Fraipont and Lohest attributed:

- The vault of a skull
- Two portions of an upper jaw, with the three right molars, the two right premolars, the left canine and left lateral incisors
- A nearly complete lower jaw, with all (16) teeth
- The left clavicle
- The right humerus, which has lost its upper epiphysis, and the shaft of the left humerus
- The left radius, without the lower epiphysis
- The proximal extremities of the two ulnae
- The nearly entire right femur
- The complete left tibia
- The right calcaneum

The parts attributed by the two authors to the second subject are:

- The vault of a skull
- Two portions of the upper jaw with twelve teeth
- Two fragments of the lower jaw with the molar teeth
- Loose teeth belonging to the lower jaw
- Fragments of the scapulae of two humeri without upper extremities
- The shaft of the right radius
- The proximal two-thirds of the left femur
- The left calcaneum
- The left astragalus

Besides these parts, there are seven vertebrae, a right patella, twenty-four fragments of ribs, and eleven bones of hands and feet, with some pieces of which it was impossible to say to which skeleton they belonged.

Repeated critical examination of the specimens left a serious doubt in Doctor Hrdlička's mind as to the accuracy of the above distribution. No photographs or sketches were made on the spot; the bones were not marked and have evidently become mixed up, their distribution being decided upon later. The specimens indicate very strongly different relations. The right femur, the tibia, and the two stronger ulnae do not harmonize with the relatively weak arm bones and clavicle of No. 1. They harmonize perfectly, on the other hand, with the bones of the male skeleton No. 2 and must, Hrdlička feels, be attributed to this skeleton. The true identification of the parts appears to him as follows:

	Skeleton I	Skeleton II
SEX	Weak male or female	Male
AGE	About 35 years	About 23 years
PARTS	Smaller skullcap	Larger skullcap
	Portion of right maxilla	Two portions of upper jaw
	Lower jaw (complete except for damage to rami)	Two pieces of lower jaw
	Sound loose teeth (probably)	Loose teeth
	The two weaker humeri	The two strong humeri
	Two damaged radii	
	Head of a weak ulna	The proximal parts of two strong ulnae
	Weak clavicle	Parts of the two scapulae
		A nearly complete right and proximal half of the left femur
		Complete left tibia
	Two fragments of fibula (probably)	Lower fifth of right fibula
		Left patella
		Right calcaneum
		Left astragalus
		Portion of sacrum
	Some small bones and fragments	Fragments of small bones

This identification removes many difficulties, making the material much more intelligible and the deductions from it of more value. All the skeletal parts show an advanced state of mineralization. In color they range from brownish to grayish, skull No. 1 representing the

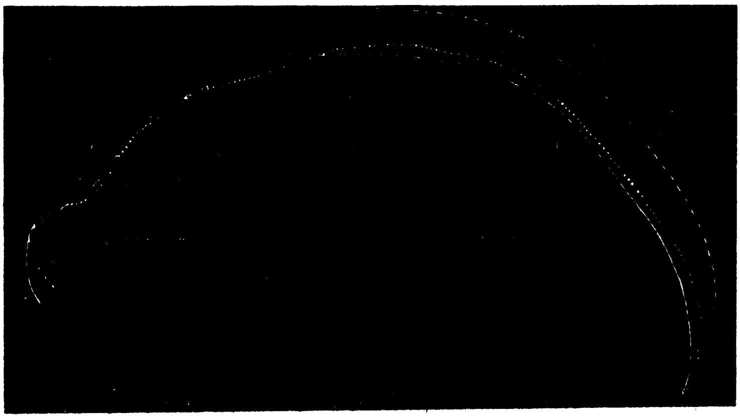


FIG. 19. Profiles of the Neanderthal cranium (unbroken line) and of Spy No. 1 (dotted line) and Spy No. 2 (broken line). Note that although the two Spy skeletons are of the same period, the forehead and vault of No. 2 are much higher than those of No. 1. After Fraipont and Lohest

former and No. 2 the latter shading. The teeth, however, are white, with yellowish roots, much as in crania from late burials.

The two skulls are plainly normal specimens, free from disease or deformation. In age, No. 1 was an adult of about thirty-five years, No. 2 had just reached the adult stage. As to sex, were it not for the heavy supraorbital arch, No. 1 would be identifiable as a female. Such identification would conform with the characteristics of all the bones that may definitely be attributed to this subject, except the skull, and even this is rather feminine except in the lower frontal region.

Morphologically the two skeletons, more particularly the two crania, show features of such interest and importance to anthropology that they deserve all possible attention. The vault of skull No. 1 and the skeletal parts of both individuals are thoroughly Neanderthal in character; but the jaws, teeth, and the vault of skull No. 2 represent nothing less than a bridge from the Neanderthal type of man to the recent.

The Spy find is without question the most important ever made in relation to the problem of transition from the Neanderthal to the more modern forms of man. Here in practically one grave, certainly at the same level and under the same associations, are found two skeletons, one of which in many respects is still typically Neanderthal; but the jaws and the teeth of this skeleton, and the skull of the second subject are far in advance of the Neanderthal stage and correspondingly nearer to modern man. No better demonstration could have been furnished, or could reasonably be wished for, of the transitional potentialities among the later Neanderthal representatives, to which the skeletons evidently belong, toward the modern human type.[1]

In Spy skull No. 1, the characteristic Neanderthaloid features—retreating forehead, heavy brows, large eye sockets, protruding jaws, retreating chin, and pronounced backward elongation of the cranium—are very plain in the profile (Plate 34).

The Diluvial Man of Krapina

One of the most important finds of the skeletal remains of Quaternary man is unquestionably that of the Krapina shelter, near Zagreb, in northern Croatia. The discovery comprises a whole series of human bones of well-determined geological age, and the remains were not recovered

[1] There exists a difference of opinion among anthropologists on the relationship between Neanderthal and modern man. While Doctor Hrdlička is convinced that *Homo sapiens* developed gradually from Neanderthal man, other authorities believe that the Neanderthalers were a distinct species who died out leaving no descendants, while modern man sprang from some other rootstock outside of Europe and eventually spread there to take the place of Neanderthal man.

accidentally or by laborers ignorant of their importance, but through prolonged, painstaking exploration.

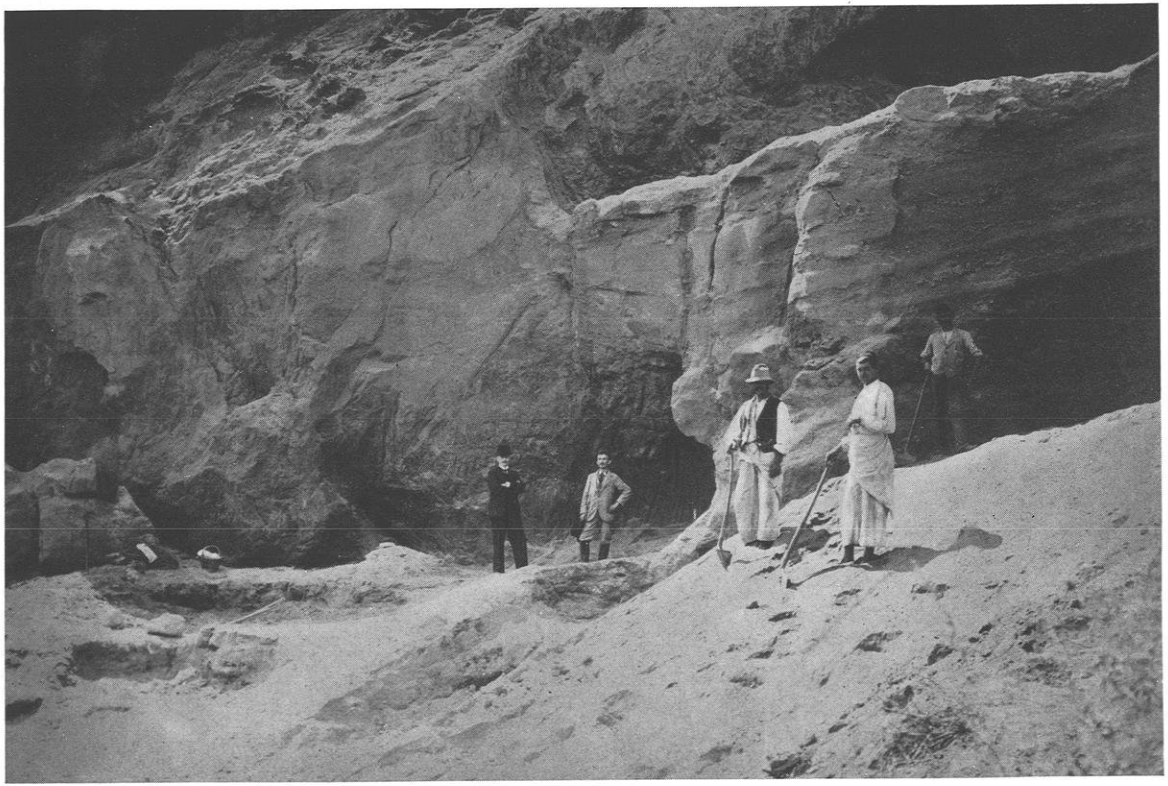
The bones themselves are for the most part fragmentary, which is much to be regretted; but they represent, as now estimated, over twenty individuals, and they show on the one hand such similarity and on the other such variation of structure that they are of great value to the student of ancient humanity.

The Krapina rock-shelter is an ancient, not very deep hollow, worn in the basic sandstone by the Krapinica, now a small stream, and subsequently filled with water-worn stones, some alluvia, and much detritus resulting from the decomposing rock of the hollow. Since the formation of the latter, the Krapinica has cut its channel so that it now flows eighty-two feet, or twenty-five meters, below its floor level.

Before and while the shelter was being filled it was utilized by the early men of the region, at first occasionally, later, for some time perhaps, continuously; and the accumulations in the cave were augmented by the remains of fireplaces and by refuse, including many primitive stone implements and rejects as well as animal bones. These accumulations were found to contain numerous human bones in more or less fragmentary condition.

The locality became known in 1895, after two Croatian teachers discovered in the superficial deposits of the cave some teeth of a rhinoceros and fragments of other fossil bones. These finds were brought to the attention of the scientific men at Zagreb (the capital of Croatia, formerly "Agram"), but no thorough examination of the site was undertaken until 1899. In that year the place was visited by K. Gorjanović-Kramberger, professor of geology and paleontology of the University of Zagreb and Director of the Geological Division of the Narodni Muzej of the same city.

The deposits in the shelter and their stratification were found well exposed. They were over twenty-six feet in



The rock-shelter of Krapina, northern Croatia, where remains of some twenty individuals of the Neanderthal race have been found. After Gorjanović-Kramberger

PLATE 36

Restoration of Neanderthal woman and child. Courtesy of the Field Museum of Natural History thickness from top to base. The initial work showed ashes, charcoal, burnt sand, and rejects of stone industry, stone implements, and a human molar.

The excavations proper, after a determination of nine distinct cultural layers, were begun from the top and carried very carefully downward. They proved from the start very fruitful, giving many bones of Quaternary animals, many rejects of stone industry with some implements, a portion of a human maxilla, eighty loose teeth, and many pieces of skulls, lower jaws, and other parts of skeletons.

From 1900 to 1905 the painstaking exploration of the shelter was carried on, partly by Gorjanović-Kramberger, partly by S. Osterman and D. Galijan, his assistants, until the deposits were exhausted.

Notwithstanding the presence of numerous cultural layers and the evidently long-continued use and occupation of the shelter, the whole represented apparently but one extended cultural period, and this during a fairly warm interglacial time. The fauna is not that of a cold climate. It consists, aside from a few snails, birds, and a turtle, of the following:

Merck's rhinoceros (frequent)	Dormouse
Cave bear (frequent)	Marmot
Wild bull (frequent)	Hamster
Beaver (fairly frequent)	Horse
Wolf	Wild boar
Brown bear	Stag
Wild cat	Roebuck
Marten	Giant deer
Otter	

There were no traces of the mammoth or of the woolly rhinoceros. The remains found represent either completely extinct forms or forms not hitherto known from Croatia or known only from diluvial times. As a whole the fauna resembles closely that of the diluvial station of Taubach, Germany.

The total number of worked stones recovered from the

Krapina shelter amounts to approximately 1,000, but most of these are waste and rejects. They are mainly of flint but occasionally also of quartz, chalcedony, and jasper. The better-characterized specimens are "typically Mousterian" (Obermaier), and this applies to all layers.

The collective human skeletal remains recovered from the Krapina shelter, though very fragmentary, are more numerous than those found in any other locality of similar age. They comprise many parts of the skull, numerous portions of the jaws ranging from fragments to nearly complete mandibles, many teeth, and numerous pieces of other parts of the skeleton.

The bones represent, as already mentioned, the remains of at least twenty individuals of both sexes, ranging from childhood to ripe adult age. The fragmentation of the skulls, lower jaws, and some of the long bones is excessive and of such a nature as strongly to suggest that it was caused otherwise than by accidental breaking or crushing. A number of the fragments show also the effects of burning, and one specimen, a portion of the supraorbital part of a frontal, presents some cuts. These different conditions, together with the absence of many parts of the skulls and bones, the total lack of association of the fragments, and the commingling of the human with the animal bones, led Gorjanović-Kramberger to the opinion, now generally shared, that the remains represent the leavings of occasional cannibalistic feasts and are not burials.

The Krapina bones are whitish, yellowish, or light brownish in color. They are not of great weight, but a chemical examination has shown that they are much altered in constitution, particularly in the fluorine-phosphates proportions.

The long bones and others of the skeleton show the Krapina man to have been, as compared with the central European white man of today, of moderate stature and, except for the powerful jaws, of strong though not excessive muscular development. Some individuals were very perceptibly weaker than others. As to form, particularly in the upper extremities, the bones in general are perceptibly more modern in type than those of the Neanderthal or Spy man; nevertheless they present, as is well shown by Gorjanović-Kramberger, numerous and important primitive features.

The fragments of the skulls show that the bones of the vault were somewhat thicker than they are in the white man of today. The crania were of good size externally, but the brain cavities were probably below the present average. The vault of the skull was of good length and at the same time fairly broad, so that the cephalic index, at least in some of the individuals, was more elevated than usual in the crania of early man. They were also characterized, like the Neanderthal and other crania of the Mousterian epoch, by relative lowness of the vault, and in every instance among the adults by a pronounced, complete supraorbital arch. The last-named feature, though less marked, is plainly distinguishable even in the children. Its invariable presence is a definite proof of the fact, not quite well established before, that this arch was, up to a certain stage of the Quaternary period, a regular characteristic of the early men of a large part of Europe.

The lower jaws in particular are very interesting. The symphysis or fore part of these bones, while in some possessing already a faint trace of the future chin eminence, slopes invariably more or less downward and backward, thus approaching the form of the mandible in apes. The mandibles are massive and in males high. Except in this height, they are akin to the lower jaws of the La Quina and La Chapelle skulls, and represent decidedly more primitive forms than the mandibles of any man of historic times, though they are rather nearer to the modern type than is the jaw of Mauer.

The teeth of the Krapina man offer numerous peculiarities, most of which point to a lower stage of differentiation. They are in general very perceptibly larger than those of the modern white man; their roots, especially, are longer; and there are some details of form, particularly in the crowns of the incisors and molars, which are related to anthropoid features. Notwithstanding the

Krapina skulls, jaws, and teeth those of the skeletons, and then contrast the whole with what is known of the corresponding parts in the western Neanderthalers, it is plain that the Krapina man, while of the same general family, differs sufficiently to be regarded as a subtype, and that, too, a subtype which on the whole was morphologically somewhat more advanced toward later man. This is difficult to harmonize with the supposed greater age of the Krapina remains. Possibly this individual lived later than we have supposed; or he may have belonged to a more progressive group.

CHAPTER VIII

NEANDERTHAL MAN

(Continued)

Remains of Early Man Near Weimar

The little village of Ehringsdorf, in the Ilm valley, three kilometers from Weimar and about the same distance from Taubach, has become quite famous within the last two decades, on the one hand for its quarries, which yield a very pure limestone (travertine), and on the other hand for the highly interesting animal and especially for the human remains that are constantly being found there.

The travertine deposits, of diluvial origin, extend from Weimar to beyond Ehringsdorf. At the latter they are found in a low broad hill on the slope of which is the village. For many years past a portion of the hill overlooking the valley of the river Ilm has been exploited for the limestone, the works being known as Kaempfer's Quarry. Herr Kaempfer was in fact still the owner of the place during Doctor Hrdlička's visits (1921, 1923) and is largely to be credited for the intelligent preservation of the paleontological as well as the human remains from his extensive workings.

By 1914, the exposed rocky wall approximated forty feet in height. It showed gross horizontal stratification. A little below the middle could be seen a belt, about three feet thick, known as the "Pariser," a largely consolidated loess formation; and beneath this in the left part of the quarry were the remains of a flat pocket of more or less consolidated looser material in which stone implements had been discovered with numerous evidences of human occupation.

It was in this layer or pocket, which lay about ten feet below the "Pariser," that workmen began to discover in April, 1914, various fossil animal bones and some worked flints; and it was here that on May 8, 1914, after a blast, there appeared, besides some animal bones, fragments of an adult human lower jaw which had been freed and partly shattered by the blast. Nearby were bones of various Quaternary animals identified later as a Merck's rhinoceros, a cave bear, an ox, a horse, and a deer; also some bones that had been partly burned, some charcoal, and numerous flints showing human work.

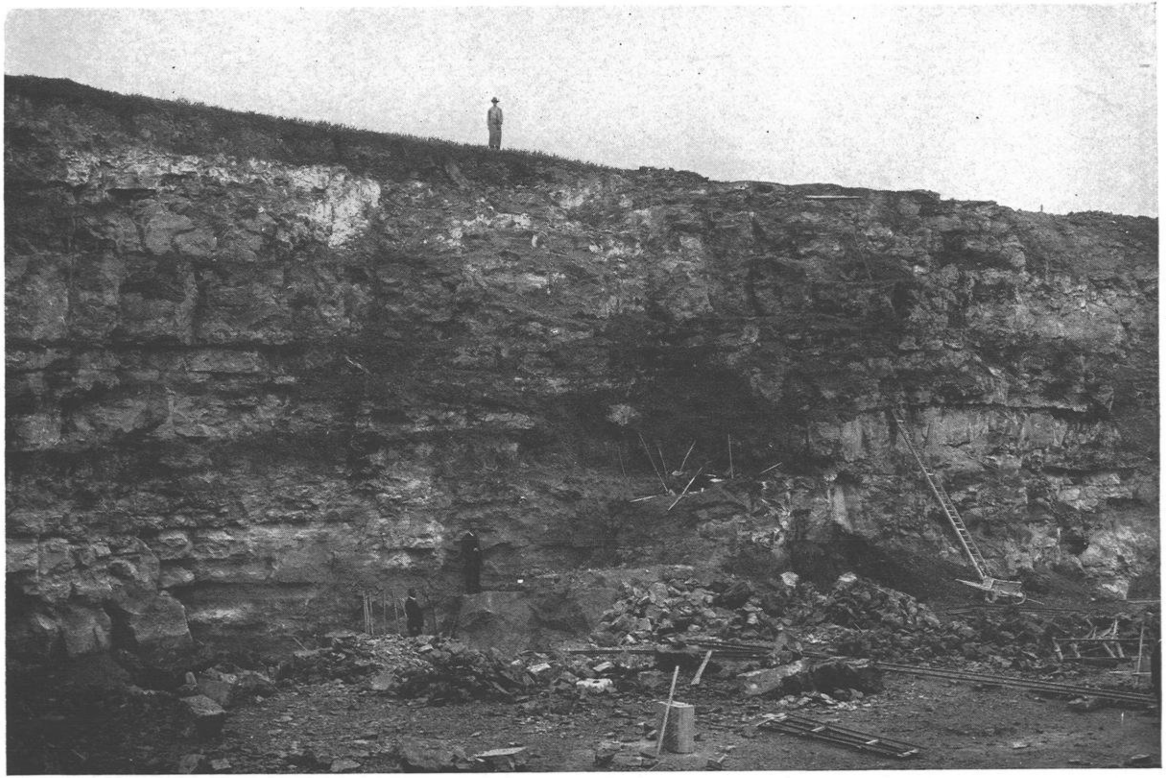
Fortunately the value of the find was promptly recognized, and the pieces of the jaw were most carefully gathered by Herr Haubold, the overseer, with the aid of Herr Lindig, the able curator of the Weimar City Museum. The specimen was then most painstakingly repaired by Herr Lindig and not long after turned over to Gustav Schwalbe for study. Basing his opinion on its form and association, Schwalbe considered the specimen to be a very valuable one and referred it to the earlier period of Neanderthal man.

After Schwalbe's death a more complete study of the jaw was undertaken by Hans Virchow, and its description forms the main part of his masterly memoir on the human skeletal remains of Ehringsdorf. While Virchow was engaged in this study, however, there came to light, on November 2, 1916, under similar circumstances and from about the same horizon but about eighty feet to the right and inclosed in rock, portions of the skeleton of a child about ten years old. The specimen was badly damaged through the blast, but thanks once more to the most careful efforts of the quarrymen and Herr Lindig, all that could possibly be saved was secured and taken to the Weimar Museum. The parts consisted of six right and five left ribs, two vertebrae, the epistropheus, the right pelvic bone, half of the right humerus, part of the lower jaw, and five teeth from the maxilla. The thoracic parts lay in a block of the stone and were found, with the rest of the defective parts of the skeleton, to be of but secondary scientific importance; but the lower jaw with its nine well-preserved teeth was a document of value and as such was submitted also to Hans Virchow and is described with the adult mandible in his memoir.

In addition to the preceding, several other finds of human remains were made in Fischer's Quarry, lying immediately behind Kaempfer's workings. They included a number of fine stone implements and two pieces of a human parietal, and were, like the child's skeleton, inclosed in the solid rock. About 1922, in the right-hand section of Kaempfer's Quarry, a blast in the travertine above its middle revealed, as Doctor Hrdlička was told, a portion of a human femur. Fossil animal bones and worked flints were found on numerous other occasions. Finally, on September 21, 1925, a blast in the lower travertine of Fischer's Quarry, in a block 55 feet (16.7 m.) from the surface, brought to light pieces of a young adult human skull. Of these additional human skeletal remains, the skull, after being most carefully disengaged from the rock and reconstructed, has been thoroughly studied and the results published by Weidenreich.

The origin of the travertine units at and near Weimar has been attributed to precipitation of lime from waters furnished by mineral springs. The formation of the deposits was evidently very gradual, leaving an ample opportunity for human habitation about the pools. As to their dates, German geologists ascribe the lower layers of the travertine to the last (Riss-Würm) interglacial; the upper limestone layers are doubtless more recent.

The 1925 skull specimen presents some of the distinctly Neanderthaloid characteristics, such as a complete and still rather heavy torus and the somewhat protruding broad occiput, flattened from above and hollowed out below, typical of the Neanderthal crania. But with these inferior features there is a higher and well-arched forehead,



Kaempfer's Quarry, Ehringsdorf. To right of man on block near bottom, white spot indicates stratum in which lower jaw was found. Note the great depth below the present surface

a higher vault, a better developed mastoid, a less heavy zygoma, and a parietal with a central rather than posterior though still low-placed eminence.

Doctor Hrdlička's examination of the Ehringsdorf originals, coupled with the study of the most recent skull and implements of which there are able descriptions, led him to the following views:

The originals in Weimar and the many fine illustrations of the artifacts in Schuster's report (1928) show plainly, especially in the knives and scrapers, Mousterian affinities. But the long and the fine points, including the remarkable double-point, the drills, and other objects, suggest further developments. There is certainly nothing very primitive about the culture, though a few of the worked stones are rather crude or simple.

Similarly with the human skeletal remains—they are certainly not more primitive than those of the Neanderthalers. They are on the whole less primitive, in fact, than the Neanderthal remains proper, or those from La Chapelle or Le Moustier, or the adult from Gibraltar.

The quarry work at Ehringsdorf proceeds, and with the intelligent interest of the owners, the overseers, and even the workmen, in the finds, and with the aid of Herr Lindig, it seems reasonable to hope that new discoveries will throw additional light on the highly interesting problems of the ancient Ilmstal population.

The Fossil Man of La Chapelle-aux-Saints

One of the most interesting, best authenticated, and, thanks to Marcellin Boule, now best-known skeletons of early man, is that of "the fossil man of La Chapelle-aux-Saints."

La Chapelle-aux-Saints is a small village in the Department of Corrèze, near the railroad station of Vayrac, south of the town of Brive, in southern France. Some 200 yards from the village and beyond the left bank of the small stream, the Sourdoire, in the side of a moderate elevation, is a cave, now known as that of La Chapelle-aux-Saints. In 1905, archeological exploration of this cave was undertaken by three Corrèze priests, the Abbés A. and J. Bouyssonie and L. Bardon. These explorations, which from the beginning were successful, resulting in the recovery of numerous industrial and other vestiges of Paleolithic man, progressed gradually until the uniform archeological stratum was nearly exhausted, when, on August 3, 1908, in the floor of the cave, the excavators came across a shallow artificial fossa in which lay remnants of the bones of a remarkable human skeleton.

The human bones were carefully gathered and sent to Professor Boule, at the Museum of Natural History, Paris, where they were cleaned and as far as possible restored. The following December Professor Boule demonstrated the skull, giving at the same time the first account of the find, before the Paris Academy of Sciences. One week later, MM. Bouyssonie and Bardon presented before the Academy their own observations, and these reports were followed at short intervals by several others before the same scientific body.

Subsequently the skull and other parts of the skeleton were subjected by Professor Boule to a thorough study and comparison (Fig. 20). The results of his work were published in a series of communications extending through the sixth, seventh, and eighth volumes of the *Annales de Paléontologie*, and in 1913 they were issued in a large individual volume.

These various reports show that the cave of La Chapelle-aux-Saints is a moderate-sized and rather low cavity, about 6 m. (19 ft.) long, 2 to 4 m. (6 to 13 ft.) broad, and 1 to 1.50 m. (3 to 4.5 ft.) high. When first approached it was seen to be nearly filled with old accumulations, which later disclosed numerous traces of man, and with débris of the rock from the roof and sides.

The stratigraphy of the cave was found to be quite simple. There was but one fossiliferous layer, of Pleistocene age, laid down apparently after the excavation of the fossa that contained the skeleton.

The worked flints and quartz gathered from this layer

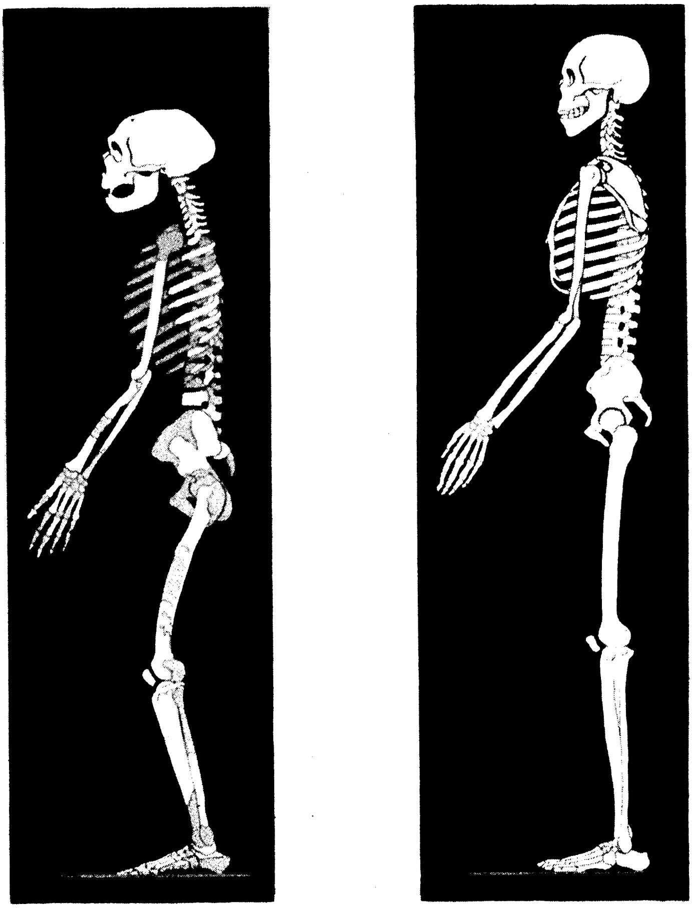


FIG. 20. Skeletons of Neanderthal man (from La Chapelle-aux-Saints) and of a modern Australian native, drawn to same scale. After Boule

reached over 1,000 in number. They showed careful and able work. They comprised especially the two classical Mousterian types, points and scrapers, and their derivatives. There were also a few instruments of Acheulian type, and a number of well-chipped blades as well as other forms that presaged the Aurignacian. There was no trace, however, of any worked bone.

The animal bones show generally signs of intentional breaking, for the marrow; some show also traces of fire or marks of implements. The following species have been identified:

Woolly rhinoceros	Fox
Spotted hyena	Badger
Reindeer	Horse
Ibex	Wild boar
Extinct bison	Marmot
Wolf	

This is a cold fauna, referable to the last glaciation.

Under the accumulations the floor of the cavern was found to be a whitish, hard, calcareous deposit. In this hard base, at a distance of a little over four meters from the entrance of the cave, was found a nearly rectangular, moderate-sized cavity, 1.45 m. long, 1 m. broad, and 30 cm. deep, which lodged a fossil human skeleton. The depression, in the opinion of the explorers, had clearly been made for the body by the primitive inhabitants or visitors of the cave, and the whole represents a regular burial, the most ancient intentional burial thus far discovered.

The body lay apparently on its back, with the head to the westward. The head reposed against the wall of the fossa in one corner and was surrounded by stones. The left arm was extended, the right bent probably so that the hand was applied to or lay near the head. The lower limbs were flexed. Above the head were found three or four large flat fragments of long bones of animals, and somewhat higher there lay, still in their natural relation, the foot bones of a large ox or bison, suggesting that the whole foot of the animal may have been placed in that position, perhaps as an offering to the dead. About the body in the fossa were numerous flakes of quartz and flint, some fragments of ocher, broken animal bones, etc., much as in the rest of the archeological stratum above the skeleton. To the right of the fossa containing the skeleton were many large fragments of various animal bones, jaws, and vertebrae of the reindeer, and vertebrae of a large ox or bison, with some very well-made implements of flint. The last-named vertebrae and the flint implements were covered by two large blocks of stone; above these stones, at the side wall of the cave, the earth showed the effects of fire, but it was not possible to determine whether this was of the same date as the deposits or the human burial beneath. There was no indication that the deposits in the cave had been moved in any way since the burial of the human body.

On taking out the human bones, it was found that through decay or other causes many were defective and that some parts of the skeleton were lost. What remained comprised the skull, almost complete, with the lower jaw; twenty-one vertebrae or pieces of them; twenty ribs or their fragments; an incomplete left clavicle; the two humeri, almost complete; the two radii and the two ulnae, all more or less defective; a few bones of the hands and feet; portions of the pelvic bones; fragments of the right femur (from which it is possible to reconstruct the bone) and the lower half of the left femur; the two patellae; and parts of the tibiae.

The state of preservation of the specimens is exactly like that of the animal bones recovered from the deposits about the burial fossa. They are ferruginous in color, heavier than any corresponding recent human bones, and very perceptibly mineralized.

The skull, except for the sexual differences, comes close in many respects to that of Gibraltar; it is also closely related to that of Neanderthal; but, except for the vault of No. 1, it is distinctly more primitive than the Spy crania, particularly in its facial portions and the lower jaw.

The characteristics that strike one most forcibly at first sight about the La Chapelle cranium are the lowness and the large size, especially the length, of the vault; the huge supraorbital arch; primitive features of the face; and the large and primitive lower jaw.

The La Chapelle skull, as a whole, is plainly one of the more typical representatives of Neanderthal man. Its closest relations, particularly in the facial portion, are with the skull of Gibraltar. It approaches in many essentials the human skull of today; yet it carries still many remnants of the prehuman past. It belonged to a male of short stature but very muscular, massive frame, which doubtless accounts in great measure for the large brain (Plate 38).

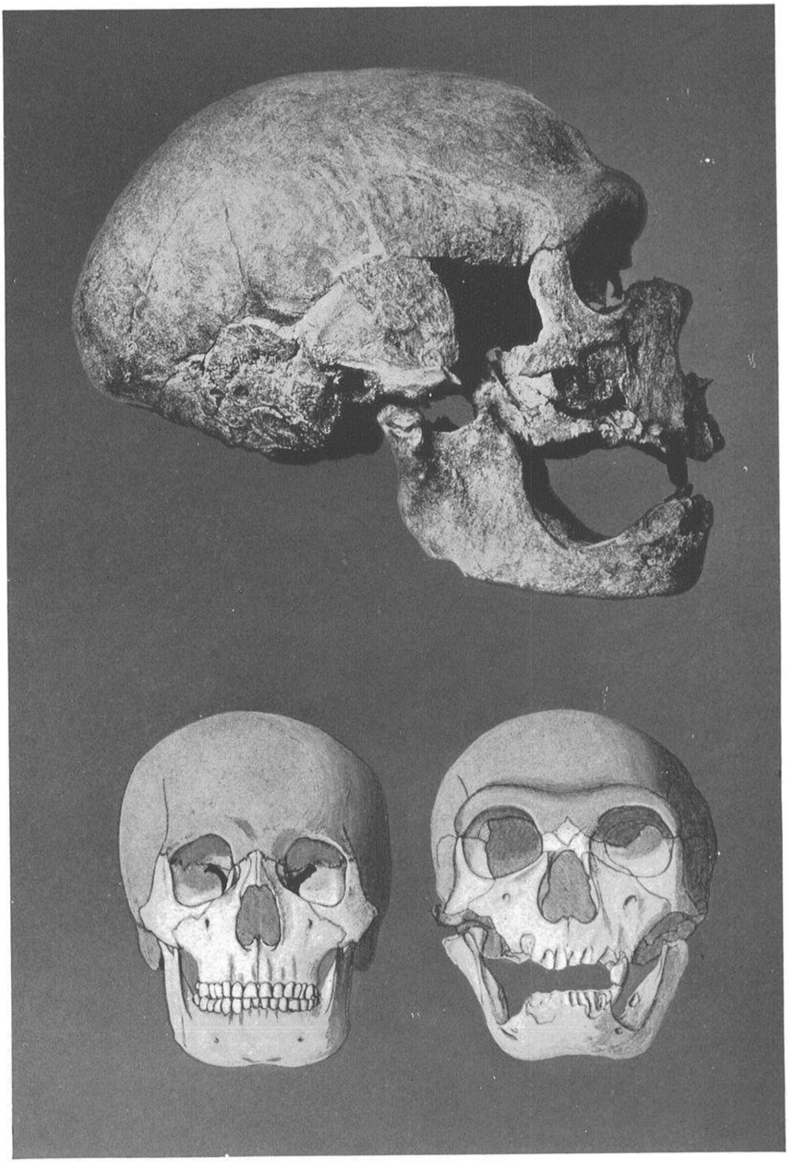
For the nontechnical reader, the most vivid impressions of the similarity of the La Chapelle skeleton to others of Neanderthal man, and of its differences, on the other hand, from skeletons of modern Europeans, will be gathered from the accompanying illustrations where these comparisons are displayed.

The Remains of La Ferrassie

"La Ferrassie" is the name of a rock-shelter close to a hamlet of that name, near Le Bugue, Dordogne, France. The locality belongs to the general region of the Vézère and Les Eyzies.

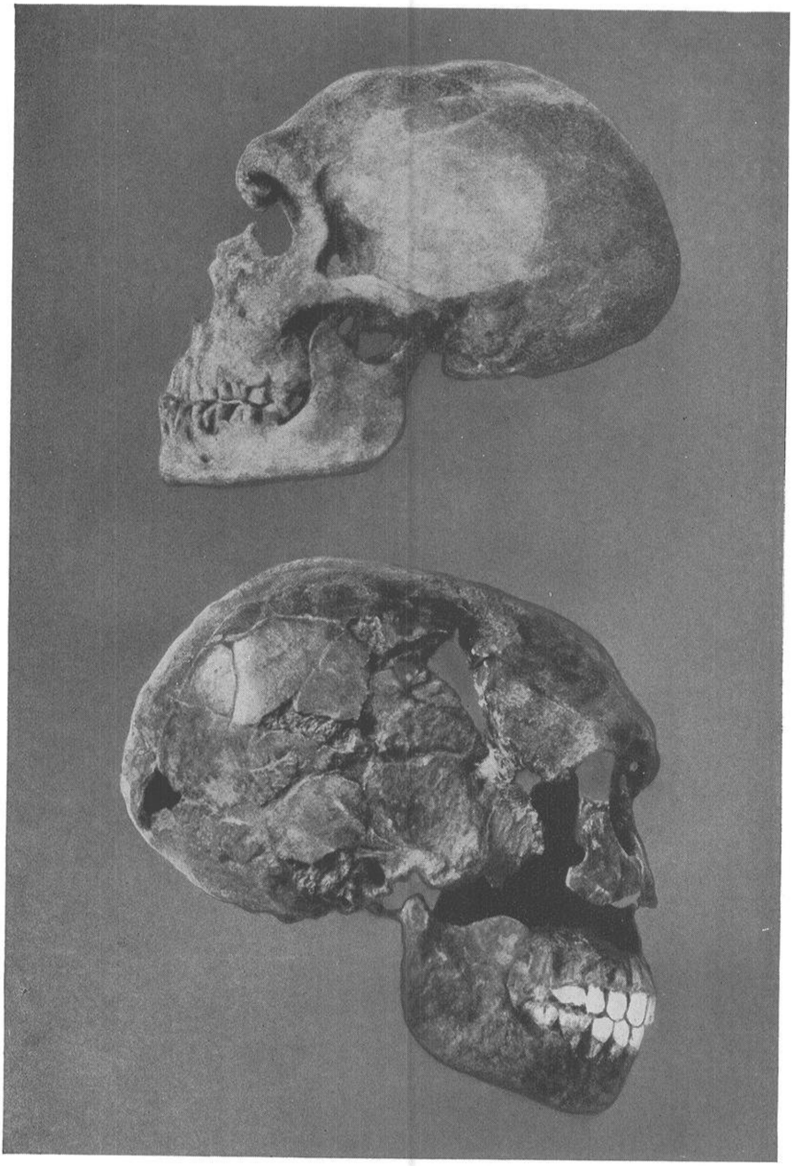
In this rather exposed rock-shelter M. Peyrony with some associates discovered in September, 1909, a human skeleton of Neanderthal affinities. The discovery was announced by the Academy of Inscriptions on November 10, 1909, and was shortly afterward published in the *Revue de l'Ecole d'Anthropologie*.

M. Peyrony had been exploring the rock-shelter and its prehistoric deposits for ten years. The excavations showed that the spacious shelter had been inhabited for a very long time by successive prehistoric populations and that each group of these left behind a layer of its kitchen refuse with its special stone industry.



Above, side view of skull of the Neanderthal man of La Chapelle-aux-Saints. Note the loss of most of the teeth during life, due principally to old age. Below, modern skull (left), compared with that of La Chapelle; brain-cases shaded to bring out the contrast. After Boule

PLATE 39



Above, skull of male skeleton found at La Ferrassie. Note the approach of the lower jaw and chin to the modern type. Below, skull of the youth of Le Moustier. After Boule

From its top to the base it was possible to identify the following horizons:

1. Upper Aurignacian
2. Middle Aurignacian
3. Lower Aurignacian
4. Mousterian
5. Acheulian

After the Middle Aurignacian the roof of the shelter fell down, and on the rocks and between them accumulated the débris of the Upper Aurignacian. Above this, reaching to the surface, was a layer of over twelve feet of humus and gravel.

The first skeleton was discovered by M. Peyrony in the lower part of the Mousterian deposits. The explorer, with Professor Capitan and another companion, removed just enough of the bones to satisfy themselves that they were human and then notified Professors Boule, Cartailhac, and Breuil, besides several local prehistorians, of the find; and it was in the presence of these, on September 27, that the skeleton was carefully uncovered and disengaged from its deposits (Plate 39 A).

The several cultural layers of the shelter were easily distinguished at sight, owing to their different coloration, and definitely so by their fauna and industry. The Mousterian layer, besides its characteristic stone industry, yielded an abundance of the bones of the bison, the stag, and the horse, with occasional parts of other later Quaternary animals.

As the explorers removed the upper layers and most of the Mousterian deposit, they found three flat stones, placed one above the skull and the two others over the shoulders or chest of the skeleton. Over the whole space inclosing the skeleton the deposits contained a considerably greater number of large fragments of animal bones than were found elsewhere. A piece of a bone lying just above the skeleton shows a series of fine intentional gravings reminiscent of the graved bones of the Aurignacian layers.

The accumulations about the skeleton contained also a large number of very well-worked flints of the Mousterian type. Such flints were found above, about, and even beneath the skeleton, those beneath being mixed up with flints showing Acheulian industry.

The work uncovered a whole skeleton in position, though numerous parts, particularly of the thorax and the spine, had been destroyed or damaged by the pressure of the superimposed deposits. The skeleton lay on its back, slightly inclined to the left and in a contracted position, with the legs bent against the thighs and the thighs half flexed upon the body, the left arm extended by the side, the right flexed. The skull lay on its left side, and the lower jaw was considerably separated in front from the upper, as if the mouth had been wide open.

All the bones of the skeleton, though damaged, were still in their proper anatomical positions; only the smaller bones of the feet and the right hand had been displaced, probably by small animals. The bones were removed with all possible precautions, in some cases with blocks of the deposits, and were thus transferred to Professor Boule's laboratory in the Paris Museum of Natural History, where eventually they were cleaned and studied and where they are now preserved.

The consensus of opinion of those present was that the remains represented a regular intentional human burial. The three flat stones and the broken animal bones had probably been placed designedly over the skeleton. It was believed, however, that there had been no burial fossa, the body having been placed on the old (Acheulian) surface and covered with broken bones, débris, and perhaps skins and branches, to become in the course of time buried by kitchen refuse and newer accumulations.

The explorations in the La Ferrassie rock-shelter continuing, the work of M. Peyrony and his associates resulted within the next year in additional discoveries of human remains. These consisted of another skeleton of an adult, in poorer condition; and of several burials of infants, in which, however, the bones have mostly disappeared.

This second skeleton was discovered in September, 1910. It lay in the middle of the same Mousterian layer, five feet from the rocky wall of the shelter, and with the head only twenty inches from that of the first skeleton. It lay at the same level and in the same axis as the latter, but in an inverse position, the heads approaching each other and the bodies extending in opposite directions. The second body had also been flexed and lay on its right side, the hands resting on the knees.

The bones of the lower members were fairly well preserved; those of the upper limbs, partially; but of the thorax there were but few remnants.

The skull of No. 1, relatively well preserved, is plainly that of a male; the skull of No. 2, defective, is that of a female. The male was about middle-aged, the female an adult of uncertain age. The brain portion of the male skull is striking because of its size, for it appears to be at least as large as that of La Chapelle. It belonged to a male taller but somewhat less muscular than the latter specimen. The second skull was evidently of but moderate proportions and belonged to a short female.

In form the skull of La Ferrassie No. 1 resembles in many respects that of La Chapelle, but it also differs from the latter in some points, including a somewhat less primitive face. The vault is large and spacious, and in all important respects much like that of the La Chapelle cranium. The supraorbital arch, the forehead, the low vault, the occiput, the far-back position of the parietal fossae, all are close to those of La Chapelle.

The face presents, below the heavy arches, similarly inclined orbits as in that of La Chapelle, similar relatively small and sloping malars with broad frontal processes and stout zygomata, and similar fullness of the suborbital (canine) surface. The nose is broad. The facial prognathism is not excessive. The dental arch is large, the palate approaches **U** shape. The teeth, all present, are stout; the crowns are worn, especially anteriorly, where the pulp cavities are exposed. The lower jaw, although large, is distinctly nearer to the modern type than are the other Neanderthal jaws with the exception of Spy No. 1. It shows clearly the beginning of a chin.

The intracranial cast of the male skull from La Ferrassie is reported by M. Boule to be "at least as large as that of the specimen of La Chapelle-aux-Saints."

The two skeletons show marked sexual differences, No. 1 being that of a fairly tall male (for a Neanderthaler), while No. 2 is that of a low-statured woman. Many parts of both skeletons are absent or more or less imperfect. The bones that remain resemble in essentials those of the La Chapelle, Neanderthal, and Spy skeletons; though there are also some differences in which some of the parts, such as the scapulae, are even a trace more primitive than the corresponding bones of other Neanderthalers, while others show more similarity to recent types.

The La Quina Remains

Two important skeletons and fragments of several others have been found by Dr. Henri Martin and his family at La Quina, Department of Charente, France. The first, discovered September 18, 1911, was found in clayey sand near the ancient bed of the small river Voultron, among Mousterian deposits. The clayey sand contained worked stones and bones showing human touch, but none of the handsome pieces characteristic of the later Mousterian. Various bones of prehistoric animals were found near by. The human remains appear to be those of a woman of Neanderthal type.

While Doctor Martin was serving as surgeon in the French army, Mme. Martin and a young son supervised further investigation of the deposits and discovered on August 23, 1915, a unique skull of a Neanderthal child about eight years of age. It belongs to the later Mousterian period, and, though approaching the Neanderthal features with relatively low skullcap and with supra-

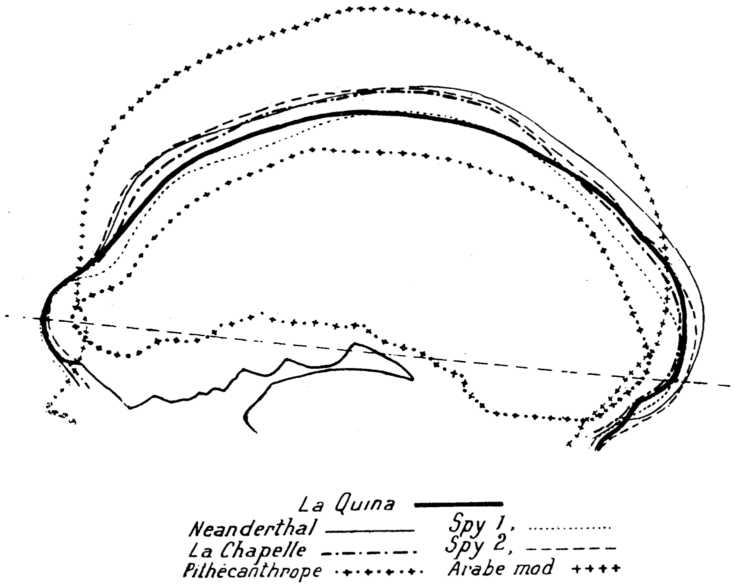


FIG. 21. Outline of five Neanderthal skulls compared with *Pithecanthropus*, or Java man, and a modern Arab. Note close grouping in intermediate position of Neanderthalers. After Henri Martin

orbital ridges already well marked in spite of the owner's youth, there is a good cranial capacity. The lower jaw is missing.

Doctor Martin is one of the most persevering as well as able workers in French prehistory. His summer chateau is near La Quina; and for over twenty years, except during the war, he has spent most of his spare time in the exploration of the deposits and in the cleaning, repair, and study of both the cultural and the skeletal remains recovered. Of the cultural and faunal remains there were vast quantities, reaching into the hundreds of thousands; yet every flint and every fragment has passed through Doctor Martin's hands and been examined by him, the only assistance he has had outside of labor being that furnished by members of his own family. And all this work at his personal expense. As Doctor Hrdlička says, may prehistory have more Henri Martins!

The excavations at La Quina have been visited by probably more prehistorians than has any other site of primitive man, aside from those in the Vézère valley. The "station" is easily accessible and relatively easily worked, though all the work must be done in the open and is made difficult by the great quantities of fallen rock and débris from what were probably in olden times more or less overhanging rock-shelters.

The quantity of archeological material and of animal bones recovered from La Quina is such that it has supplied many European and even some American museums. The archeological material is clearly Mousterian, and in general shows much differentiation as well as improvement from below upwards; but the determination of definite strata, except in the case of the very lowest one, seems difficult. There was evidently a very long-continued occupation attended with local developments.

The fauna of the Mousterian layers of La Quina, as determined by Doctor Martin, consists essentially of the following forms:

Mammoth (scarce)	Cave bear
Horse	Wolf
Wild boar	Hyena
Reindeer	A large feline
Deer (large)	Blue fox
Marmot	Small rodents

Birds (including vulture)

It is throughout a cold fauna; there are no traces, even in or beneath the lowest cultural layer, of animals of a warm period.

NEANDERTHAL MAN

The Moustier Man

It is appropriate that the site which lends its name to the culture of Neanderthal times should at length have yielded a specimen of human remains, the so-called "*Homo mousteriensis.*" The skeleton is preserved in the addition to the Ethnological Museum at Berlin, where Doctor Hrdlička saw it in 1923 and again in 1927. It was discovered in March, 1908, by O. Hauser, during archeological excavations in what is known as "the lower Moustier cave," or "Paleolithic station No. 44," at Le Moustier, in the valley of the Vézère, Department of Dordogne, France, and was purchased from Herr Hauser for the Berlin Museum.

The cave, or more properly rock-shelter, when excavated, gave numerous evidences of man's occupation but no human bones. The skeleton was discovered in the terrace in front of the cave, almost vertically below its entrance. It lay about three feet deep, and no disturbance in the superimposed deposits was noticeable.

The human bones were uncovered with great care in the presence of responsible witnesses, then covered again with earth and left *in situ* for several months, though shown during this time to a number of visitors. On August 8 they were exposed for Virchow, von der Steinen, Klaatsch, and other scientific men, and finally, two days afterwards, in the presence of Professor Klaatsch, they were taken with the utmost precautions from the deposits.

The skeleton, it appears, lay on its side in a natural extended position, with the right hand under the occiput, the left extended along the body. About the body and among the bones were found seventy-four worked flints, ten of which were of a well-defined form. On the skull rested a charred bone of a wild bull and in the neighborhood of the thorax lay a tooth of the same animal. Besides this, forty-five other fragments of animal bones were gathered in close vicinity to the human remains.

The examination of the human bones was begun on the spot by Klaatsch and continued after the removal of the remains to Germany, resulting in the following conclusions by this author:

The skeleton belongs to an adolescent of perhaps sixteen years of age and probably of the male sex. The height of the boy, as estimated from the long bones, was probably 1.45 to 1.50 meters (4 feet 9 inches to 4 feet 11 inches).

The skull, notwithstanding the youth of the subject, shows a number of characteristics which are peculiar to the Neanderthal group. While of good size, with the bones of the vault only moderately thick and of fair height, it shows nevertheless a rather low and sloping forehead; a well-marked complete supraorbital arch, or torus, which later in life would doubtless have become much more prominent; relatively large dental arches, with decidedly large and somewhat primitive teeth; a massive lower jaw with no chin eminence; and other interesting features (Plate 39 B).

The long bones and others, as far as preserved, possess numerous primitive characteristics. Especially noticeable among these are the relatively large extremities, particularly the head of the femur; a strong development of the external condyle of the femur; the peculiar arching of the femur; and the very marked curvature of the radius. Klaatsch reached the conclusion that the skeleton belongs undoubtedly to the *Homo neanderthalensis* variety of early European man.

The Galilee Skull

In 1925 the British School of Archeology in Jerusalem decided upon the exploration of certain caves in Galilee, and the work was intrusted to Mr. F. Turville-Petre, who during a previous season had made a preliminary survey of the area. The main site explored by Mr. Petre during the year was what is now often referred to as the

Le Moustier, on the Vézère, in southwestern France, showing the upper cave; the lower one, where the human skeleton was found, is obscured by the houses. Photograph by Hrdlička

"Galilee Cave," and in this cave at a depth of 6½ feet toward the lower limit of a Paleolithic horizon, were found parts of a Neanderthaloid human skull. The main details of the discovery, since published, are as follows:

> Entering the ravine of the Wadi el 'Amud and walking some 150 m. up stream, a cave known as the Mugharet-el-Zuttiyeh is to be seen high up in the cliffs to the north of the stream. The stream at this point is not more than 3 m. wide, and the width of the ravine from base to base of the cliffs might be estimated at about 15 m. The cave, a natural limestone formation, is situated at the base of a precipitous wall of rock, facing south-west; the cliff, which rises to a height of some 20 m. above the entrance, renders it inaccessible from the plateau above; while from below, the cave, the modern floor of which lies some 40 m. above the level of the stream, is approached by a steep, rocky slope. . . .
>
> No flint implements, or other evidences of habitation, were to be seen either on the floor of the cave or on the slope which led up to it, but its size and convenience as a place of habitation, together with the impregnability of its situation, seemed to merit the digging of a trial trench through the debris which had accumulated during generations of use as a stabling for goats.
>
> A preliminary trench was dug from the mouth of the cave inwards to the back wall, running some 2.5 m. north-west of the medial line of the cave. For the first 120 cm. the deposits were of comparatively recent origin, yielding fragments of bone and potsherds, among which Late Roman and Byzantine types predominated, but at a depth of 120 cm., towards the front of the cave, a layer was reached composed of large blocks of rock apparently fallen from the roof, and from below these blocks some fragments of bone in a highly mineralized state were obtained; also a small *coup-de-poing* of Middle Paleolithic type and a few chert flakes of indeterminable form.

The deposits of the cave showed eventually a number of distinguishable layers. The layers of approximately the upper four feet showed that the cave had served latest of all as a sheep stable; below this and up to about 3½ feet in depth were signs of human occupation extending to the Early Bronze or Neolithic Period. At a depth of about 3½ feet a layer of fallen rock was found over the central area of the cave.

Below this layer of rock there was a marked change in the character of the deposits. They were here composed of a fine reddish, clayey earth, which was comparatively dry; the bone fragments which they contained were hard and heavy, reddish in colour, and gave out a sharp metallic sound when tapped. This layer averaged 90 cm. in thickness, and rested on another consisting of yellowish sand, containing water-rolled pebbles. Throughout the layer were blocks of fallen rock, but they never formed a continuous layer, as they had done at a depth of about 120 cm. . . . Fortunately only a small part of the deposits had thus become hardened, and throughout the layer numerous fragments of bone and many worked flints in good condition were found. . . . No implements were found anywhere above the dividing layer of rock, showing conclusively that the deposits had undergone no serious disturbance since their deposition.

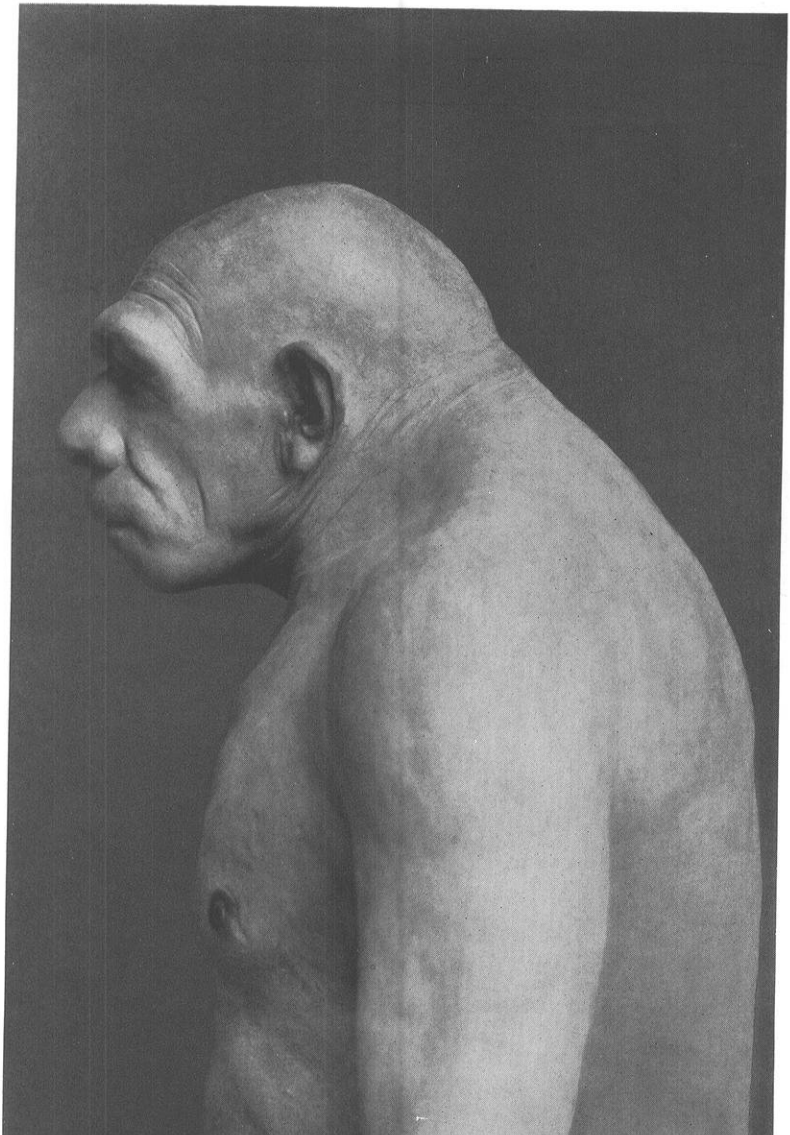
Towards the bottom of this layer of Paleolithic occupation, at a depth of 2 m. below the modern floor level, were four fragments of a human skull. . . . They were lying in a shallow depression formed by irregularities in the cave floor, and were covered by two blocks of rock apparently fallen from the roof. The frontal bone has been separated from the skull to which it originally belonged along the line of suture, and there is nothing to indicate that the separation was produced by force, or least of all to suggest that the individual may have been killed by the fall of the rocks beneath which the fragments lay. Nor was there anything in the position of the bones and arrangements of the blocks of rock to suggest an intentional burial. It is difficult to surmise what may have become of the rest of the skull. Careful sieving of all the earth taken from the surrounding area and from numerous other parts of the layer failed to disclose any further human remains. The fact that the four fragments, namely, the frontal bone, part of the right zygomatic bone, and two fragments of the sphenoid, were all found together, indicating that they have become separated since reaching their final resting-place, seems to preclude the probability of their having been washed into the cave from outside, for in such a process the projecting sphenoid portions would almost inevitably have become detached; nor is it possible that they could have fallen through from a higher level, for if so, how did they come to lie beneath two large blocks of rock, themselves entirely covered by Paleolithic deposits? The bone itself is in a hard, highly mineralized state, extremely heavy and reddish in colour, in fact in every way similar to the other bone fragments found in the layer; it differs absolutely from the soft light pieces of a yellowish colour found in the superior layers.

In 1926 the work in the cave was finished, without further discoveries of note. Sections through the water-laid

PLATE 41

The Galilee skull. This fragment shows that Mousterian man was not confined to the continent of Europe. After Keith

PLATE 42



Restoration of Neanderthal man, showing especially the shape and carriage of the head. Courtesy of the Field Museum of Natural History deposits below the Paleolithic layer showed no earlier traces of occupation, human or animal.

The fauna recovered from the Paleolithic layer, as determined by Miss Bate, was in the main as follows:

Hippopotamus	Leopard (?)
Bison or ox	Wild Cat (?)
Horse	Lynx
Brown bear (?)	Porcupine
Striped hyena (?)	Deer
Spotted hyena	Fallow deer
Pig	Gazelle (2 kinds)
Fox	Extinct goat (2 kinds)

The stone implements, of flint and chert, show essentially Mousterian affinities. There are also, however, some short and some long blades and a few other implements that resemble somewhat later types.

One of the most interesting facts disclosed by the study of the animal remains from the Emireh and Zuttiyeh Caves is the definite association of *Hippopotamus* with a Middle Palaeolithic culture, and the probable association of *Rhinoceros hemitoechus* with a slightly later culture. This seems to point to the fact that there has not been any great faunal change in this region between the Mousterian and the following period. The fact that this rhinoceros is *R. hemitoechus* and that this species also occurs in Syria is highly important, emphasizing the absence of evidence of a so-called cold fauna.

Below the Middle Palaeolithic occupation layers of the Zuttiyeh Cave "African" types are represented by the spotted hyaena (*H. crocuta*) and perhaps by a river hog (*Potamochoerus*); these were associated with a large form of brown bear (*Ursus arctos*), a typically Palaearctic animal.

There can be no doubt that the Galilee skull belongs to the Neanderthal group; but many points, including the accompanying industry as well as fauna, indicate that it belongs probably well forward in this group. Morphologically, the shape of the forehead, the height of the vault, the size and form of the orbits, and other characteristics, as well as the general features of the brain, point toward later man, while there is still enough to connect the specimen with the far past (Plate 41).

Explorations in Palestine, thus auspiciously initiated, will continue; some new undertakings are in fact now (early in 1929) under way; and Palestine, with other parts of Asia Minor, may give much that will complement,

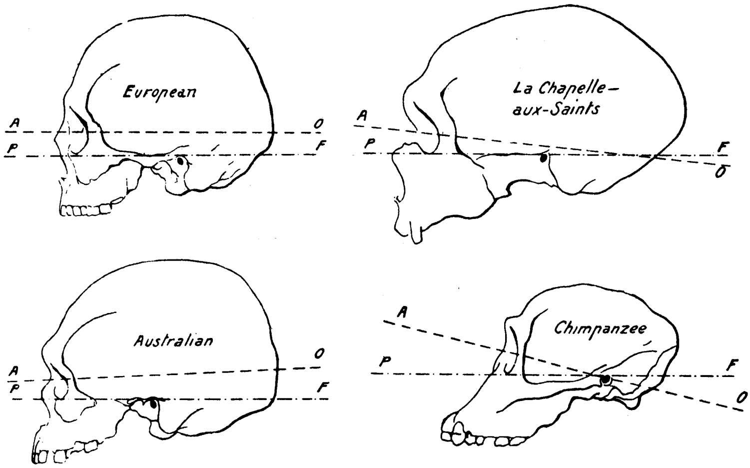


FIG. 22. Profile views of the skulls of a modern European, a modern Australian, a Neanderthaler (the man of La Chapelle-aux-Saints), and a chimpanzee. After Boule

and perhaps improve, our understanding of conditions in western Europe.

Such are some of the most important discoveries of human remains of Neanderthal type associated with the Mousterian culture. They have been found over a wide range in Europe and Asia. Animals of cold or arctic habit accompany them.

Though displaying certain variations of anatomy, the Neanderthal remains present on the whole so well-marked a type as fully to deserve assignment to the species *Homo neanderthalensis* rather than to the modern *Homo sapiens*. Indeed it has been remarked by several zoologists that, if characters so different occurred in animals other than man, they would warrant assignment to a different genus.

Prof. Marcellin Boule has concisely summed up the anatomical peculiarities of Neanderthal man as follows (Plate 42):

Body of short stature, but very massive. Head very large, with facial region much developed in comparison with cerebral region. Cephalic index medium. Skull much flattened; orbital arches enor-

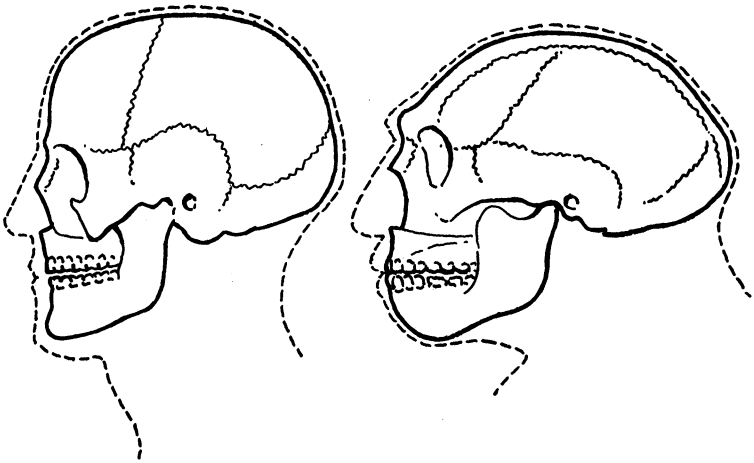


FIG. 23. Modern (left) and Neanderthaler (right) head forms compared. The Gibraltar skull was used as a basis for the drawing of the Neanderthal type, a lower jaw being modeled from one of those found at Spy. Modified from Keith

mous, forming a continuous ridge; forehead very receding; occiput protuberant and compressed in a vertical direction.

Face long and projecting, with flat and receding malar bones, upper jaw lacking canine fossae and forming a kind of muzzle. Orbits very large and round. Nose prominent and very large. Subnasal space extensive.

Lower jaw strong and chinless, with large ascending rami, and truncated in the region of the angle. Dentition massive, structure of back molars retaining certain primitive characters.

Vertebral column and limb bones showing numerous simian characters and indicating a less perfect bipedal or upright carriage than in modern man. Legs very short.

Brain capacity averaging about 1,450 cubic centimeters. Brain formation presenting numerous primitive or simian characters, especially in the relatively great reduction of the frontal lobes and the general pattern of the convolutions.

A comparative study of the morphology of various living human groups confirms the idea that we are here concerned with an altogether special type, very different not only from the so-called superior races but also from the Eskimo, the Fuegians, the Bushmen, the Pygmies, African or Asiatic, the Veddas, the Polynesians, the Melanesians, and even from the Australians, with whom attempts at comparison have often been made.

The skeleton of the last-mentioned racial type is as dissimilar as possible to that of Neanderthal man. It can no longer be asserted that the Australians are descended from our Mousterians; indeed, the idea of this relationship would probably not have occurred to the mind of the early observers, if in place of having only a skullcap they had had the opportunity of examining a complete skull with its facial portion. All that can be admitted in this respect is that the Australian group of men, certainly one of the least developed groups of modern mankind, is less far removed than other races from the primitive forms, and that in consequence, it ought to have certain characteristics in common with the Neanderthal type. Perchance our Mousterians led the same wandering life as the modern Australians.

Conclusion

In this and the preceding chapter we have described at some length various discoveries of remains of Neanderthal man. We have been more particular regarding these skeletal remains because, in contrast to earlier periods, numerous Neanderthal specimens have already been discovered and exhaustively studied, so that the Neanderthalers represent the earliest race of men to disclose for us in any degree of thoroughness the anatomical characteristics of man.

Neanderthal man, as we have intimated, was closely, if not indeed exclusively, associated with the Mousterian type of human culture. This seems to have spread over

Europe and certain other portions of the Old World, probably toward the close of the third interglacial epoch, when the climate was growing colder and more moist. With the advent of the last great glacial stage, that of the Würm, Neanderthal man was compelled to take up the life of a cave dweller.

Of the Cro-Magnon and Neanderthal cave dwellers, we have a number of more or less complete skeletons, but for still earlier culture stages, the Acheulian and others, human skeletal remains almost fail us, for the reasons given in Chapter VI. Even so, intensively studied as they have been, they throw no little light on the remoter past of our race and deserve our attention.

CHAPTER IX

THE MOST ANCIENT REMAINS OF MAN

The Piltdown Remains

We have already mentioned the Piltdown race in connection with Sir Arthur Keith's interesting experiment. The race to which this individual belonged has been named *Eoanthropus dawsoni*, or "Dawson's dawn man," in honor of its discoverer, Charles Dawson. Between 1908 and 1912, laborers, digging in the ancient gravels of the river Ouse, at Piltdown, in southeastern England, found the fossil remains of a human skull of most unusual character. Not realizing the importance of their find at first, however, they permitted the fragments to be scattered about. At length it was brought to the attention of Mr. Dawson, and his careful and painstaking researches brought to light at various times several fragments. These consisted of certain portions of the skull itself, a pair of nasal bones, a portion of a lower jaw, and a canine tooth. Mr. Dawson kept up his search for additional remains. Early in 1915 he discovered, some two miles from the first site, two fragments of a skull of similar type and a lower left molar tooth.

With the earlier remains were found worn fossils of mastodon, rhinoceros, and *Stegodon*, evidently washed out of Pliocene formations, as well as others probably of early Pleistocene age, among them hippopotamus, beaver, and elk. From the same gravels came also water-worn "eoliths," which may likewise have been washed out from an older formation; and rare flints with "obvious signs of human workmanship," representing a very old type of Paleolithic implements. There was also found a large crude tool made of the femur of an extinct elephant—by far the earliest bone implement thus far known (Fig. 24).

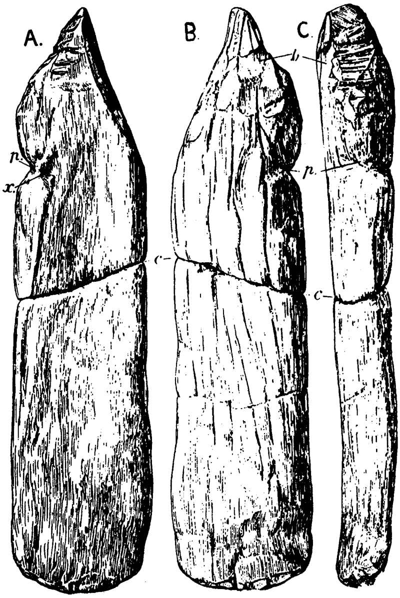


FIG. 24. Bone implement from Piltdown, England, made from the thigh bone of an elephant. A is the inner surface; B, the rounded outer surface; and C, the edge; *b*, an accidentally broken hollow; *c*, a natural break due to pressure in the gravel; *p*, the inner wall of a perforation from which the outer wall has been broken away; and *x*, the beginning of another perforation never completed. After Smith Woodward

The discoverers, as well as English anthropologists in general, regard the first group of finds as those of a single individual and all of them together as belonging to one very early form of man, the *Eoanthropus*, or "dawn man."

Taking all the circumstances of the find into consideration, Sir A. Smith Woodward, of the British Museum, who had been associated with the discovery almost from the very first, decided that the skull and mandible could not safely be "described as being of earlier date than the first half of the Pleistocene Epoch. The individual probably lived during a warm cycle in that age." In 1922, in his *Guide to the Fossil Remains of Man*, the same authority states: "So far as can be judged from present evidence, it is therefore reasonable to suppose that Piltdown man dates back to the beginning of the Pleistocene period." It is only fair to say, however, that there has been much divergence of opinion among English, French, and American scientists as to the period to which the Piltdown remains are to be assigned. But all are agreed that they are extremely ancient and date from a very early period in the Ice Age, or Pleistocene period, if not indeed from the still earlier Pliocene.

The Piltdown skull is plainly that of an adult, probably a female, of over thirty years of age. One of the most striking things about it is its extraordinary thickness; its walls measure from eight to twelve millimeters, or roughly twice the thickness of an average modern European skull.

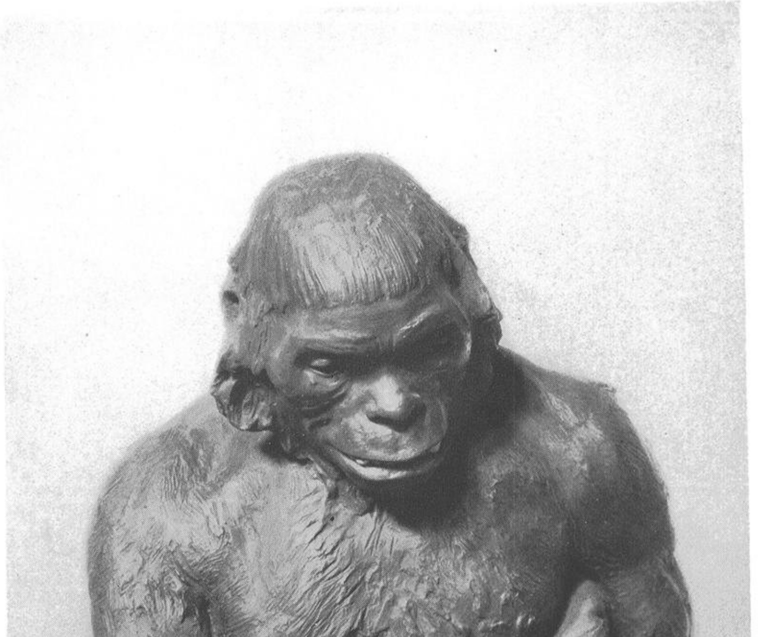
From the fragments of the cranium, together with the portion of the lower jaw and the loose canine, a number of prominent authorities have attempted with infinite pains to reconstruct the whole skull. The principal efforts of this sort are those of Sir A. Smith Woodward, of Dr. Elliot Smith, of Sir Arthur Keith, and of J. H. McGregor of New York. These reconstructions differ somewhat in size and in details, but all agree in regard to certain characteristics.

In the opinion of Smith Woodward, a detailed examination of the bones of the skull as far as preserved "proves the typically human character of nearly all the features they exhibit." Keith believes that "except for the thickness of the skull bones, the head was shaped and balanced as in us." It is a skull that "in its general conformation does not differ materially from human skulls of the modern type" (Fig. 25).

The capacity of the skull has been estimated by the different authors who attempted its reconstruction as follows:

RECONSTRUCTION	APPROXIMATELY
Second Smith Woodward	1,300 c.c.
Elliot Smith	1,200 c.c.
Keith	1,400 c.c.

PLATE 43



Restoration of Piltdown man (the "Dawn Man"); shown using an eolith. Modeled by Mascré under the direction of Rutot

The various determinations show that:

1. The skull, taken as female, was in size above rather than below the present average of female crania.

2. The skull *cavity*, and hence the size of the brain, were about the average of the ordinary white females of today.

3. The vault of the skull was not low as in all the other known early forms of man.

In addition it is certain that the forehead was well arched and filled out; the parietal, temporal, and occipital regions were fashioned practically as they are in modern skulls; the supraorbital ridges were very moderate and did not form a con

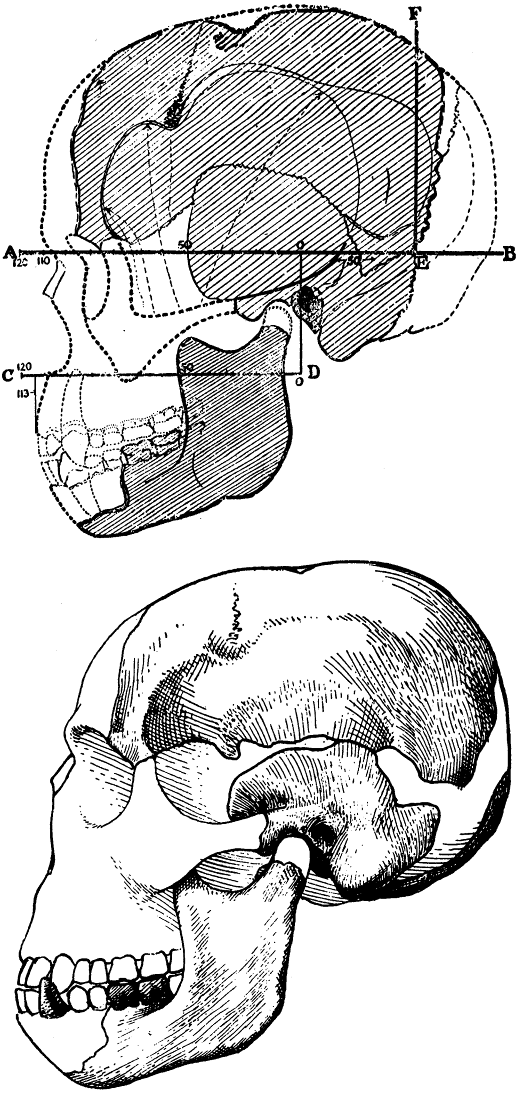


FIG. 25. Two reconstructions of the Piltdown skull. Upper, by Sir Arthur Keith; lower, by John I. Hunter. After Elliot Smith

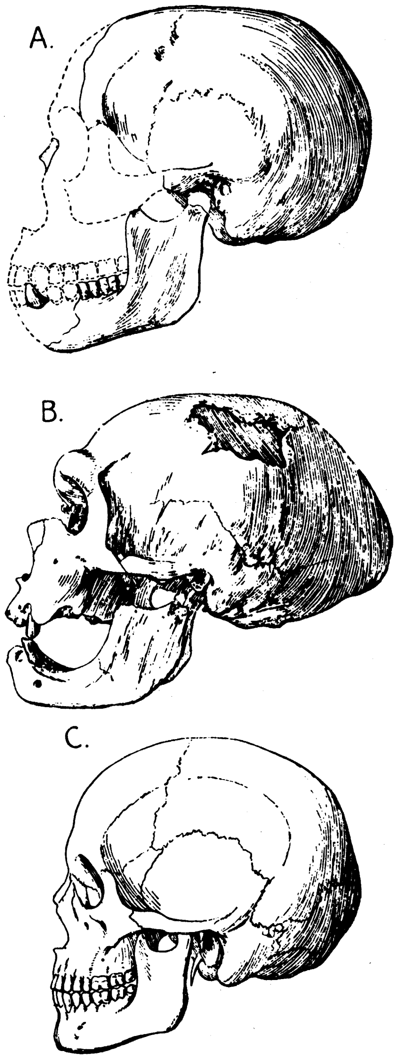


FIG. 26. Piltdown (A), La Chapelle-aux-Saints (B), and modern (C) skulls contrasted. In some ways Piltdown man seems nearer the modern type than Neanderthal man (B). After Smith Woodward

nected arch; there were no occipital or other crests; the glenoid fossa and the mastoids were well developed.

In short this skull, though it may have shown some secondary inferiorities, if it were not for the exceedingly primitive lower jaw and canine tooth found near it, would inevitably have had to be classed with those of modern man.

It is the lower jaw, together with the subsequently found canine, that has become the great "bone of contention" in the case. The reason is that, as tersely stated by Smith Woodward, "while the Piltdown skull is thus completely human, the half of the lower jaw, so far as preserved, is almost precisely that of an ape." And in another place the same authority expresses the uncertainty thus caused:

It may next be questioned whether this apelike mandible belongs to the skull. We can only state that its molar teeth are typically human, its muscle-markings are such as might be expected, and it was found in the gravel near the skull. The probabilities are therefore in favor of its natural association. If so, it is reasonable to suppose that the skull will prove to be that of a very primitive type, not that of a highly civilized man.

No other such jaw or anything even approaching it has ever been found with such a skull. The two at first sight do not belong to the same being or even the same species. In other early remains, especially one of the Spy skulls, in the La Quina and La Ferrassie specimens, it was the jaw rather than the skull that showed a form advancing toward the modern. While the probabilities of the discovery itself seem overwhelmingly in favor of an organic association of the skull with the jaw, the morphological features of the specimen, on the other hand, are all against it.

Doctor Hrdlička sums up his own views on the primitive mandible in the following words:

The first strong impression which the specimen conveys is that of normality, shapeliness, and relative gracility of build rather than massiveness. When, after studying the specimen for a good part of two days, the observer took in hand the thick Piltdown skull, there was a strong feeling of incongruity and lack of relationship, and this feeling only grew on further study. As a rule there exists a marked correlation between the massivity of the skull—particularly if as in this case the upper facial parts were involved in the same—and the lower jaw. A finely chiseled mandible of medium or submedium strength belongs as a rule to a skull that is characterized in the same way, and vice versa. To connect the shapely, wholly normal Piltdown jaw with the gross, heavy Piltdown skull in the same individual, seems very difficult. After prolonged handling of both the jaw and the skull there remained in the writer a strong impression that the two may not belong together, or that if they do the case is totally exceptional.

The next important question in connection with the jaw was whether or not it was human. All possible pains were taken to determine this point, regardless both of the skull and of previously expressed opinions. It may as well be said at once that all the results of the study point to the specimen being a very early man or an advanced human precursor, and not an anthropoid ape.

. . . .

The jaw is more primitive than any other known jaw relating to early man. It still had a marked submentoneal shelf, in all probability a large canine, and teeth of ancestral prehuman form. It resembles more or less in a number of points the jaws of the chimpanzee, but it differs from these in a whole series of points of importance, such as the form of the notch; type of coronoid process; subdued musculature; markedly reduced internal massiveness of body, especially near symphysis; and the most important characteristics of the teeth, namely, height of crown, height of enamel, nature of "cingulum" and stoutness of cusps—in all of which features it is more nearly if not actually human.

Thus most authorities feel, in view of all this, that it is no longer possible to regard the jaw as belonging to a chimpanzee or any other anthropoid ape; but that it is really the jaw either of man's precursor or of very early man himself. Hence Smith Woodward's designation of this form as *Eoanthropus*—a being from the dawn of the human period—seems entirely appropriate.

Portions of at least one other skull of similar type were found, it will be recalled, two miles away. These included a fragment of the frontal bone and another of the occipital, both probably belonging to the same cranium.

This second specimen makes it certain that in the Piltdown gravels, within a few feet of the surface, there occur fossilized skulls nearly if not wholly of modern form, though some, at least, are markedly thicker; and that with them are associated very primitive human implements, as well as animal fossils of early Pleistocene and Pliocene age. The problem is this: Are the skulls, the implements, and the animal fossils contemporaneous; or, in other words, may the skulls not be intrusive?

The probabilities all seem to point to the specimens being of the same age; but in view of the history of the deposition of the gravels, together with some of the uncertainties of the find and the apparent incongruity of the parts, there is room for no little disagreement.

The original main problem, the genetic and chronological association of the jaw and the teeth with the two skulls, remains much as it was soon after their discovery, and no amount of thought, discussion, or even reexamination of the specimens can promise, it seems, for the present, definite conclusions. The only hope, as in so many other cases of this sort, lies in new and sufficient discoveries.

Doctor Hrdlička concludes:

In view of all this it must be plain that any far-fetched deductions from the Piltdown materials are not justified. This applies particularly to the superficially attractive conclusion that the Piltdown remains demonstrate the existence in the early Pleistocene, and long before the Neanderthal and even the Heidelberg forms, of men with practically modern-sized and modern-formed skulls and brains and directly ancestral to *Homo sapiens*, or recent man. This hypothesis is a proposition that would change the whole face and trend of human prehistory, and that against all other better substantiated evidence in this line. Such a theory, all science will agree, could only be established as a fact by the most ample and satisfactory material demonstration, which is quite impossible in the present case.

THE HEIDELBERG MAN

If so many apparent contradictions and uncertainties surround the Piltdown discoveries, nothing of the sort attaches to that other extremely ancient specimen, the lower jaw of Heidelberg man.

The Heidelberg, or more properly, Mauer jaw is one of the oldest relics of early man. For its preservation and thorough description we are indebted to Dr. Otto Schoetensack, at the time of the discovery professor of anthropology at Heidelberg University, who for years had been watching for human remains in the sand pits near Mauer which eventually yielded the specimen. Much credit is due also to Herr Joseph Rösch, of Mauer, the owner of the sand pits, who saved the jaw from destruction, immediately brought it to Professor Schoetensack's attention, and eventually donated it unselfishly to science.

The specimen, the lower jaw of an adult male, was discovered accidentally on October 21, 1907. On the date of the find, two of the laborers were working in undisturbed material at the base of the exposure, over eighty feet below the surface, when one of them suddenly brought out on his shovel part of a massive lower jaw which the implement had struck and cut in two. As the men realized the importance of carefully preserving all fossils, the specimen was handled with some care. The missing half was dug out, but the crowns of four of the teeth broken by the shovel were not recovered. The men were struck at once with the remarkable resemblance of the bones to a human lower jaw; but it seemed to them too thick and large to be that of man. They called Herr Rösch and he also was puzzled; but he saw at once that the specimen might be of considerable interest to Professor Schoetensack, and so took charge of it. Returning to the village he telegraphed to the professor, who came the next day; and "once he got hold of the specimen, he would no more let it out of his possession." He took it to Heidelberg, cleaned it, repaired it, and in 1908 published its description in an exemplary fashion (Plate 45).

Shortly following the discovery of the jaw a most careful examination and study were made of the Mauer deposits. They were found to range from recent accumulations on the surface to Tertiary deposits in the lowest layers. The jaw lay a little less than three feet (0.87 meter) above the floor of the excavation and seventy-nine feet (24.1 meters) from the surface. The same level, as well as some of the higher layers, yielded fossil bones of the straight-tusked elephant, Etruscan rhinoceros, an extinct lion, and various other animals. The age of the human jaw has been determined by these and later explorations to be of the early Quaternary, or Glacial Period, though there is still some uncertainty as to the exact subdivision of that period to which it should be attributed.

The original specimen, when seen, impresses one at once and strongly with its remarkable character. So completely mineralized is it that it resembles limestone rather than bone. It is an enormous lower jaw, which presents at one and the same time both human and apelike characteristics (Fig. 27).

There is no indication of abnormality or any diseased condition which might have altered it in shape; on the contrary it may be regarded as a perfectly normal representative of its type. The bone is dull yellowish-white to reddish in color, with numerous small and large blackish spots. The crowns of the teeth are dirty creamy white, with blackish discolorations on the somewhat worn-off chewing surfaces of the canines and incisors, and a few similar spots over the molars; while all the parts of the teeth beneath the enamel are dull red, as if especially colored.

The jaw is considerably larger and stouter than any other known human mandible. The ascending rami are exceedingly broad, and the coronoid processes, thin and sharp in modern man, are thick, dull, broad, and markedly

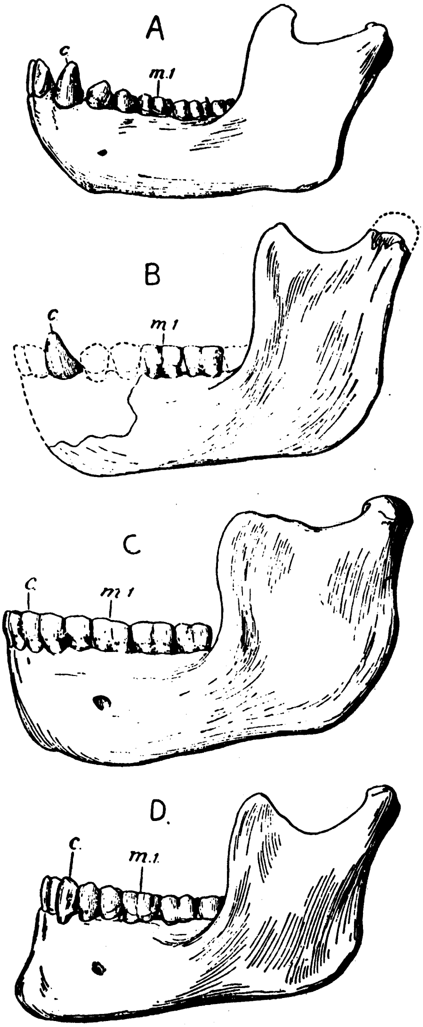
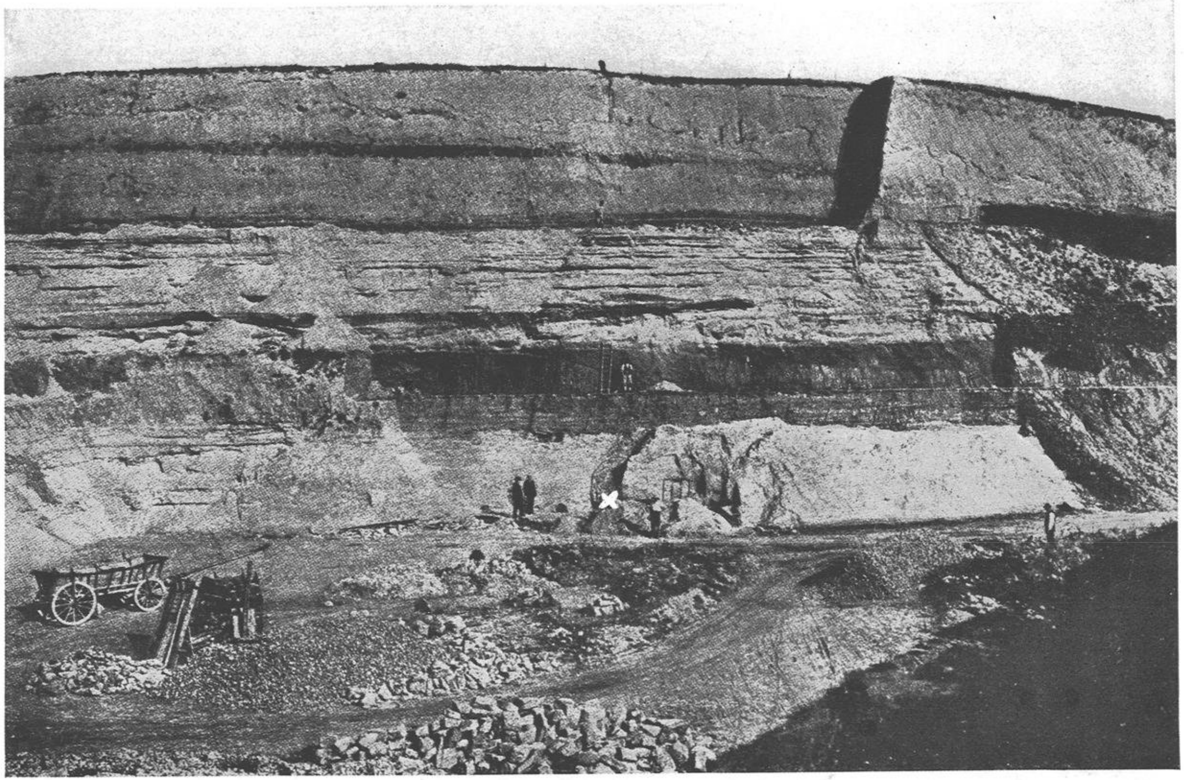


FIG. 27. Development of the lower jaw. Chimpanzee (A), Piltdown man (B), Heidelberg or Mauer man (C), and modern man (D), compared. Note especially the canine teeth and the region of the chin. After Smith Woodward

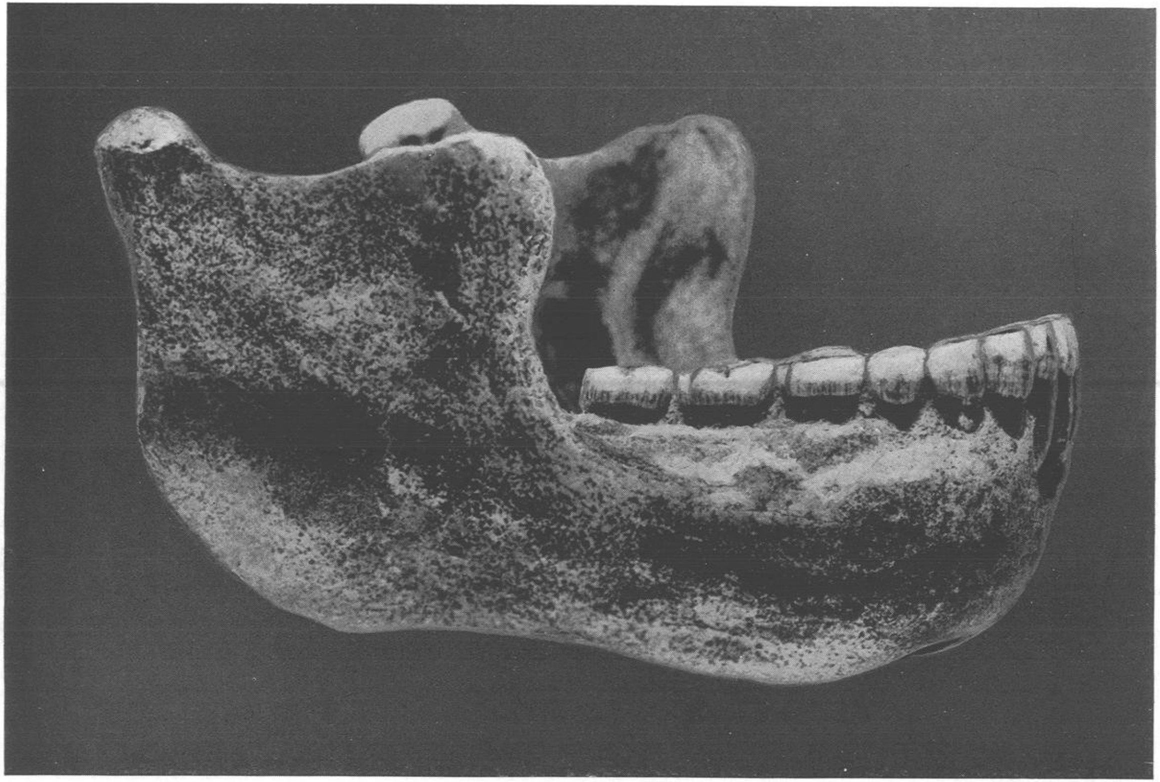
everted. The chin slopes backward as in no human being now known or thus far discovered, and there are other primitive features. The total effect of the characteristics of the bone is such that, had the teeth been lost, it would surely have been regarded as the mandible of some large ape rather than that of any human being.

The teeth of the Mauer jaw, however, are perfectly preserved, and though large and provided with great roots, and in various other ways primitive, they are unquestionably human teeth. They show no crowding, nor diastemata. The labial cusp of the anterior premolar was decidedly pointed, the lingual cusp moderate. The teeth force the conclusion that their possessor, while of heavy protruding face, huge muscles of mastication, wide and thick



The Mauer Quarry, near Heidelberg, Germany. White cross marks the spot where the lower jaw was discovered; note its great depth below the present surface. After Schoetensack

PLATE 45



The Mauer or Heidelberg jaw. Note the entire absence of a chin-prominence, a very apelike trait, in marked contrast to the entirely manlike character of the teeth. After Schoetensack zygomatic arches, thick skull, probably heavy brows, and possibly not yet quite erect posture, had nevertheless already crossed the line dividing man from the ape. His food and probably his mode of life were related to those of primitive man, and he was already far removed from his primate ancestors with huge canine teeth resembling tusks, like those of the gorilla.

Pithecanthropus

This celebrated discovery was made by Dr. Eugene Dubois, distinguished as anatomist, paleontologist, and prehistorian. At his own request Doctor Dubois was appointed to the Dutch military service in Java, in order that he might find some opportunity to search for prehistoric human remains in the East Indies. He arrived in Java in April, 1889, and carried on his researches, by permission of the Colonial Government, until 1895. Paleontological work was not new in Java and had already led to the discovery of Pliocene and Pleistocene strata rich in fossil plant and animal remains along the Solo or Bengawan River and its tributaries.

In his report of 1898, Doctor Dubois describes the circumstances of his discovery in part as follows:

> By order of the Netherlands Indian Government I conducted in Java, from 1890 to 1895, explorations for a fossil vertebrate fauna, of which already some remains had been discovered, many years ago, by Junghuhn and others, and later extensively described by Professor K. Martin, of Leiden. I found a very large quantity of remains of mammals and reptiles, for the most part derived from extinct species, which show, as might be expected, an unmistakable relation to the later Tertiary and Pleistocene faunae of India.
>
> The chief localities of these finds are in the southern slope of a range of low hills, the Kendengs, which extend between the residencies of Kediri, Madiun, and Surakarta on one side, and of Rembang and Samarang on the other, over a distance of about sixty miles. The area in which these vertebrate remains are abundantly found, in many places, may have on an average a breadth of from one to three miles.
>
> . . . It can be said, in accordance with geological circumstances, and the relations which this fauna has with the Post-Tertiary and

Pleistocene vertebrate faunae of India, that most probably it is young Pliocene; in no case, however, can it be younger than the oldest Pleistocene. For, whilst on the one hand the species surely belong almost exclusively to living genera—only the genus *Leptobos* and the subgenera *Stegodon* and *Hexaprotodon* are extinct—and it must therefore be younger than the principal part of the Upper Miocene or Lower Pliocene Siwalik fauna, including not a few extinct genera; on the other hand, the number of the extinct species seems to be in proportion somewhat greater than that of the Narbada fauna, which is put in the early Pleistocene. Further, the inclination which the strata show does not well agree with a Pleistocene age. . . .

From Trinil to Ngawi the steep banks of the Bengawan or Solo river, for an extent of seven and a half miles, consist exclusively of volcanic sands and lapilli, cemented into soft rocks, very much like the rocks which I saw in the Siwalik hills. The strata have in this area a general dip S. of about 5°, and are only concealed by a thin covering of vegetable soil. In these strata the Solo river has cut its channel, 12 to 15 metres deep, near Trinil. North and west of Trinil the Pliocene marl and limestone appear under them.

It was near Trinil, in the left bank of the river, at the foot of the Kendengs, that I came, in August, 1891, upon a place particularly rich in fossil bones, and found there, in that and the following year, among a great number of remains of other vertebrates, bones and teeth of a great manlike mammal, which I have named *Pithecanthropus erectus*, considering it as a link connecting together Apes and Man.

Among hundreds of other skeletal remains, in the lapilli bed on the left bank of the river, the third molar tooth was first found in September; then, the hole having been enlarged, the cranium a month later, at about one metre distant from the former, but in the very same level of that bed. The species of mammals, of which remains were found in the same bed, are, for the greater part at least, extinct ones, and almost certainly none of them are at present living in Java. Among these remains we find a great number of the . . . small species of *Cervus*, which certainly is not extant in the Malayan isles. Also many bones of *Stegodon* were found. One or two *Bubalus* species seem to be identical with Siwalik species; a *Boselaphus* undoubtedly differs from the known species, living and fossil; further on there were found the extinct genus *Leptobos*, the genera *Rhinoceros*, *Sus*, *Felis*, *Hyaena*, and others; a Garial and a Crocodile, differing little from the existing species in India, but which cannot be classed among them.

Of the animals found in the same strata in other places, the most interesting species are a gigantic Pangolin (*Manis*), three times as large as the existing Javanese species, and a Hippopotamus belonging to an extinct Siwalik subgenus. Further a Tapir and an *Elephas*.

The work having been brought to an end that year on account of the setting in of the rainy season, it was taken up again at the beginning of the dry season in May, 1892. A new cutting was now made in the left rocky bank, which comprised the still unfinished part of the old excavation. Thereby bones were again found in great numbers, especially in the deeper beds; and among these, again in the same level of the lapilli bed, which had contained the skull-cap and the molar tooth, the left femur was found in August, at a distance of about 15 metres from the former; and at last, in October a second molar, at a distance of 3 metres at the most from the place where the skull-cap was discovered, and in the direction of the place where the femur had been dug out. This tooth I did not describe, because I only found it later among a collection of teeth derived from the place stated above.

Thus altogether Doctor Dubois's finds, eventually attributed by him to *Pithecanthropus*, comprise a lower jaw, two molar teeth, a skullcap, and a femur. With these is associated another tooth, a premolar, discovered in the Trinil deposits several years later.

Toward the end of the year 1895, Doctor Dubois returned to Europe. His discovery was universally acknowledged as one of great importance; but his views were soon combated. The case presented two main problems. The first was the question whether the several parts, *i.e.*, the skull, the two teeth, and the femur, belonged to the same individual or at least to the same form; the other, that of the identification of this form.

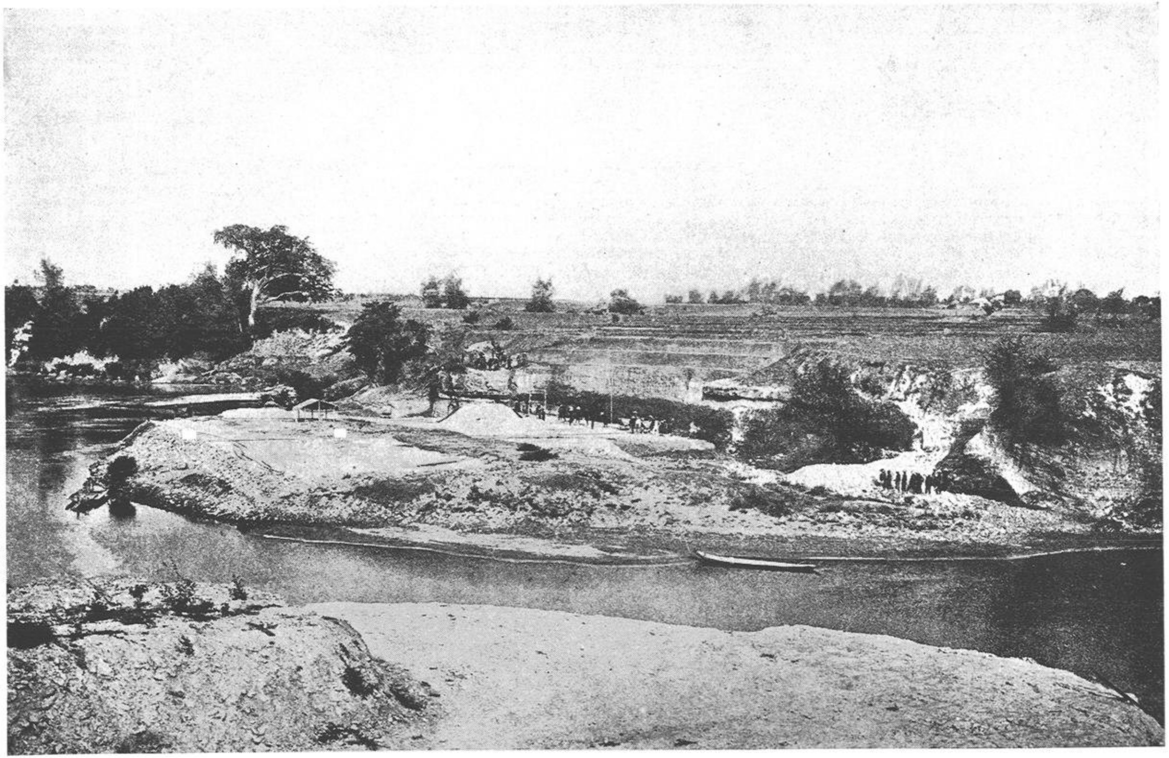
Dubois believed, as has been seen, that all four specimens, namely the skull, the two teeth, and the femur, belonged to one stratum, one age, and one individual, a female *Pithecanthropus erectus*. To this there were soon many objections, and for several years the question was debated, not wholly without bitterness. Of some of its later aspects Doctor Hrdlička speaks as follows:

In the summer of 1923, the writer visited Europe in the temporary rôle of Director of the American School for Prehistoric Studies in Europe. The first visit was to Professor Smith Woodward at the British Museum of

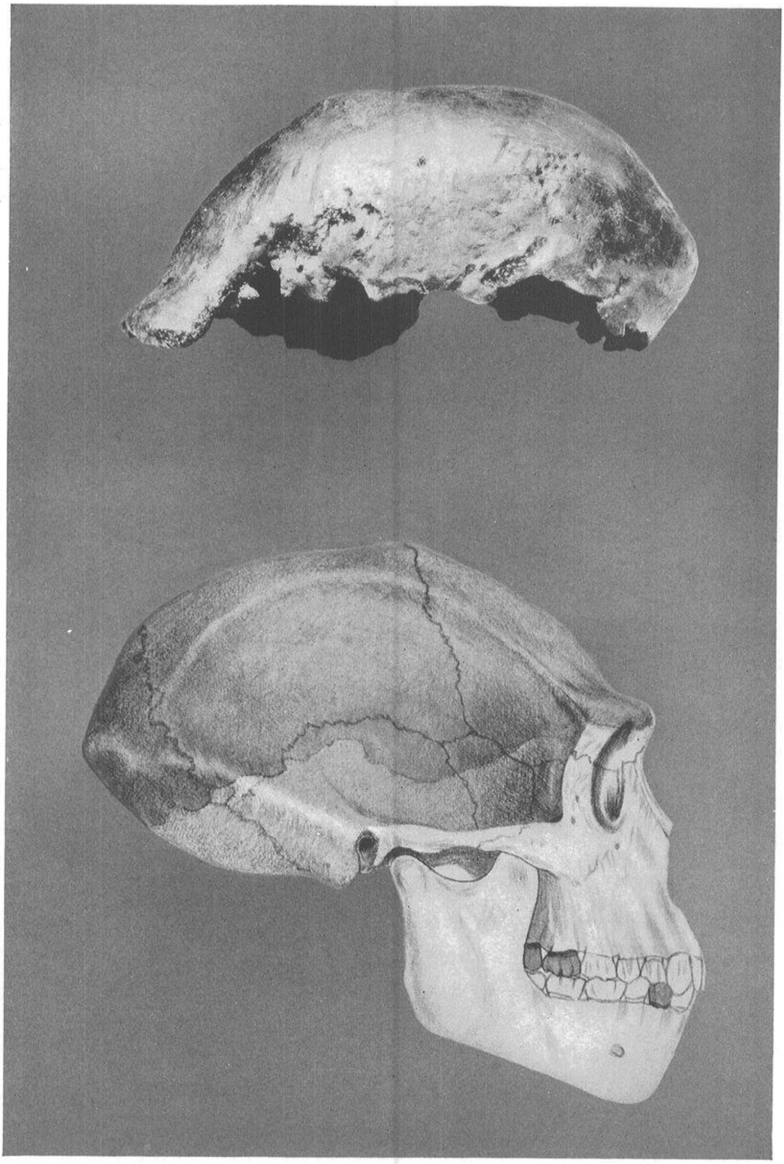
Natural History. Before meeting we had had some correspondence in which I had expressed my great desire to see once the *Pithecanthropus* originals. These wishes had most kindly been communicated to Professor Dubois at Amsterdam. Upon my arrival, to my great astonishment and joy, Sir A. Smith Woodward handed me a telegram from Professor Dubois inviting me most courteously to the Teyler Museum in Haarlem, his home town, where he would show me all the originals in his possession. This great privilege was taken full advantage of by me and my class on July 15. It was the first time the precious specimens were shown to a scientific man after their long seclusion. We found Professor Dubois a big-bodied and big-hearted man, who received us with a cordial simplicity. He had all the specimens in his possession brought out from the strong boxes in which they are kept, demonstrated them to us personally, and then permitted me to handle them to my satisfaction. Besides the four specimens attributed originally to the *Pithecanthropus* there was the additional tooth (a premolar), the fragment of a curious fossilized lower jaw, and two interesting, Australoid-like mineralized skeletons from Wadjak. The interior of the skullcap of the *Pithecanthropus* had now been completely freed from the consolidated tufa that filled it before; a cast of it was made, and this revealed a very remarkable brain of an unexpectedly humanlike conformation.

The examination of the originals made a deep impression. It was seen that none of the casts of the skull that have been seen in different institutions were wholly faithful, and the same was felt to be true of the hitherto published illustrations. The originals were seen to be even more important than they had seemed hitherto. Professor Dubois told us he had about finished a final study of the specimens, which was soon to be published; and we left, truer and profounder prehistorians than we had been before.

PLATE 46



Locality of the *Pithecanthropus* find near Trinil, Java. Two white squares show where the femur (on left) and the skullcap (on right) were discovered. After Selenka and Blanckenhorn



Above, the *Pithecanthropus* skullcap, side view. After Dubois, 1924. Below, reconstruction of the *Pithecanthropus* skull. The darker shading indicates those portions of the skull (the brain-case and some teeth) which were actually found. After Weinert

Later during the same summer the specimens were shown also to Professor McGregor, of Columbia University. Since then they have been demonstrated on a number of occasions, including that of the Twenty-first International Congress of Americanists at the Hague, 1924.

Finally, during this same year (1924), there appeared in the *Proceedings* of the Academy of Sciences, Amsterdam, three new important publications on the *Pithecanthropus* remains by Professor Dubois: The first, on the skull and brain, with which the author now definitely associates the fossil mandible, all three teeth, and the thigh bone; the second showing eleven excellent plates of the specimens; and the third dealing with the femur; with a final exhaustive work on the whole of the remains promised for a not-far-distant future.

In these latest and ripest communications on the Java remains are found the following statements of special interest:

> The bones are in a state of perfect mineralization. Their specific gravity, like that of the bones of other mammals dug up at Trinil, has risen to about 2.7. They contain only traces of organic matter in the form of human substances, which give them a chocolate-brown color. The skull-cap has been greatly corroded on the outer surface by sulphuric acid, formed from pyrites in the volcanic tufa; the femur appears to be free of such corrosions.

The physical and chemical characters of the bones are such, in Dubois's opinion, that they "stamp the remains of *Pithecanthropus* as Pliocene"; which possibility is further strengthened by the somatological characteristics of the specimens. Dubois, therefore, is still inclined to regard the *Pithecanthropus* remains as late Pliocene rather than Pleistocene.

Ventrally, the skullcap, particularly in the frontal region, shows strong impressions of the cerebral convolutions. In details of its conformation it agrees partly with man, partly with the gibbon. "The form of the skull of the *Pithecanthropus* is on the whole not human; nor is it a transition of any type of manlike apes to the human type. The agreement with the anthropoid cranial type, particularly that of the small gibbon species of the genus *Hylobates*, may on the other hand be called perfect." It extends to many features such as the arching of the vault, the receding forehead, the precerebral part of the frontal bone, the constriction behind the orbits, etc. "In all these points *Pithecanthropus* is distinguished no less strongly than the Anthropoid Apes from the Neanderthal Man." The detailed characteristics of the skull indicate now to Dubois that the erect posture of the body of the *Pithecanthropus*, "which clearly appears from the shape of the femur, was not such a perfect one as in Man; the correlation, at least, did not extend to the skull."

> Nor can the skull, however, have belonged to an Anthropoid Ape, because the relatively very large skull as regards shape presents a close, nay striking resemblance with the skull of a small *Hylobates* species, the smallest of the Anthropoid Apes, whereas judging not only from the femur and the molar teeth, but also from the skull itself, *Pithecanthropus* must have surpassed the size of a large chimpanzee, and was very much that of a middle-sized man.

As to the size of the brain, "it may be assumed that with equal body weight *Pithecanthropus* possessed double the brain quantity of the Anthropoid Apes." The endocranial cast in its side view "presents a striking resemblance with the endocranial cast of a small *Hylobates* species reproduced at the same size. There is on the other hand a great difference—and a difference of great importance—between the profile of the endocranial cast and that of the Neanderthal Man of La Chapelle-aux-Saints." (Fig. 28.)

To which Dubois adds:

> It seems to me that it is evident, at least, from all this that Man and *Pithecanthropus* both descend from a common primitive Simian ancestor. From this, among the living species, the Hylobatidae, though greatly differentiated by their long arms and sabre-shaped canines, depart least, several fossil Simiidae still less. Also through his mandi-

ble and teeth *Pithecanthropus* deviated less from this common stock type than the three living Gigantanthropoidea and the Hylobatidae. . . . The approach of the mandible and the teeth, as also of the femur, to the human type, and the large cranial capacity, added to consider-

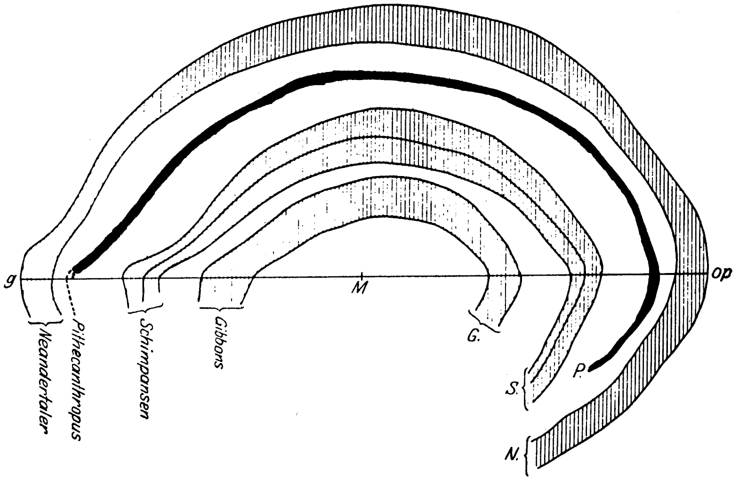


FIG. 28. Profile view of the *Pithecanthropus* brain-case (heavy black line) compared with those of Neanderthal man, the chimpanzee, and the gibbon; all drawn to the same scale

ations on the brain-quantities in nearly allied mammalian genera, all this leads me to the conclusion that *Pithecanthropus* should be considered as a member, but a distinct genus, of the family of the Hominidae.

The resemblance of the fossil femur to that of man, in contrast to the apes, is very marked in the knee joint, which was adapted for perfect extension of the leg.

A discussion of the characters of the femur leads Doctor Dubois to remark:

. . . *Pithecanthropus* cannot have possessed a human-shaped pelvis, but as the femur could to all appearance be extended to a human degree, the pelvis may have been comparatively more human than that of *Hylobates* and chimpanzee. . . With such an unhuman pelvis the locomotion of *Pithecanthropus* cannot have been exclusively, perhaps not even chiefly, on the ground. The erect type was not perfectly developed.

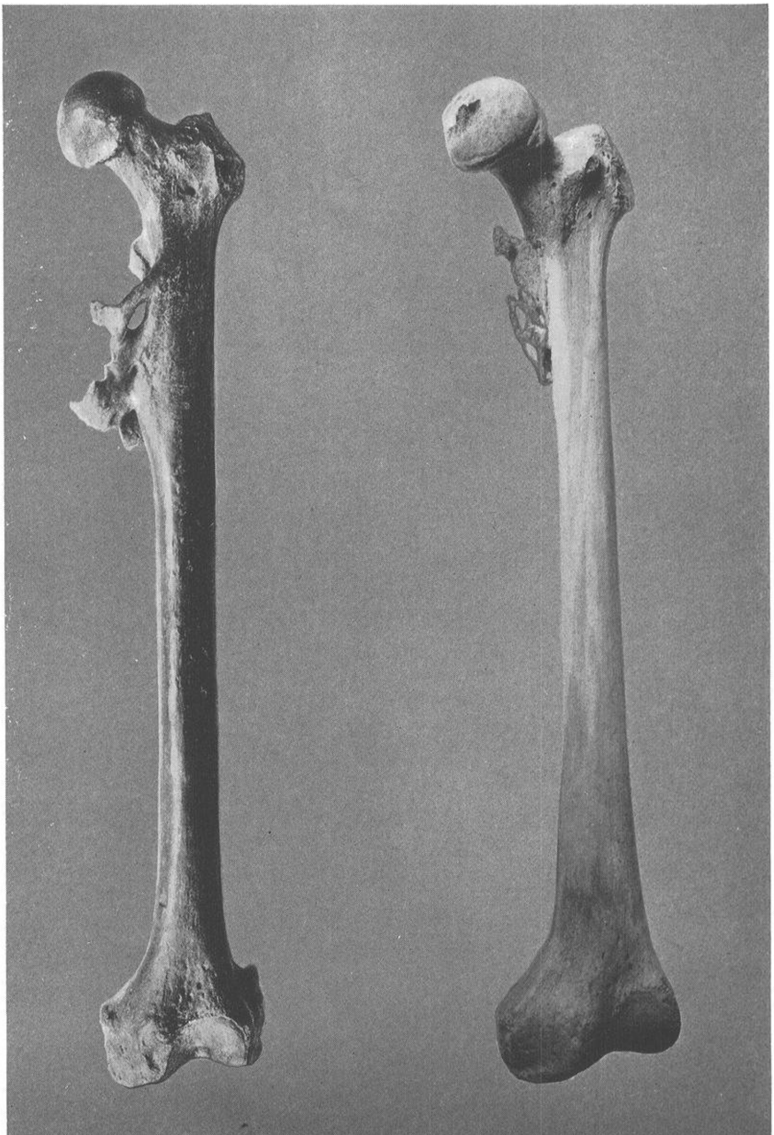
The characteristics of the hip joint and also the knee joint "render it probable that *Pithecanthropus* was less ground-walker than tree-climber, but did not climb with a prehensile foot, in the way of Apes. . . . The femur of *Pithecanthropus* was, therefore, also fit for locomotion on the ground, but by no means adapted so exclusively for it as in *Homo sapiens* and *Homo neanderthalensis*." (Plate 48.)

Doctor Hrdlička finally concludes:

But all this is not the pivotal essential of the find, and diminishes in no wise its high interest and value, both of which are universally acknowledged, particularly since the endocranial cast has become available. Neither should the student allow himself to be confused by the seeming flood of discrepancies of opinion on the remains. The differences are often more apparent than real, and even where real they by no means discredit the find, but are only so many trials, under all the great limitations of our present collections and knowledge, to reach a true conclusion.

The Trinil skull alone is sufficient to establish the presence in what is now Java, somewhere during the early Quaternary and possibly earlier, of a class of beings that so resembled the anthropoid apes, on the one hand, and came so far in the direction of man, on the other, that if it was to be named today we could hardly find a more appropriate name for it than *Pithecanthropus*.

It really is of little moment whether one student calls these beings giant gibbons, another, human precursors or intermediary forms, and a third, *proto-homo* or even a very low man; unless one is led astray from the truth by a lack of sufficient contact with the remains, they all mean a form somewhere between the status of all the known apes and of all except perhaps the earliest man. Who can say



Thigh bone of *Pithecanthropus* (left) and of a white American, on the same scale; both show abnormal growth of bone near the upper end. The straightness of the bone shows that *Pithecanthropus* had already acquired an erect posture. Photograph by Hrdlička

just where we could class a being with such an apelike skullcap but within it such a near-human brain, if he appeared in life today? Witness the able discoverer alone, who moreover has had the originals at hand now for thirty-six years. First they represent for him a great chimpanzee; then a human precursor and direct ancestor; and then they are of an intermediary but not human ancestral form.

The brain form of *Pithecanthropus*, which, due to the filling of the skull cavity with a hard mass, did not become available until three years ago, is exceedingly important. Its size and form and gyration appear to remove it at once from the brains of all known apes and bring it correspondingly close to that of man. It is inconsistent with and morphologically superior to its own skull. The female brain cavity measured in capacity at least 900 c.c. A corresponding male brain cavity would measure somewhere about 1,100 c.c. These dimensions connect already with the human (see Fig. 29). In my collections in the United States National Museum, I have thirty-two American Indian skulls, of small-statured but otherwise apparently normal individuals, ranging in capacity from 910 to 1,020 c.c. In the largest gorilla this capacity does not exceed, so far as known, and mostly is well below, 600 c.c.; and in the chimpanzee or orang-utan it never reaches even this proportion. The frontal lobes of the Java specimen, while still low, approach in their form the human, lacking the pointed keel-shaped appearance they have in all the apes; and the rest of the brain is of a higher type than that of the apes. Had this form advanced in size and shape of brain by as much again as it already stood above those of the known apes, it would be wholly impossible to exclude it from the human category, unless it was done by the establishment of a separate genus of creatures equivalent in brain mass and brain differentiation to *Homo*.

With all this it would not be legitimate to assert that the *Pithecanthropus* was either a form of early man or one that eventually evolved into man. Either of these conclusions would demand decisive supporting material, which does not exist. The most that appears justifiable until further and conclusive evidence appears, is to consider the *Pithecanthropus*, as represented by the skullcap, to have been a high primate of as yet uncertain ancestry and no known progeny, far advanced in what may be termed a humanoid direction.

. . . .

Taking everything into consideration the indications are that the *Pithecanthropus erectus* was a being that well deserved the name of "a human transitional form from Java" which, not in single specimens but as a type, can show us the way followed in human evolution from the lower forms.

Rhodesian Man

Another extremely important discovery of recent years is that of the fossil man of Rhodesia, in South Africa. This is discussed here, not because it is earlier than those of Piltdown, of Heidelberg, and of Java, but because there is even less certainty regarding the period to which it belongs than is the case with these others. Of Rhodesian man Doctor Hrdlička writes as follows:

On June seventeenth, 1921, a very remarkable human skull was discovered in the Broken Hill Mine, northern Rhodesia (Plate 49). It was the skull of a man whose features were in many ways so primitive that nothing quite like it had been seen before; and coming from a part of the world which hitherto had given nothing similar and in which nothing of that nature was ever suspected, it aroused much scientific attention.

Fortunately the specimen was saved, with but a minor damage, and later in the same year was brought by the manager of the mine to the British Museum of Natural History, where, safely preserved, it constitutes one of the scientific treasures of that institution.

The sparse data about the Rhodesian find left a desire for more details about the position of the skull, about its surroundings, about the cave itself and its fillings, about the nature of the animal bones in the cave, about the general region in which the "broken hill" with its cave existed, and about other possible remains, as well as the native types of the territory. The skull was so remarkable that every view of it and every further word published upon it served only to intensify the feeling of need for more complete answers to the above questions. It was this motive, together with the recent discovery of the skull of a highly interesting anthropoid ape near Taungs, Bechuanaland, that induced the writer to extend his late journey to South Africa.

Upon arrival at Broken Hill the writer was rather astonished to find the whole region for many miles in every direction to be a great, level, loosely forested plateau, barren of hills with one slight exception. This exception is a small "kopje" situated near the railway tracks as one nears the Broken Hill mine and settlement. This little hill, only about ninety feet high, is said to resemble closely the former "broken" hill which gave us the Rhodesian man and which has now, through mining, been removed.

The plateau of the town of Broken Hill is 3,874 feet above sea level. Up to the time of the commencement of mining operations it was a part of a vast, featureless, more or less openly forested region. But the minerals in the two "kopjes"—lead and zinc—may have been known to the natives in earlier times. At all events, in digging ditches and in other surface excavations about the mines and in the town, there are being found, buried up to eight feet in depth from the present surface, old primitive native smelters, with here and there some Negro pottery, indicating probably former burials.

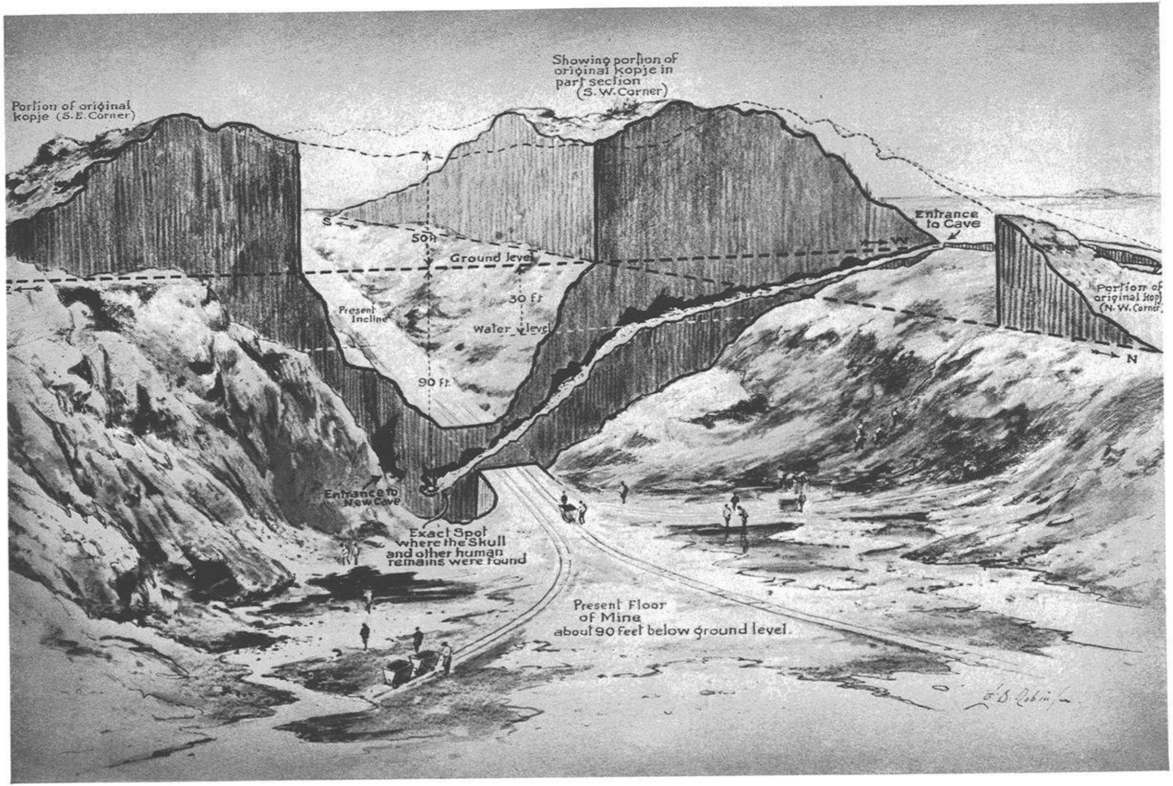
The "broken" kopje consisted of hard dolomitic limestone impregnated with lead, zinc salts, and vanadium. It was originally full of crevices and holes, and as shown in the course of mining, at least two large caves led deeply into the interior.

The cave of special interest became known as the bone cave. This cave in the course of time had become filled with sand, soil, bones of animals, and detritus of various kinds, which in turn were impregnated by seepage carrying in solution mineral matter. This matter formed incrustations on the walls, here and there formed new ore deposits, and in general consolidated most of the contents, bones included, into a "paying ore."

The kopje that yielded the "Rhodesian skull" was situated approximately northwest to west of the present railroad station and measured about 50 feet in height by 250 feet in its longer diameter. This entire elevation has now disappeared, and where there was a hill there is now a deep hole, in and about which mining operations are still energetically proceeding.

Before mining began in this craggy "broken" kopje there was nothing to indicate the presence of any human habitations about the hill, or at least nothing sufficiently conspicuous to be noticed. Mining was carried on from the side, but due to the condition of the mineral deposits work was later commenced also from the top proceeding downward. During the earlier operations from the side, a good-sized cave or fissure was reached and found to contain dirt, ore, and numerous bones. The bones were those of animals; if any others were present they were not noticed. They were for the most part so mineralized that they were smelted with the rest of the ore and, after the first flurry occasioned by their discovery, received little further attention.

When the excavations from the top reached in the center to approximately ninety feet below the surface of the ground surrounding the kopje, a large inclined plane was opened to the central funnel from near the side at which the original work began. At some distance this plane once more encountered the large bone crevice that had



The Broken Hill cave, in Rhodesia, South Africa, shortly following the discovery of the skull. From the *Illustrated London News*

been discovered before. The crevice passed here obliquely across part of the incline and, as in the portion seen earlier, was filled with detritus, bones of bats or rodents, ore, and more or less mineralized bones of larger animals. The extent and contents of this cave or crevice were only learned gradually in the course of the prolonged work of mining.

After the inclined plane reached the bottom of the central excavation, some of the workmen were directed to turn back and work on the ore and stone exposed by the plane; and it was in these parts, not long after, at a level of approximately sixty feet below the surface, that a Swiss miner, Mr. T. Zwigelaar, working with his black "boy" in some softer fillings, was confronted, after a stroke of the boy's pick, with the Rhodesian skull (Plate 50).

As good fortune would have it, before the writer's departure from Broken Hill he was able to locate and interview five of the men concerned from the beginning in the discovery, including Mr. Zwigelaar, who actually found the skull; and a sixth one was reached later by a letter. Each of these men was most willing to tell all he knew, but their memories regrettably were no longer clear as to the particulars. However, what was obtained is not without importance. At the British Museum the writer was very kindly furnished with copies of all the official entries relating to the find and to an earlier collection from the same cave.

As the collective sifted result of the information obtained from all quarters, as the result of the personal inspection of the mine and of what remains of the bone cave, and with the impressions left by the different men associated with the finds, the conclusion is that the real conditions had probably been somewhat as follows:

The "bone cave" was an extensive irregular crevice running for 120–150 feet inward and downward from near the base of the hill and reaching the maximum depth below the surface of about 70 feet.

There is no recollection of the mouth of the "cave" and this may have been covered or obstructed. Inside, the crevice enlarged to a cavern which at its maximum measured probably over thirty feet in breadth and twice as much in height.

For some distance from the mouth of the cavern the floor of the latter was nearly level or but moderately inclined, then there was a steeper descending slope, and after that the crevice ran irregularly downward and inward.

The outer part of the cavern was largely filled with more or less mineralized and consolidated bones of animals, cave detritus, large quantities of bones of bats or small rodents, and nondescript earthy material, the walls being covered with crystals of the ores of zinc and vanadium. The larger bones were distributed unequally through the filling of the cave, in some places there being large quantities of them, in others few or none. They extended to and beyond the descent in the floor.

The lowest and innermost part of the cavern was filled by detritus, some bones, and by a considerable layer, or rather layers, of very pure and more or less crumbly lead ore. The ore contained no bones or foreign substance; but it is not absolutely known whether the contents of the farther part of the cavern had a direct connection with the materials in the large outer portion through or underneath this lead ore.

The skull was found at some distance beneath a layer—according to Mr. Zwigelaar's recollection, about ten feet thick—of this ore. It was not itself embedded in the ore but in a detrital material not mineralized to any extent and containing a quantity of "bat" bones.

The skull was an isolated object. It lay upright. There was no lower jaw, nor any other bone in apposition. Beneath it was something which looked like a large, flattened skin bundle, thoroughly mineralized. This may or may not have been merely a natural laminar formation of the lead ore. Barring a few fragments, it was smelted.

Somewhere in the vicinity of the lower portion of this "bundle" was found a remarkably straight but otherwise not peculiar, full-sized human male tibia, and lower, at some distance, were portions of a mineralized lion's skull. In the vicinity there may have been found also one or two other human fragments, but here much is uncertain.

The larger part of the bony contents of the main part of the cave was so mineralized that it passed for a good grade of zinc ore and was smelted as such. Various portions of the cave fillings, however, were poorer and were brought out and thrown on a dump where, covered by poor rock and débris thrown out subsequently, they still repose. The ground and the débris in the dump are still full of fragments and pieces of bone, teeth, chips of quartz, etc.

Only traces of the great cave now remain in the mine, and as the work progresses they will disappear. The opposite wall of the mine shows an even larger old cavern, completely filled with less consolidated and somewhat darker materials than the surrounding rock. This cave has yielded no bones.

The main part of the bone cavern was for a long time a habitat or a feasting place of the ordinary Africans, Bushmen or Negroes. The larger bones were none of them brought in by animals, but were the remains of the repasts of the black men. A very large majority were broken for the marrow. Similarly broken human bones suggest cannibalism. There were apparently no human burials in the cave. How the strange Rhodesian skull got in is unexplainable.

The skull was found alone in the lowest and most remote part of the cave, some distance beneath considerable accumulations of soft, pure lead ore. There was no lower jaw. There was no skeleton. One human bone, the tibia, and parts of a lion's skull, it is well established, lay within ten feet of the skull, but at a lower level.

As to the other human bones deposited at the British Museum with the skull and those now added, all that may be said is that they proceed from several skeletons of modern size and form; that some of them, at least, probably came from other parts of the cave; and that there is no proof, and but a remote possibility, of any of them belonging to the skull.

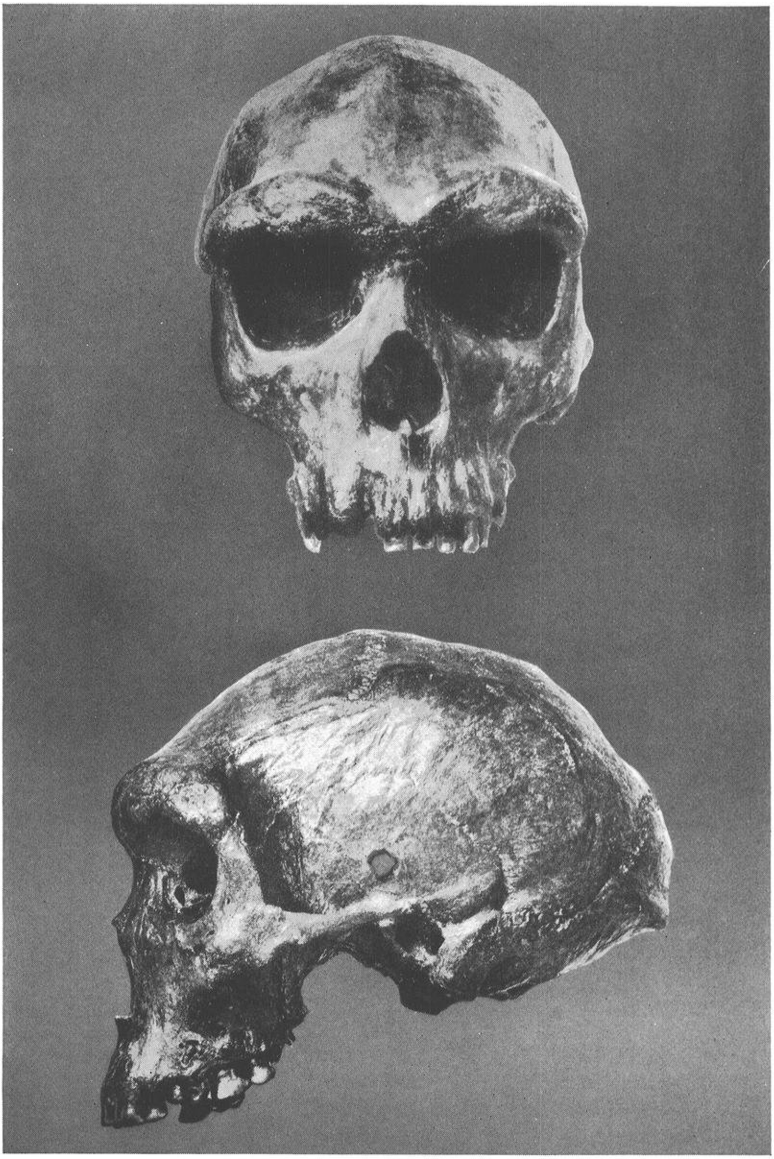
The skull itself is positively not the skull of any of the now known African types of man or their normal variants. Neither is it a pathological monstrosity, such as might be due to gigantism or leontiasis. It is a most remarkable specimen of which the age, provenience, history, and nature are still anthropological puzzles.

Morphologically the skull is frequently associated now with the Neanderthal type of Europe. This may be fundamentally correct, but only to that extent. In its detailed characteristics the specimen in some respects is inferior, in others superior to anything known as yet of the Neanderthal man.

The skull is monstrous, its frontal and most of the facial parts exceeding in primitiveness every other known specimen of early man. The skullcap, on the other hand, from behind the frontal ridges is of a decidedly higher grade, equaling in many respects, and in some even exceeding, those of the more typical Neanderthal crania.

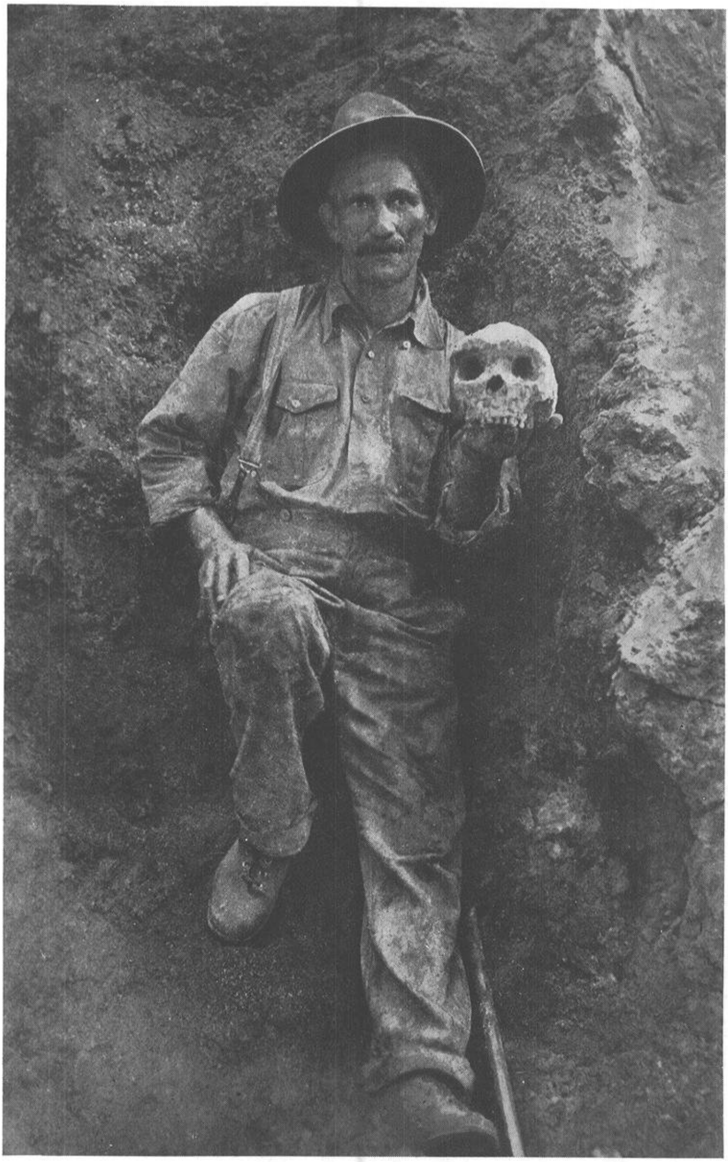
The subject was plainly a very powerful male, of probably over forty years of age. The skull is in no way pathological, though showing some diseased conditions; and it can not be conceived as a near-reversion. It represents a distinct, crude variety of man, which strangely combines many ancient, even pre-Neanderthal conditions, with others that are relatively modern. It could represent conceivably a very brutish individual development of the upper Neanderthal or the post-Neanderthal period.

The most striking features of the skull are its huge supraorbital ridges. They are not far from twice as stout



The Rhodesian skull, front and side. Notice the enormous development of the bony ridges over the eyes. After Pycraft

PLATE 51



Mr. Zwigelaar, the discoverer of the Rhodesian skull, shortly after the find was made. Photograph presented to Doctor Hrdlička by Mr. Zwigelaar as in the Neanderthalers. No such immense welts have ever been seen in any other human specimen, nor even, if their thickness alone is considered, in the anthropoid apes. They constitute a huge exaggeration of this ancient characteristic of male primates. Yet these ridges are already human rather than anthropoid in character.

The slope of the forehead is as great as it is in some of the apes. In this quality, in its marked metopic ridges, its narrowness, and also in its anterior flare and relative smallness as a whole, posteriorly the Rhodesian frontal approaches closer to the frontal of the *Pithecanthropus;* though the ridges of the Rhodesian skull are much the heavier.

The study of the specimen leaves an impression of anamorphism. It is a combination of pre-Neanderthaloid, Neanderthaloid, and recent characters. It is not a Neanderthaler; it represents a different race or at least variety.

The specimen does not seem to belong in its surroundings. It does not fit with any of the other human remains, skeletal or cultural, saved from the cave. It does not fit with anything, the Negro in particular, found thus far in Africa.

It seems impossible to conceive of the specimen as a reversion. Reversions tend as a rule to manifest themselves in a single character or in a small group of associated characters. The primitive conditions of the Rhodesian skull are more comprehensive.

It seems equally impossible to regard the strain of man represented by the skull as a survival to recent time. There is nothing in anthropological knowledge that would support such an assumption. Yet the diminishing third molars, the shape and size of the other teeth, the extensive caries, and other points, speak against hoary antiquity.

The Rhodesian skull is a tantalizing specimen to the student, who is wholly at a loss as to just where it belongs taxonomically or chronologically. It is a comet of man's prehistory.

Professor Elliot Smith shows the volume of the brain of the Rhodesian skull to have been but 1,280 c. c., which is markedly smaller than in any of the Neanderthalers with the probable exception of the Gibraltar female.

The cast, very successful, shows the brain to have been in general very definitely human, related to that of the Neanderthalers, and superior to both that of the *Pithecanthropus* and *Eoanthropus*.

Mr. Hopwood has identified the mammals of the Broken Hill cave, of which he has the following to say:

> The study of the mammalian bones found at Broken Hill was undertaken in the hope that they might afford some evidence as to the age of the human remains found in the cave. It seemed reasonable to suppose that, if the contents of the cavern were of any degree of antiquity, there might be found portions of animals which are extinct, or, at any rate, of species which are not at present represented in the fauna of Rhodesia. This hope has been realized only in part. The cave fauna is composed of living forms with the exception of *Rhinoceros whitei* Chubb and a new species of Serval cat.
>
> . . . .
>
> It is also well to remember that the African continental plateau is of extraordinary stability, and that it has been a land area from very early times. Furthermore, the climate has always been tropical, or sub-tropical, at least to the south of Egypt. Hence, apart from possible change in the rainfall, conditions of life have been comparatively fixed and the fauna is not likely to have altered in character so rapidly as in other regions, Europe and North America for instance, where great changes in the climate and geography have taken place in comparatively recent times. For these reasons it is practically impossible at present to estimate the age of African cave deposits by means of the fossil mammals. The fact that two extinct forms are known proves nothing. It is becoming ever more apparent that the mammal-bearing horizons of Central Africa are not comparable in age with those of Europe, and that in dealing with them it is useless to apply European standards. On the evidence of the associated mammalian fauna there is no reason to suppose that the human remains are of anything but recent date.

Conclusion

Accounts given in the last four chapters by no means cover all the finds of ancient human remains made thus far in various parts of the globe. But they cover briefly the more important discoveries and will perhaps suffice to make clear the nature of the steadily growing evidence upon which is based our knowledge of the remote past of mankind.

We have now discussed the physical side of man's development including both the world in which he found himself and also his own bodily structure. In doing this, we have proceeded step by step from the known to the unknown, from the comparatively recent past back into an antiquity almost inconceivably remote (Fig. 29), reaching a point at last where man or manlike creatures are indistinguishable from the anthropoids. The table on page 165 summarizes this panorama of man's physical history.

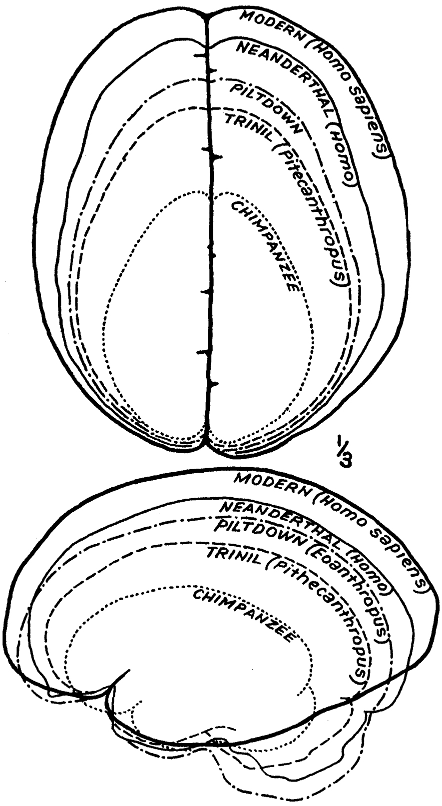


FIG. 29. Diagrams showing the top and side views of the outlines of the brains of chimpanzee, *Pithecanthropus*, Piltdown, Neanderthal, and modern man, to illustrate the progressive increase in size. After Osborn

MAN FROM THE FARTHEST PAST

In the remainder of this book we shall deal with the achievements of man's brain as distinguished from the development of his body. Beginning with the earliest known traces of his handiwork, we shall follow his rise stage by stage, from the first dawnings of his intelligence to the time when, in both the Old and the New World, he had laid the foundations of the civilization of today.

COMPARATIVE TABLE OF SKULL MEASUREMENTS AND BRAIN CAPACITIES OF MODERN AND PREHISTORIC MEN AND APES

	Old American White Males Average	Pawnee Indian Male	Neanderthal Man	Rhodesian Man	Pithecanthropus	Gorilla 8 Females Mean	Chimpanzee Males
Skull length, maximum, cm.	19.1	18.7	*20.1	*20.2	*18.3	....	....
Skull breadth, maximum, cm.	14.7	13.9	14.7	14.5	13.0	10.3	10.0
Cephalic index, %	76.5	74.3	73.1	71.8	71.04	†	‡
Diameter frontal, minimum, cm.	10.2	8.9	10.7	9.9	About 9.1	7.1	6.0
Diameter frontal, maximum, cm.	12.2	11.1	12.3	12.3	Near 9.6	8.2	8.2
Thickness of parietal, mm.	3.5–6.0	3.5–4.5	6–8	6–10	3.5–5.5	3–5.5	2.5–4.5
Cranial capacity, c. c.	1550	1480	Estimated 1230–1350	1280	About 950	500	400
Cr. cap., normal range, males, c. c.	1300–1850	....	.....	.....	.....	420–600	340–470
Cr. cap., incl. extremes, c. c.	910–2000	....	.....	.....	.....	.....	.....

* These measurements include the great protrusion of the supraorbital arch.
† Not measurable, but tending to slight dolichocephaly.
‡ Not measurable, but mesocephalic.

CHAPTER X

THE UNFOLDING OF MAN'S INTELLIGENCE

We can say with a fair degree of assurance that Cro-Magnon man appeared in Europe something like 25,000 or 30,000 years ago. With not quite so much certainty we can assign the beginning of the Mousterian culture, so closely associated with Neanderthal man, to a period somewhere around 50,000 years ago, more or less. But before that, we recall, there stretched away behind us, ever further back in the mists of the past, the Acheulian, the Chellean, the Pre-Chellean, and, earliest of all, the Eolithic or "Dawn Stone" Age. The last seems to have begun very far back in the Ice Age, or Pleistocene period, if not indeed earlier still, in the geological period known as the Pliocene.

Dr. Albrecht Penck estimated that the Ice Age began somewhat more than half a million years ago. There is reason for believing that, long before that, man had developed enough intelligence to employ sticks and stones in various ways, though without doing anything toward shaping them into more convenient forms.

How long ago he began to do this, we can not say. But let us assume, for the sake of illustration, that it was a million years ago. At this figure, at least seventy or eighty per cent of man's total existence as a tool-using creature had already gone by before he reached even the beginning of the Old Stone Age—the Pre-Chellean epoch. By the opening of the cave-dwelling epoch, when he took to living in grottoes, at the approach of the Würm glaciation, ninety-five per cent of his culture history thus far had been completed. When Cro-Magnon man appeared in Europe, ninety-seven and one-half per cent or more of it had elapsed. By the time the Ice Age had at last come to an end in Europe, ninety-nine per cent was already a thing of the past. The beginning of the Age of Metals and of the knowledge of writing in the most advanced portions of the globe occurred only something like 5,000 or 6,000 years ago. Hence the entire historical portion of man's existence, the only part which we know through written records, amounts to but one-half of one per cent of his whole career up till now. It is this fraction of one per cent that has witnessed the blossoming of civilization in Babylonia, in Egypt, in India, in China, and elsewhere. It represents the time between the building of the Pyramids and the invention of the aeroplane and the radio. Of course, the precise figure of 1,000,000 years for the total length of man's existence as a tool user is an arbitrary one. It may have to be cut in two on the one hand or doubled on the other, in the light of future discoveries. But for the time being it will serve its purpose of helping us to realize what a very brief space of time is allotted to the historical epoch by contrast with the long prehistoric period that went before.

Recent discoveries have shown that during the earlier and by far the greater part of the life history of our race, more than one kind of man existed. The human species of today, in all its various races and subraces, represented at first but one among several different forms of which remains are already known. Moreover, there were almost certainly others not yet discovered, or which died out without leaving any traces of themselves in the form of fossils. How long any of these now extinct forms survived we do not yet know. Some may have lingered on in out-of-the-way regions until comparatively recent times, as that strange monster, Rhodesian man, may possibly have done in South Africa. The existing type has achieved the mastery of the globe, slowly and patiently and under conditions of hardship and danger such as we now can scarcely imagine, only because it was on the whole the form best adapted to win in the struggle for existence.

Perhaps we can picture to ourselves something of the appearance of primeval man. From the earliest human remains found thus far, we know that very far back man already stood nearly if not quite upright. He was probably covered fairly thickly with hair, of which indeed we still find traces on our own bodies. No doubt it tended to grow longer and thicker on the head and jaws, and it must have been shaggy and matted. In texture we may be pretty sure that it was neither coarse and straight, like that of the Mongol or the American Indian, nor kinky like that of the Negro, but something in between. Probably, too, it was not black but brownish in color. How man came to lose his body hair to such an extent remains an unanswered question. One of the most plausible explanations suggests that some connection exists between this loss of hair and the wearing of clothing. But even this theory has a weak spot, for it seems to imply that all existing races, even those which go about naked today, must have worn clothes at some period of their development.

Regarding the skin color of primitive man, we have reason to believe that it was neither the pale white of the North European nor the sooty black of the darkest Negro, but again something in between—some shade of brown.

We have few clues to the features of man earlier than the Neanderthaler, about whose facial structure we know a good deal, but who comes on the stage rather late in the long drama of human progress. It is clear that true chins had not yet developed, for the more primitive lower jaws already found are in this respect quite apelike. The teeth, on the other hand, seem early to have acquired definitely human form, indicating that primeval man was depending more and more on his hands and less and less on his jaws for self-defense and the performance of various tasks.

Some of the early races had brows that projected far over the eyes, especially among the old males, to whom they must have imparted a scowling and malignant expression; others, however, almost if not entirely lacked this feature. Noses at first probably resembled those of babies today in flatness and shapelessness, while full and prominent lips such as characterize most modern races can hardly have developed very early. Among apes, true lips are almost wholly lacking, so that the mouth consists of little more than a straight slit across the lower part of the face. In this respect, the white man of today differs widely from the gorilla, and the Negro even more so. In primitive man resemblance to the anthropoid apes must have been considerably greater than in any existing race.

In the last chapter we saw that man, or perhaps his forerunner, had begun to develop a comparatively big brain very far back in his career. The famous Trinil skullcap, for example, indicates that the brain it once covered stood almost exactly halfway in size between that of the highest ape and the lowest human form of today. Piltdown man's brain was larger still, following well within the human limit. Scientists long debated whether man acquired a nearly erect posture and consequent freer use of his hands before he developed a big brain, or whether increase in brain capacity preceded these other anatomical changes. But now there seems to be pretty general agreement that growth of intelligence came first, that the brain led the way in man's development.

The determining factor in man's success was, of course, this growth of his brain. Physically he was less well fitted for the battle of existence than many other creatures. The wild bull far surpassed him in strength, as did the wild horse and various other animals which he in time domesticated and made his obedient servants. The lion, the tiger, and many other species which he has either exterminated or driven to take refuge in the depths of the wilderness, exceeded him in ferocity. But thanks to his superior intellect, he asserted his supremacy first over the animal world and then over inanimate nature. The struggle goes on, though the tiger and the mammoth as man's most dangerous enemies have given place to insects like the fruit fly and the boll weevil and to small mammals like the rat. His conquest of inanimate nature has gone on much more slowly; in fact even today it has only barely begun.

This increase in brain power and the consequent growth of ideas would, however, have profited early men as a group but little if they had not had some means of communicating with one another. Language in the broadest sense, including gesture as well as sound, began long before man himself first appeared; but only he, of all living creatures, was able to develop it and be developed by it. It constitutes the earliest as well as the greatest of the achievements of his genius, none the less important because achieved unconsciously.

For untold ages, however, man had to depend wholly on word of mouth and on signs for the communication of ideas, and on the unaided memory alone for their preservation, limitations which account, in part, for the extremely slow progress made by mankind in early ages. Only within the last few thousand years has mankind slowly been learning to preserve the results of past experience by putting them down in writing. The keeping of records is even yet far from universal, or even general. The greater portion of mankind, outside of America and western Europe, remains illiterate, although nearly everywhere it has come more and more under the control and direction of ruling elements, native or alien, familiar with the art of writing. In fact, largely by this very knowledge have these classes gained the ability to control and exploit their fellow men.

The mechanical problems involved in the struggle for existence, of course, far antedate the human race. At first man had no better means of solving them than had the lower animals. For ages he prowled about, naked and shaggy, depending for his food and his safety solely upon his own hands and teeth and muscles. But there came a time when his dawning intelligence suggested to him that he might make use of tools other than those with which nature had equipped him. The discovery that he could strike his enemy a heavier blow with a broken bough than with his unaided fist, or crack nuts and shellfish more easily with a pebble than with his own back teeth, or hurl

FIG. 30. Eoliths from Cantal, France, of the Tertiary Period (preceding the Ice Age) showing how marginal chipping was done on one face only. At left, two views of a scraper: at right, two views of a spokeshave. After Verworn

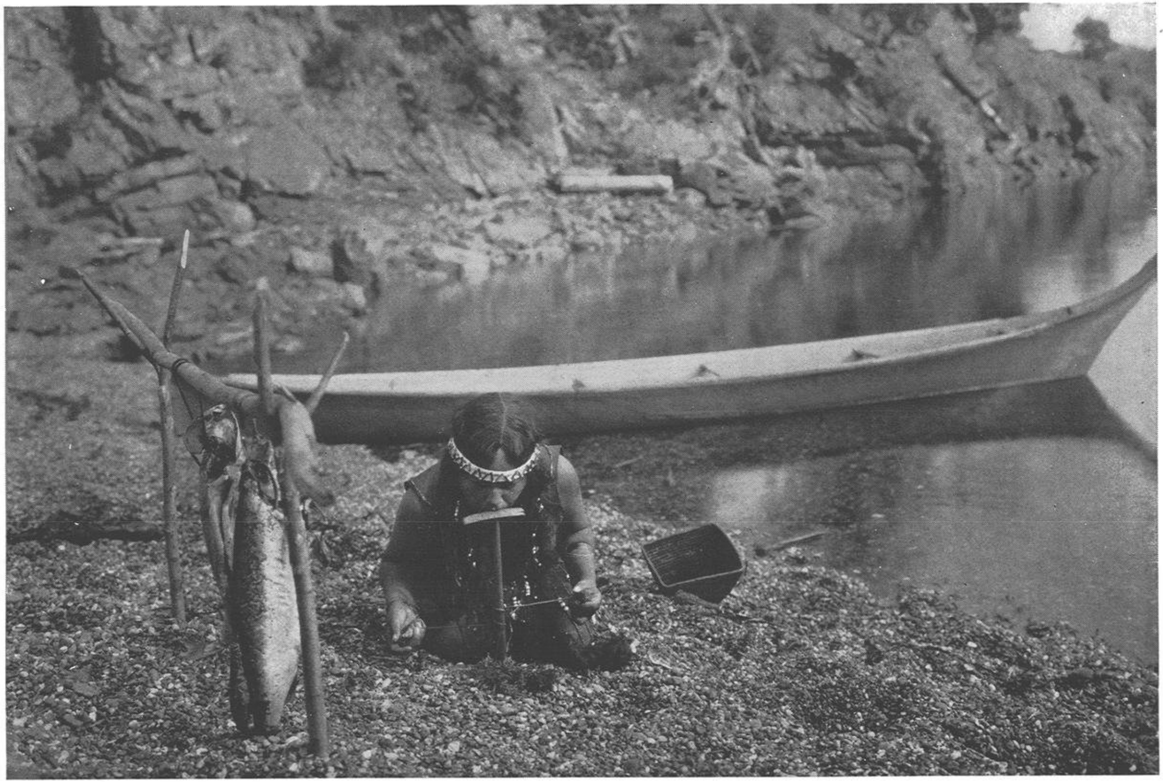
a stone and thus bring down small animals out of the reach of his arm, marked a great step in advance in his age-long struggle to master his environment. He had at last become a tool user.

At first, of course, after learning this lesson, primitive man merely used such sticks and stones as came handy, throwing them away when the momentary need was over. But through long experience he discovered that certain forms were so much more useful than others as to be worth keeping and carrying about. Then he found that they could be still further improved by a little shaping and trimming. A club was easier to wield if twigs and irregular projections were broken off; a straight, slender branch scraped down to a point made a fairly effective dart; a few chips knocked off the sides of a flint pebble gave it a rough edge with which raw meat could be cut up instead of being torn with hands and teeth. But how infinitely slow this process of self-education was, the very long duration of the earlier stages of man's existence shows. When it was completed, however, man had at last attained to the Eolithic or Dawn Stone Age. He had become not merely a tool user, but actually a tool maker as well, even though on the humblest imaginable scale.

Sometime during this same early period that other epoch-making discovery, the use of fire, took place. How long ago this happened we do not exactly know as yet. In the Acheulian epoch, during the third interglacial stage, fire was certainly already known and used, as we know from layers of burnt wood and charred bones uncovered on Acheulian sites. But the practice appears to go very much further back still. At Foxhall, near Ipswich, in the east of England, burnt flints, along with bones, flint implements, etc., have come to light, which may belong to the Eolithic Period. If so, it carries us back, not merely into but actually *before* the Ice Age itself.

Fig. 31. Primitive method of starting a fire by twirling a stick between the palms of the hands. Northeast Australia. After Frobenius

All authorities seem agreed that man knew fire and understood how to utilize it and keep it going long before he learned how to kindle it. Many natural phenomena may start a fire, lightning, for example, or volcanic eruptions with their accompaniment of white-hot lava. Sometimes, during long dry spells, two interlocking branches rubbed together by the wind may burst into flame. But how man found that fire, hitherto only a source of danger and superstitious awe, could be made useful, we can but guess. In any case he knew this ages before he learned to make it. In fact, a quick and easy way of starting a fire



Fire-making by rotating a stick swiftly with the aid of a piece of string held taut between the two hands. Western North America. Photograph in the Library of Congress

is a very recent discovery, the invention of the first really practical matches dating only from 1827.

The discovery of the usefulness of fire is one of man's greatest achievements, without which progress would have been utterly impossible. But at first he must have put it to a very limited number of uses, probably to give warmth and protection against wild animals, and later to prepare food. The primitive camp fire was the first gathering point around which men could meet, so that it wielded enormous influence in encouraging social activities and the interplay of ideas. For long man looked upon it as something mysterious and uncanny, as a living being with an insatiable appetite. Even today we are voicing ideas handed down from our remote prehistoric ancestors when we speak of "feeding" the fire to "keep it alive." Nowadays such expressions are regarded only as figures of speech; but there was a time when they were meant literally. Because fire had to be tended constantly, while the men were often away hunting or on the warpath, its care fell naturally to the women. Out of this practice arose in later ages the institution of vestal virgins, keepers of the undying fire, found not only among the Romans but among many other peoples both ancient and modern.

We have, then, the three basic inventions—speech, tools, and fire—by which man first raised himself definitely above the animals about him and which in time led to further advance.

Along with these three basic inventions, although coming much later and possessing nothing like equal importance, we may consider the origin of clothing. Fundamentally this had for its motive the desire for protection, mainly from cold but partly, too, from injuries, whether real or imaginary, that is, of a magical sort. Thus its development has tended to vary with climatic conditions.

In cold countries, the use of animal skins for warmth must date back pretty far. The natives of Tierra del Fuego, at the extreme lower tip of South America, apparently represent a very primitive branch of the American Indian stock. Although they occupy an extremely cold and wet region, until recently they wore only a piece of sealskin slung about their necks, which they shifted about so as to keep it on the side from which the wind, sleet, and snow came. This represents only a slight improvement upon primitive total nudity (Fig. 32). Cutting and fitting skins and sewing them together to form fur garments, such as the Eskimo wear, represents a much greater advance. This stage must have been reached in some countries before the close of the Old Stone Age, for well-finished bone needles have been found in deposits of that period. Skins remained the material for clothing until the invention of weaving; the buckskin garments of our own North American Indians furnish an example. Such clothing belongs more especially to cold regions, or at least to those having cold winters.

FIG. 32. Native of Tierra del Fuego wearing only a piece of sealskin slung around his neck as a protection from the cold and rain. After Deniker

Skins have, it is true, been worn in warm countries; but the original motive there seems to have been mainly magical. They were thought to confer upon the wearer the qualities of the animals to which they once belonged, just as did necklaces and bracelets of teeth and claws (Fig. 33). It seems to have been for this reason that a leopard skin came to be an emblem of rank and power among the Egyptian Pharaohs. The lion's skin, which distinguished

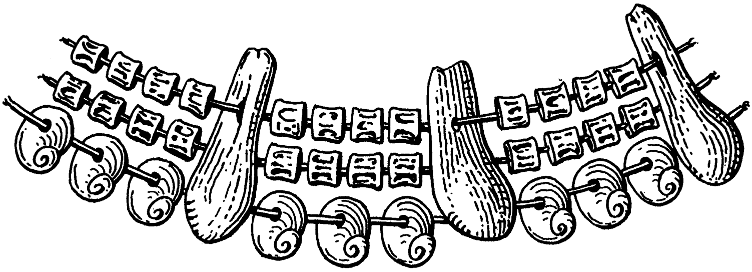


FIG. 33. Necklace of the later Old Stone Age, from the Grimaldi caves, composed of deer teeth, fish vertebrae, and shells. It was found with the skeleton of a young man. After Verneau

Hercules, doubtless originated in a similar idea, when lions still existed in the lands about the eastern Mediterranean.

Another great idea which must have dawned upon primitive man pretty far back in his career was that of fastening things together by tying them. The invention of string enabled man to do countless things he otherwise could not have done, though, no doubt, he realized only very gradually the full extent of its usefulness. The earliest and for a very long time the only string must have been that provided by nature, in the form of tough vines and tendrils of various sorts. With these, tools and weapons and objects of magic could be more conveniently carried about; for they might now be slung from the waist or over the shoulder or about the neck. With them, too, bundles could be made of firewood, edible roots, and the like, for convenience in transporting or keeping.

Later, man came to employ strips of fibrous bark, the sinews of animals, and thongs cut from skins. These made it possible to lash stone axes and spearheads to their handles, and to sew together fitted garments. In time some genius also found that lines of almost any length and strength might be made by twisting fibers together, thus providing cords for fishhooks of shell or bone and har-

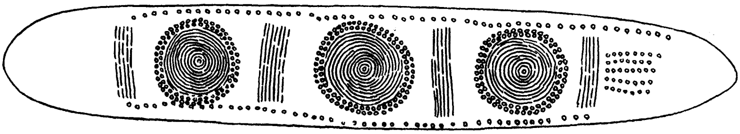


FIG. 34. Central Australian churinga or sacred object, decorated with totemic devices. It is unlawful for women and uninitiated males even to look on these. After Spencer and Gillen

poons of deer antler, as well as ropes for towing canoes upstream against currents too swift for the pole or paddle. Without the knowledge of string, too, the invention of that most important appliance, the bow and arrow, would have been impossible. The varied uses of cords, ropes, cables, and hawsers in the rigging of ships, or of thread, yarn, and twine in connection with the weaving of cloth, will occur to everyone. Consideration of these things will, perhaps, indicate the vast though often hardly recognized importance of string in the history of human progress.

On these bases man's later achievements rest; what were some of the obstacles which he had to overcome? Among these, perhaps, disease and the fears, beliefs, and practices to which disease gave rise stand first. We make a great mistake if we suppose that perfect health blessed the primeval savage. His fossil remains show that in many cases he suffered severely from pyorrhea and other ailments that affect the bone. He was a prey to bacterial and zymotic diseases. Epidemics doubtless occurred; and changes for the worse in diet, caused by alterations in climate, perhaps helped to bring about the extinction of some of the early species of man.

An Arab still. These people in the centuries after Muhammad seem to have spread the knowledge of distilling alcohol from western Europe to eastern Asia. From an old print in the Library of Congress

The modern man finds it difficult to realize how completely early man was a slave to magic. No matter what happened to him, he immediately laid it to some supernatural influence, usually evil. Injuries, whether due to accident, to attacks by wild beasts, or to struggles with his fellows, were the result of his being bewitched. Failure in hunting meant that some enemy's "medicine" was more powerful than his own and was working against him. Nowhere was this belief stronger than in the case of disease, which mankind has ascribed during by far the greater part of its existence to the action of mysterious and malignant forces, at first vague, formless, and invisible, but later personified as spirits which might at times appear in bodily shape. The belief in witchcraft by no means first acquired importance during the Middle Ages.

The dominance of magic over the life of early man can not be overestimated. It represented his first attempts to inquire into the secret workings of nature and to control and exploit them for his own benefit. It played the part with him that religion, philosophy, and science occupy with us. It shaped and influenced all his thoughts, and it lies at the root of all his various slow, blundering, and halting steps upward—his gropings toward the light. The primitive medicine man, because of the mysterious knowledge and consequent power attributed to him, was the first ruler and director of mankind. He could, and often did, terrorize whole communities; but woe to him if his magic failed or if he was suspected of imposture, for then nothing could save him from the fury of his dupes.

This way of thinking still persists among many peoples, and did until recently among many more. In the struggles of that remarkable Indian, Tecumseh, against the encroachments of the whites, his followers drew their inspiration not only from his genius as a leader, but fully as much from the claims to magical powers put forth by his brother, "the Prophet." When these were discredited by the loss of the battle of Tippecanoe, all Tecumseh's efforts to unite the Indian race against the whites proved useless.

And so with disease; only the most enlightened peoples deal with its prevention and cure along scientific lines. Everywhere else, even today, it is the medicine man and the witch doctor, with their drums and their charms and their incantations, who are called upon in case of sickness.

FIG. 35. African witch doctor or medicine man, wearing mask and other paraphernalia of his profession. After Frobenius

From bad habits, as we understand them, early man seems to have been comparatively free. These have come largely with a higher civilization, with increasing knowledge of the various processes by which nature may be controlled. Alcoholic drinks of any sort, for example, were discovered only comparatively late in man's history, toward the close of the prehistoric period. And even then, at first, man knew none but comparatively mild fermented beverages. He made these from various substances, such as honey, grain, and the juice of different fruits, especially grapes. They were thus analogous to the "light wines and beer" of which so much has been heard in recent years in connection with the prohibition controversy.

Moreover their use was for long almost wholly confined to ceremonial and sacramental occasions. Primitive man thought that they were imbued with a mysterious divine influence which they could impart to the worshiper. The expression "to drink to one's health" contains a last lingering trace of this once general belief. Owing both to their low alcoholic content and to their limited use, they did relatively slight, if any, harm.

But when, during the past thousand years or so, man learned to subject various fermented fluids to distillation and thereby first produced spirituous or "hard" liquor, containing a high percentage of alcohol, the question became vastly more serious. By a strange irony of fate, it seems to have been the Muhammadan Arabs, themselves a temperate people, who spread the knowledge of this process through the Old World during the Middle Ages, from Europe on the one hand to China on the other.

At first distilled drinks were regarded and used as medicines. We still see a trace of this in our word "cordial" as applied to certain alcoholic beverages. Readers of *Robinson Crusoe* will recall that hero's satisfaction upon finding a "case of cordials." Later, particularly in Europe, as distilled liquors became common and cheap, they began to be consumed in enormous quantities. The frightful ravages wrought by the unrestricted drinking of gin among the poorer classes in England during the eighteenth century are an example. Then for the first time the "liquor problem" really became a serious menace to the welfare of mankind. It was distinctly a product of civilization.

Certain practices which we now regard with abhorrence, such as infanticide or the putting to death of the old and decrepit, were usually based on economic causes. So long as man remained ignorant of any means of growing his food, and so had to depend entirely for his living upon what he could gather or capture, famine remained an ever-present danger. Just as savages try, almost instinctively, to kill or chase away intruders upon their special hunting grounds, so they have also felt obliged to restrict their own numbers by doing away with an excess of newborn infants and those whom age or infirmity have rendered useless as food providers. In this respect savage man, constrained by his environment, has been mercilessly logical.

Regarding the effects of war upon man's progress in primitive just as in later times, it is impossible to make any sweeping statement. Some wars have ushered in striking advances in civilization on the part of one or even both combatants; for examplo, the conquest of the Persian Empire by Alexander the Great, and the spread of the Arab power from Spain to Turkestan. Others have resulted in desolation, the blasting of cultures, and the retarding of progress for generations, as did the Mongol onslaught upon western Asia and eastern Europe. War has also been a valuable, if stern, school of social discipline, teaching loyalty, self-sacrifice, and cooperative effort on a large scale. As long as it consisted of hand-to-hand contests involving actively the entire adult male population of any community, it resulted in the survival of those best fitted to perpetuate themselves in their offspring. The weak and

FIG. 36. African chief armed with shield and javelins and wearing plumes, necklaces, skin about the waist, and leg-rings; he stands on the bow of his war canoe. After Frobenius

stupid perished, while the strong and intelligent survived to transmit their qualities to their descendants. This weeding out of the unfit, going on without ceasing for tens of thousands of generations, could only have a beneficial effect on the quality of the race as a whole.

Only in very much later times did war become a struggle between organized armies whose success depended mainly on the possession of means of wholesale destruction. Since then it has been the brave, the patriotic, and the physically fit who have perished, usually before they have had time to found families, while the weak and timid have stayed at home to carry on the race. No intelligent stock breeder would dream of trying to improve his herd in any such way. Yet that is exactly what modern war does. As in so many things, here, too, civilization has checked and even reversed natural tendencies.

CHAPTER XI

THE OLD STONE AGE

MUCH uncertainty still exists regarding the Eolithic or Dawn Stone phase of man's cultural development, although such a stage must have preceded the Old Stone Age. This long and important period is usually considered to have begun with the Pre-Chellean, already mentioned more than once. Regarding the steps by which that culture period gradually developed out of the preceding Eolithic, or the region where it did so, we as yet know little, though it probably took place elsewhere than in Europe.

Nor have scholars reached full agreement regarding the relation of the earlier culture stages to the different phases of the Ice Age. That the Pre-Chellean falls early in the third interglacial stage is Osborn's view. He pointed out, for example, that Pre-Chellean implements are never found in the sands and gravels of the higher river terraces, which, as we saw, were laid down earlier in the course of the Ice Age. Other authorities, however, date the Pre-Chellean as early as the second interglacial, while a few even ascribe it to the first.

THE PRE-CHELLEAN EPOCH

The Pre-Chellean culture seems to have reached Europe from Africa, although this, of course, by no means implies that it was the work of Negroes. In fact at that time, and for ages after, the various human races had not yet acquired their present-day distinguishing characteristics. Whoever he was, whether of Piltdown or Heidelberg or still another stock, Pre-Chellean man appears to have wandered from northern Africa by way of the ancient land-bridges into western Europe. But traces of his presence, in the shape of flint implements in the river gravels, occur so rarely that the population of the time must have been extremely sparse. Into central Europe the Pre-

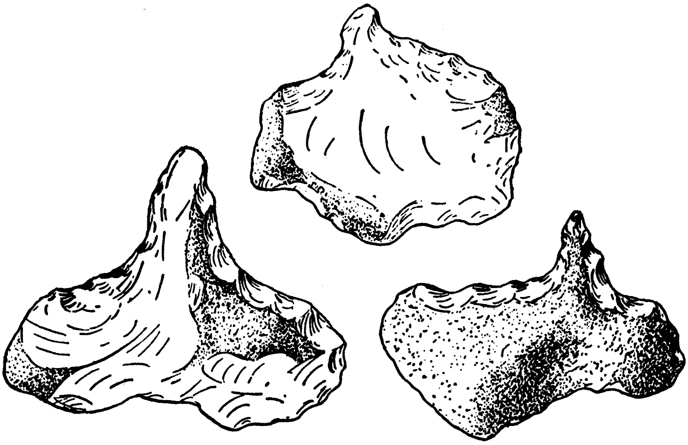


Fig. 37. Pointed types of eoliths, from southeastern England, made by man or his ancestor who lived 500,000 to 1,000,000 years ago, and probably used for boring or punching holes. After Harrison

Chellean culture seems not to have penetrated at all, its place there being taken by a form known as pre-Mousterian. This may indicate that different races or even species of men inhabited the two regions; but of this there is so far no positive proof.

The climate of Europe then, in marked contrast to that of the glacial stages, was in the main a genial one, even the winters being very mild. Hence both the vegetation and the animal life were rich and varied. In the forests and meadows and along the river banks ranged at least one form of now extinct elephant, if not two; the hippopotamus; two species of ancient rhinoceros; a primitive horse; deer; wild cattle; hyenas; and apparently the saber-toothed tiger. Man then found food, both animal and vegetable, plentiful, and he had little need for protection from cold. He may have known and used fire, although we have little actual evidence thereof. Probably he wore no clothing, and it is extremely unlikely that Pre-Chellean man had learned to erect even the simplest sort of shelter against inclement weather. His chief if not only need of defense, indeed, must have been against the dangerous wild animals of the time. The wandering life of the primitive hunter and food gatherer of those far distant days, unlike that of later Mousterian man, was surely on the whole an easy one, entailing little in the way of real hardship, privation, or peril.

The stone implements of the Pre-Chellean epoch are very roughly chipped; and the number of different types is extremely limited, their forms, indeed, being apparently determined mainly by accident. Pre-Chellean man made them almost exclusively from the cores of pebbles or nodules and not from the flakes chipped off from the latter. This distinction between a core and a flake industry is an important one. The Pre-Chellean flint worker clumsily left much of the crust or original surface of the pebble on his implements—something that the more expert tool makers of later periods rarely if ever did. The true *coup-de-poing*, or "fist-ax," so characteristic of the Chellean and Acheulian epochs which were to follow, was not yet fully developed (Fig. 38), and it is most unlikely that the idea of providing an implement with any sort of handle or haft had yet occurred to man. In fact this device, which seems perfectly obvious to us, appears to have been beyond the inventive powers of so recent a people as the now extinct Tasmanians, who when they first became known to Europeans, less than 300 years ago, were still actually living in the lower Old Stone Age.

The Pre-Chelleans probably used wood for clubs and perhaps spears, although of such objects we have no actual remains. However, at Piltdown, in the same deposit in which the famous skull came to light, there was also discovered a strange implement (see Fig. 24), made of a great slab of bone, sixteen inches long, taken from the leg of an extinct elephant. This had been shaved down to an irregular point at one end and also had a hole bored through it. Men who could do all this with bone must have been familiar with the idea of working in wood.

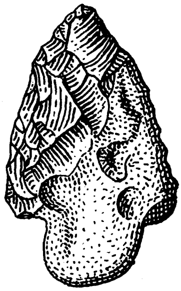


Fig. 38. Pre-Chellean type of stone implement. From St. Acheul, northeastern France. Note clumsy and incomplete chipping. After Commont

The Chellean Epoch

Directly out of the Pre-Chellean arose the true Chellean. This advance also seems to have taken place mainly in Africa, whence it spread both into Europe and into Asia. The climate continued genial, as indeed it seems to have been during all three earlier cultural periods. Hence Chellean man, like his predecessors, lived in the open. Vegetation flourished, and animal life continued with but few changes of species, though the lion had now largely if not entirely replaced the saber-toothed tiger and one form of rhinoceros seems to have died out. Fire was probably known, but there is little reason to suppose that Chellean man, any more than his forerunners, erected shelters or wore any sort of clothing. In fact even the

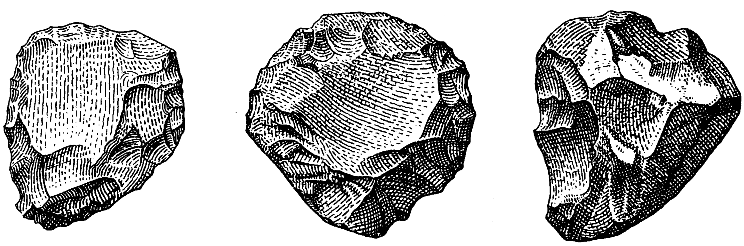


Fig. 39. Tasmanian stone implements, typical of the lower Old Stone Age. Tasmanian culture was by far the most primitive that has survived down to recent times. After Ling Roth

lowest of existing or recent savages have probably known far more of the arts of primitive life than he.

A considerable improvement in the making and a much greater variety in the forms of its flint implements marked the period. In all there have been distinguished seven or eight types, each apparently adapted primarily to some one particular purpose, though not a few seem to have been "combination tools." The uses to which they were put included cutting, scraping, piercing, and boring (Fig. 40). The Chellean continued in the main a core and not a flake industry, although occasionally the flakes knocked off from the cores of pebbles were themselves shaped into

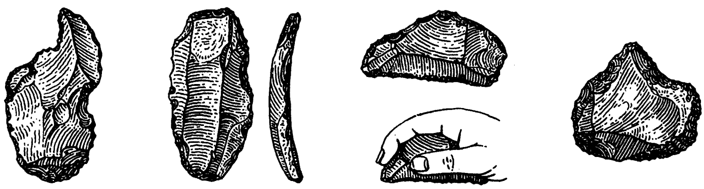


Fig. 40. Chellean flint tools for cutting, scraping, piercing, and boring. After Commont and Obermaier

tools or weapons. The uniformity displayed by these implements over large areas shows that as various improvements developed they gradually spread far and wide, from one nomadic hunting group to another. Possibly, too, even then race and culture were not coextensive, any more than they are today. That is, two or more races may have used the same types of flint implements; or, on the other hand, branches of one and the same race may have had different "industries." Thus it is not impossible that both the Piltdown race and that of Heidelberg possessed the Chellean form of culture, though it may be that Heidelberg man was pre-Mousterian. More than one investigator has come to look upon the Neanderthal race, with its Mousterian type of culture, as descended from him, and he seems to have lived in central Europe where the pre-Mousterian culture has been found.

Of the various types of stone implements made during the Chellean, that known as the *coup-de-poing*, or "fist-ax" (because it was almost certainly held in the hand and not hafted), now appears in a much more highly developed form than that which it had in the Pre-Chellean. It occurs in several shapes, probably denoting a variety of uses. Perhaps the most typical is a rough, heavy, almond-shaped utensil which must have been used for hacking with the edge and striking with the pointed end. It is sometimes of large size, indicating that it was wielded by a muscular and vigorous race.

Chellean implements are found in the river gravels, for their makers and users had no reason to resort to caves for shelter but lived in the open. They may have erected simple windbreaks of hides or bark, but this is purely matter for conjecture. The utmost that can be said is that Chellean man employed some of the tools known as "scrapers" in dressing down the skins of animals preparatory to tanning them; on the other hand he may have designed them for fashioning various objects out of wood.

It can not be emphasized too often in this connection that what we have today in the way of remains of early cultures necessarily represents but a small fraction of their original total content. Only those objects composed of the most durable substances have survived; and this means, for the earlier periods at least, almost exclusively stone. Yet ancient man must have made even greater use of wood, bone, skins, sinews, vegetable fibers, and many other materials, which have decayed without leaving a trace and whose existence we can therefore only infer.

The Acheulian Epoch

Following the Chellean, at any rate in western Europe, came the culture stage known, from its type station of St. Acheul, in northern France, as the Acheulian. This appears to be a direct development from the Chellean, a fact which implies that there was no break of continuity, such as might have been caused by the intervention of a glacial stage or the intrusion of a different race. It seems pretty clearly to have occurred during the third interglacial stage, and has been divided by archeologists into two phases, an earlier and a later.

During the Early Acheulian, the climate of Europe resembled that of the Chellean, the chief differences being, apparently, that it was rather cooler, drier, and perhaps more dusty. The animal life of the preceding periods continued with but little change. It included the southern mammoth, the straight-tusked or "ancient" elephant, Merck's rhinoceros, the hippopotamus, lion, hyena, deer, wild bull and horse, bison, wolf, beaver, and many other forms.

Man still continued to live in the open; and it is now that we come upon the first absolute proof of his use of fire, in the layers of charred wood and bones found on his ancient camp sites. Little direct evidence bears on his physical characteristics and indeed there may have been more races than one occupying western Europe then. For some have regarded the Piltdown race as belonging to the Acheulian, while there may have been also a Neanderthal element, or at all events one ancestral to the latter.

It seems to have been during the Late Acheulian that the chill of the approaching Würm glaciation began seriously to be felt. Conditions in western Europe now slowly underwent radical changes. Forms of animal life that had survived all the vicissitudes of the three earlier glacial stages now commenced to disappear, replaced by species better adapted to withstand severe cold, including the hairy northern form of mammoth, the woolly rhinoceros, and the reindeer. But even yet the roving bands of hunters and food gatherers still preferred to pitch their camps in the open and only occasionally sought the protection of overhanging cliffs and the mouths of caves.

Despite these changes in the physical environment, a great improvement in the forms of its stone implements characterized the Acheulian type of culture. These were now much more skillfully made and far more symmetrical in shape than those of the Chellean. They had also come to be smaller and lighter and included a far greater variety of types. Acheulian man still used mainly the cores of the nodules, but he also occasionally employed flakes. During this period the *coup-de-poing* or fist-ax reached the acme of its development, being carefully chipped over its entire surface as well as along all its edges, perhaps man had even learned to attach a handle of some kind to it (Fig. 41). Nevertheless even the finest Acheulian artifacts, far in advance as they are of anything that had gone before, appear coarse and clumsy by contrast with those of later periods.

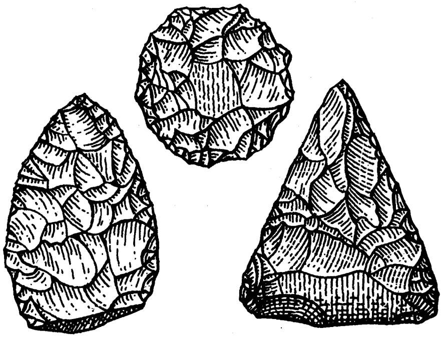


FIG. 41. Acheulian *coups de poing* or "fist axes." After de Mortillet

Certain of the stone implements of Acheulian times would have been well adapted for scraping and dressing hides, and this has led some observers to infer that the people of that day used skins in various ways. There can hardly as yet have been any question of regular clothing, but the increasing cold of the Late Acheulian may have forced upon man the idea of using furs for simple wraps.

It is not impossible that during this same Late Acheulian phase burial of the dead began to be practiced. How this custom might have arisen, we have, of course, no means of knowing; but it may have been connected in some way with the growing concentration of the population in certain sheltered localities, owing to the increase of cold.

The Mousterian Epoch

Toward the close of the Acheulian epoch the climate grew increasingly severe, as the Würm glacial stage drew on. The changes in animal forms to which this led have already been noted. A similar alteration manifests itself clearly in the human life of the time. To whatever race Acheulian man may have belonged, the type of culture which he had steadily been developing during the latter portion of the third interglacial now gave way to another, that known as the Mousterian. This change, of course, did not take place all at once throughout the whole of western Europe. It may very well have required hundreds if not thousands of years for completion, and no doubt it occurred earlier in some places than in others. Thus in certain regions, like the valley of the Garonne, in southwestern France, the Mousterian culture seems to have appeared even before the advent of the full Würm glaciation.

Some students have thought that this developed directly though gradually from the Acheulian, in western Europe itself. But fundamentally there seems to have been in the long run an actual replacement of one type of culture by another which had grown up in some different part of the world; for pretty clear evidence exists that the Mousterian culture appeared in western Europe as an intruder from central Europe, out of which the advent of the Great Cold had probably driven it. In other words, while the Acheulians were dwelling in what is now France and the neighboring regions, the Mousterians had been living in Germany and thereabouts. However, men of Neanderthal type may have existed in western Europe also during the Acheulian and even earlier periods. We have as yet far too few actual skeletal remains from the latter to enable us to say definitely to what type, or types, of men the cultures preceding the Mousterian are to be ascribed.

Some investigators have thought that there is evidence of a "warm" as well as a "cold" Mousterian; that that particular culture existed in Europe during a milder as well as a more severe climatic phase. But Obermaier, perhaps our leading authority on this point, emphatically denies this. He says:

> We must strongly insist that in western and central Europe there is no true Mousterian with warm fauna. Such a fauna is found only in the Pre-Chellean, the Chellean, and the Early Acheulian, for, from the Late Acheulian on, we find a cold fauna which lasts through the final Magdalenian. Indubitable Mousterian with warm fauna is found only in southern Europe—as in Italy (Mentone) and Spain—where then and ever since the climate and fauna naturally would be different.

To state the length of the Mousterian epoch in terms of years with anything like accuracy is still impossible; but, thanks mainly to the Swedish investigations of the last glaciation, we can make a far better guess than we can for

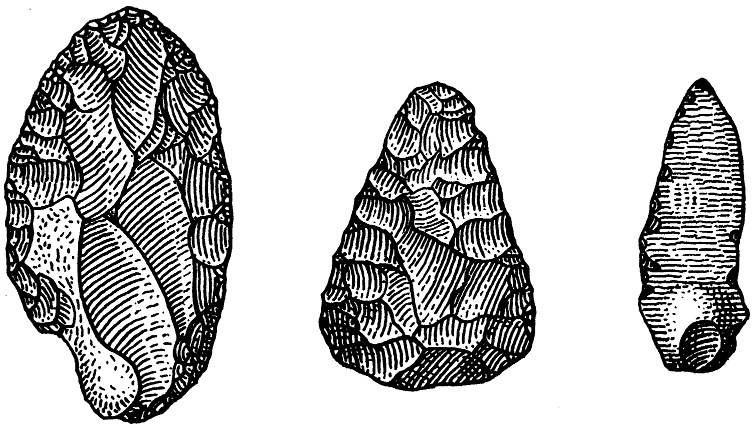


FIG. 42. Mousterian implements from the north of France. At left, a scraper; center, a flint carefully dressed on both faces; right, a long, narrow point. After Commont

the still earlier periods. Thus it seems fairly safe to say that in western Europe the Mousterian epoch began somewhere between 40,000 and 60,000 years ago, and continued down to something like 25,000 or 30,000 years ago.

We have now arrived at the cave-dwelling period in human history. No doubt man had in earlier times resorted to caves occasionally for shelter from the weather or protection from enemies, human or animal; but the first real cave man was the Neanderthaler, whom we find so closely associated with the Mousterian type of culture. Unlike his predecessors of the Acheulian and still earlier periods, he camped in the open very rarely, and then perhaps only during the summer months. But it is a mistake to suppose that he ever permanently occupied the depths of caverns. He lived, on the contrary, only in the portions near their mouths—in their "vestibules," so to speak; for it is invariably in or just outside the latter that remains of his old camp fires are found.

Fire, as we have seen, man had known and used for ages, and it seems likely that even before the Mousterian epoch he had learned to kindle it himself. In fact, without this knowledge it is hard to see how the Neanderthalers could ever have survived the terrible damp cold which we know oppressed and desolated Europe during the last great glacial stage.

The shapes of certain types of implements of the Mousterian epoch suggest that they were used for scraping and preparing skins for curing (Fig. 42). It appears certain that man employed pelts and furs in some way as protective coverings during the bitterly cold weather of the time. Probably he did not cut them out or fit them to the body in any way, but wore them merely as loose wraps. It is not impossible that Mousterian man regularly wore a skin around his waist; but if he did we may be sure that it was not from motives of what we nowadays call "modesty"; for the latter feeling is one that has appeared in the world only very late in man's history, and far from universally at that. It arises only from teaching and habit, and not out of any deep-seated or fundamental instinct.

Mousterian man, unlike his forerunners, manufactured his stone implements mainly out of flakes struck off from the pebbles he selected for working, and not out of their cores (Fig. 43). This practice, as already stated, forms one of the fundamental points of difference between the Mousterian "industry" and those which preceded it. At first, it is true, the fist-ax, or *coup-de-poing*, a "core" implement, continued to be made, but only in degenerate form; and it gradually disappeared altogether. The instruments especially typical of the Mousterian culture were formed from large flakes of flint struck off from a nodule. The inner surface of a flake thus detached from the parent core is of glassy smoothness and slightly bulging form, and requires no further treatment to render it fit for use. Only its outer side needs to be chipped or "retouched" until the flake assumes the desired shape. These flake implements, therefore, combined greater ease of manufacture with undoubtedly much greater effectiveness. They took different forms, designed for chopping, hacking, scraping, boring, drilling, piercing, cutting, and sawing, so that Mousterian man had a tool kit of no mean proportions.

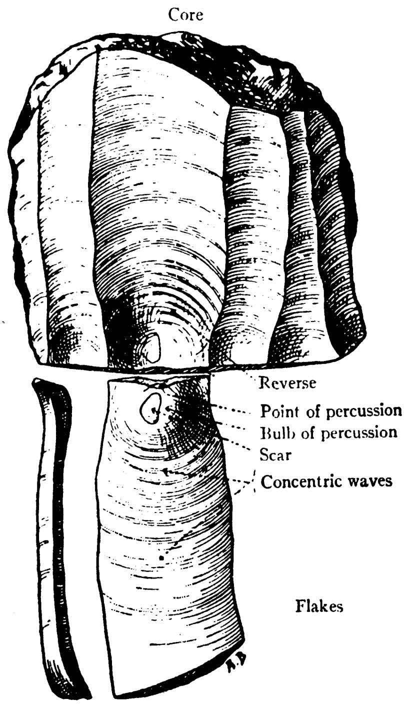


FIG. 43. The core of a flint nodule (above), and flakes detached from it (below) by means of sharp blows at the point of percussion indicated. After Schmidt

During this period, also, we find the first indications of the regular use of implements made of bone. The latter substance seems to have been occasionally employed before, although the only example known thus far is the artificially shaped fragment of an elephant's leg bone from Piltdown, already mentioned. Now, however, among the instruments employed by Neanderthal man we find bone "anvils," or chopping blocks, and leg bones of the cave bear worked down at one end, apparently for use in helping to remove the hides from large animals.

Undoubtedly the Neanderthalers also utilized wood in many ways, among others in the manufacture of spears, clubs, and perhaps throwing-sticks. They seem to have used a certain type of notched scraper of flint, somewhat after the manner of a modern spokeshave, for dressing down cylindrical wooden objects such as spear shafts. At Claxton-on-Sea, in the east of England, there has actually been found the point of a wooden spear which almost surely belongs to the Mousterian epoch.

Quite possibly, too, by this time man had learned the secret of arming spears, and perhaps clubs also, with flint points, to secure greater power of penetration. To us nowadays, the working parts of any tool—the head of an ax, the point of a spear, or the tines of a pitchfork—seem the essential and primary ones. But that was not at all the way in which primitive man looked at it. With him the spear, for example, made entirely of one straight and pointed shaft of wood, came first. Only very long afterward did the idea dawn on him that if he fastened one of his piercing implements of flint to the end of his spear he could increase its effectiveness. Similarly with implements designed for striking, the plain wooden club must have been used for ages before anybody thought of improving it by fastening to it such things as flint flakes, sharks' teeth, or fragments of volcanic glass, as various peoples have done. The shapes of some of the flint implements of the Mousterian epoch make it hard to see how they could have been used with any effect unless fitted with handles of some sort.

But even so, it still remains something of a puzzle how Neanderthal man, with such primitive weapons, could have hunted large and dangerous animals like the mammoth, the woolly rhinoceros, the cave bear, the wild bull, and numerous others whose bones we find among the refuse of his ancient "garbage piles." It must have been through recourse to superior intelligence and cunning that he was able to overcome them at all. For he did not know the bow and arrow, that most effective of early hunting devices; and the structure of his skeleton shows that he was a slow and clumsy runner, supporting his weight mainly on the outer edges of his feet, and incapable of straightening his knee joints fully. He may have stampeded his prey into running over cliffs (see Plate 21) or into boggy ground or deep snow; or he may have lurked in the underbrush and behind rocks at water holes, so as to take it by surprise. He may have used pitfalls, fire, and possibly poison. Round stone balls have been found which seem to have been used for throwing, perhaps at the end of a thong or even from a sling. As these balls sometimes occur in sets of threes, they may have been attached to one another by skin cords and hurled so as to entangle the legs of running animals, like the well-known *bolas* used by the Gauchos of South America. But whatever the hunting methods used by the Mousterians, they must certainly have been accompanied by a considerable degree of social organization and discipline, with well-directed cooperation and loyal, intelligent teamwork.

Possibly during the summer months, when freer to wander about in pursuit of game or to visit localities where especially fine qualities of workable flint occurred, the Neanderthalers erected temporary shelters, of bark or leafy boughs or even skins, against wind and rain; but we have no proof. For the rest of the year we know that they lived in the vestibules of caverns, under the most crowded, unsanitary, and comfortless conditions imaginable. The caves were in general excessively damp and draughty, and, of course, there was no such thing as "keeping out the cold," which was often bitter. Doubtless the Neanderthalers accepted as a matter of course hardships which we should regard as unbearable; and the inexorable weeding out of the weak and unfit, particularly in infancy, must have kept the racial capacity for endurance at a very high pitch. Nevertheless, some of the known Mousterian skeletons show unmistakable signs of very severe arthritis, pyorrhea, and other ailments. There are also instances in which bones have sloughed away as the result of injury or disease.

Naturally we can infer little regarding the social organization of Neanderthal man. He must have had something of the sort, however, in order not only to hunt the larger animals but even to survive at all under the conditions of hardship, discomfort, and danger which were his daily portion. Nor can we expect to know very much regarding the nature of his religious beliefs, although it is safe to say that he, like so many present-day savages, made no distinction between the "natural" and the "supernatural." For everything must have seemed to him perfectly natural and at the same time imbued in varying degrees with magical potentialities. Strong or ferocious animals in particular were undoubtedly thought, in the language of our own Great Plains, to be "big medicine." In the Drachenloch cavern in Switzerland and at Petershöle in Franconia there have come to light specially arranged skulls and other bones of the cave bear, indicating the existence of some sort of bear cult.

Man of the late Acheulian may have practiced burial, occasionally at least, but its indications become unmistakable early in the Mousterian. Already we find red mineral pigment which may, as in later times, have been used in connection with burials. Vestiges of the custom exist even today in China. Judging from analogies among more modern peoples, the Neanderthalers may have reasoned that life was closely associated, if not actually

PLATE 54

Restoration of Neanderthal man. Note carriage of head; his skeleton shows that he could not quite straighten his knee joints. Courtesy of the Field Museum of Natural History

Restoration of a Neanderthal woman scraping a hide. The large number of flint scrapers found indicates that the skins of animals were cured in Mousterian times. Courtesy of the Field Museum of Natural History identical, with the blood, and that any substances resembling the latter in color possessed, therefore, life-giving, strengthening, and auspicious power. The Neanderthalers also buried with their dead an abundance of finely worked flint implements, shells, and joints of meat from such animals as they most depended on for food.

The original motive inspiring these grave-offerings, representing Neanderthal man's richest treasures, was probably the desire to keep the dead man or his ghost from suffering the pangs of want and so returning in an angry frame of mind to terrorize his survivors. The same wish to prevent the return of the ghost led in some cases to doubling up the body, with its knees close under its chin, and then tying it securely in that position before consigning it to the grave. For thus it would be impossible for the dead to walk.

We have mentioned (see Chapter VII) the finding in a cave in Croatia of deposits of Mousterian age, including the charred and broken bones of about a score of individuals, both adults and children, of a local type of the Neanderthal race. One theory of some plausibility explains these as the remains of a cannibal feast of perhaps a religious nature. But unless further discoveries of a similar sort are made elsewhere, it would hardly be fair to stigmatize the Neanderthalers as habitual cannibals.

Signs of any sort of artistic feeling in Mousterian times are almost wholly wanting. The Neanderthalers seem to have worn certain shells, and possibly they smeared themselves with the red pigment already mentioned in connection with their burial customs. But if so, they can scarcely have had any idea of enhancing their own personal charms. Rather they, like more recent savages, regarded such practices simply as "good medicine," sure to place them in a more favorable relation to their environment.

From time to time scientists have attempted to reconstruct the bodily appearance of Neanderthal man from his skeletal remains (see Plates 28, 42, and 54), often with great care and with close attention to measurements of the originals. Hence, so far as the restoration of the fleshy covering of the bones is concerned, they may be accepted as fairly accurate portrayals. But when it comes to questions of skin color, of the amount of hair covering the body, and other external features, to say nothing of such purely artificial ones as the mode of hairdressing and the wearing of amulets or skins, we can be guided only by inference, analogy, and probability drawn from modern savage life.

The Aurignacian Epoch

Neanderthal man and his Mousterian culture, as already stated, gave way, in western Europe at least, to the splendid Cro-Magnon race, with its vastly superior culture known as the Aurignacian. This seems to have developed in Africa from another and earlier "industry" known as the Capsian. The early Cro-Magnon invaders of Europe appear to have advanced from northern Africa toward their new homes by way of the land-bridge which then extended across the Mediterranean Sea from Tunisia to Italy. Their movements apparently began while the Würm or last great glaciation still held much of Europe in its grip. But it is unlikely that they made any great mass migrations across wide stretches of country. That was not the way in which primitive man gradually occupied the earth. Rather, the Cro-Magnons and others advanced slowly, season by season, in whatever direction they found the hunting good and general living conditions favorable. The direction in this particular case happened to be one which eventually carried them up through Italy and so into southern France; but the movement undoubtedly occupied many hundreds if not thousands of years before the Aurignacians began to spread out over western Europe. For they do not seem to have done so until well on in the final periods of the Würm glacial stage.

The climate at this time was becoming drier and more bracing. Great glaciers still covered what are now Norway and Sweden, as well as the Alps; but the plains in time became ice-free, and though the winters continued very severe, the summers had become mild, if not actually warm. The animal life changed little from that of Mousterian times, retaining its northern or arctic character, and including such forms as the hairy mammoth, the woolly rhinoceros, the reindeer, and the arctic fox. Among other species, more adapted for life on the open steppes, were the horse, the wild ass, and a gigantic form of rhinoceros with an enormous single horn situated, unlike that of any existing type, on the forehead above the eyes. Forest- and meadow-loving animals included the brown bear, the wolf, the bison, the wild bull, the stag and the giant deer, sometimes miscalled the "Irish elk." The cave lion and the cave hyena were also present, as well as many other forms, some now extinct, while others still survive, in Europe or elsewhere. In time there also appeared the mountain sheep and the musk ox.

The Aurignacians were cave dwellers, but cave dwellers of a type in every way superior to the lowly Mousterians whom they replaced. It is clear, however, that, as we saw in Chapter VI, the two races influenced each other to some extent. Very recent finds in East Africa have made this even more evident, for here, too, the Mousterian and the Aurignacian cultures have lately appeared; but instead of the former preceding the latter, as it does in Europe, both forms prove to have existed together during a very long period. In one case, indeed, a Mousterian deposit overlay an Aurignacian one and therefore actually came after it. Eventually the two cultures become fused into one. So far, lack of skeletal material prevents us from saying whether or not the African Mousterian and Aurignacian were the handiwork of different types of man, as they were in Europe. But the existing evidence points that way.

These very recent African discoveries thus render it practically out of the question that the Aurignacian culture, connected in Europe with the advent of Cro-Magnon man, could have been developed out of the Mousterian, associated closely as it is with the Neanderthal race. On the contrary, the Aurignacians, on their arrival in Europe, appear to have exchanged a few cultural elements with the Mousterians, and even, perhaps, to have mingled with them racially to an extremely limited degree, but finally to have replaced them entirely.

The situation may very well have paralleled the case of the American Indian and the European settler, although with far less difference in degree of culture. When two peoples come into close and prolonged contact, it is not the less civilized which does all the borrowing of ideas; the more advanced one also almost invariably adopts some culture elements from its humbler rival. Thus to the American Indians, for example, we owe not only various food plants, such as potatoes and maize, but also such things as tobacco pipes, hammocks, snowshoes, canvas canoes (modeled after the birch-bark craft of the aborigines), and the game of lacrosse.

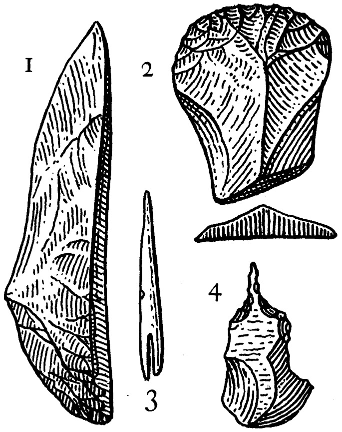


FIG. 44. Aurignacian implements. No. 1 is a flint point; 2, a scraper seen from the side and end; 3, a bone point with a cleft base; 4, a borer. After de Morgan

Authorities have divided the Aurignacian epoch into a Lower, a Middle, and an Upper phase, during all of which it underwent a steady development. Like the Mousterian but unlike the earlier Pre-Chellean, Chellean, and Acheulian industries, the Aurignacian based its flint-working mainly on the utilization of flakes and not of cores. Indeed it used far fewer core implements than did even the Mousterian, while the flake tools and weapons were longer, narrower, thinner, and more delicately worked. Cro-Magnon man made flint knife blades, points, borers, scrapers, and planing tools. He used stones both as hammers and anvils and also for throwing, while from horn and bone he made javelin points, drills, and polishers (Fig. 44). He undoubtedly utilized wood to a great extent; indeed many of the flint implements found evidently were meant to be used in working up that material into various objects.

Yet the Aurignacians, far ahead as they were of any of their predecessors of the Old Stone Age, still depended wholly for their livelihood upon hunting, fishing, and the

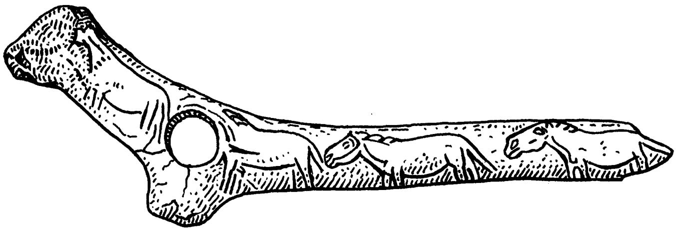


FIG. 45. *Bâton de commandement* of reindeer antler, with engravings of wild horses. After Lartet and Christy

gathering of such vegetable foods as they found growing wild. They had no domestic animals, not even the dog; nor had they grasped the idea of making pottery, even the crudest. Nothing exists to show that they had canoes, and they seem not to have known the bow and arrow. Yet they probably built huts or wigwams of saplings covered with sheets of bark or with skins, at least for their summer camps.

During the Late Aurignacian we begin to find a curious object consisting of a section of reindeer antler with a rounded hole bored through it, generally at the point where the main shaft, or "beam," and the brow-tine join. At first they ornamented this with rude engravings, but in later times with elaborate carvings. It is commonly called a *bâton de commandement*, or staff of office, but this is merely guesswork (Fig. 45). Was it a sort of war-club, ceremonial or otherwise, or the badge of a medicine man? Was it a toggle used to hold the edges of a fur cloak together? Was it a shaft straightener, or was its purpose that of taking the kinks out of a length of rawhide rope? As yet we can not tell.

In the Late Aurignacian also there begin to appear bone needles, at first without eyes; these indicate a considerable advance in the working up and stitching together of skins, probably for clothing.

But perhaps the outstanding technical achievement of the Aurignacian epoch was the invention of the burin, or engraving tool, a flint with a sharp angulate point used for incising figures of various sorts on the walls of caves. Their remarkable artistic genius constitutes the most notable thing about the Cro-Magnon race, although, like all art in its beginnings, theirs was inextricably bound up with magical ideas and practices.

The Cro-Magnon hunter, like many savage races since, believed unshakably that, if he drew a representation of an animal and then performed over it magical ceremonies of the right sort, he could cause animals of that species to become more numerous or easier to capture, as the case might be. So far as we know now, this represents man's earliest scheme to increase his own food supply by assisting or coercing nature to be more liberal. To us the notion of producing food through the growing of crops or the rearing of animals seems perfectly obvious. It was not so, however, to the primitive hunter and food gatherer, and he must have endured long and painful experiences of scarcity before he finally grasped the idea that he himself could do anything at all to make food more plentiful.

When this idea first dawned on him, however, Aurignacian man did not set to work right away planting and tending various wild seeds and tubers or catching and domesticating certain wild animals. Such a line of conduct would have been entirely beyond his reasoning powers, based as these were upon a very limited fund of accumulated experience. He first attempted to control his food supply by resort to magic, the only means that he knew. That it was a mistaken method does not lessen the fundamental importance of the step for the future of mankind, for once he had grasped the idea that he himself could increase the food available, it was only a question of time until he hit upon the right way of realizing it.

In their efforts for the benefit of the larder the Cro-Magnon medicine men performed ceremonies in the deepest recesses of the caves whose entrances they inhabited. The kinds of animals which they wished to render more plentiful they represented by drawings, images, or masks, with the aid of which they performed rites and incantations. Some of the more backward races of the earth, like the Australian natives for instance, have never progressed beyond this stage, while traces of its former existence survive among many more advanced peoples.

The wonderful representations of animals, which the Cro-Magnon artists incised and painted on the walls of caves and molded in the damp clay of their floors (Plate 56) during the latter part of the Old Stone Age, have attracted attention and admiration the world over. Until a generation or two ago modern man did not even suspect their existence, and their discovery and study form one of the most fascinating and romantic chapters in the story of man's recent inquiries into his own past.

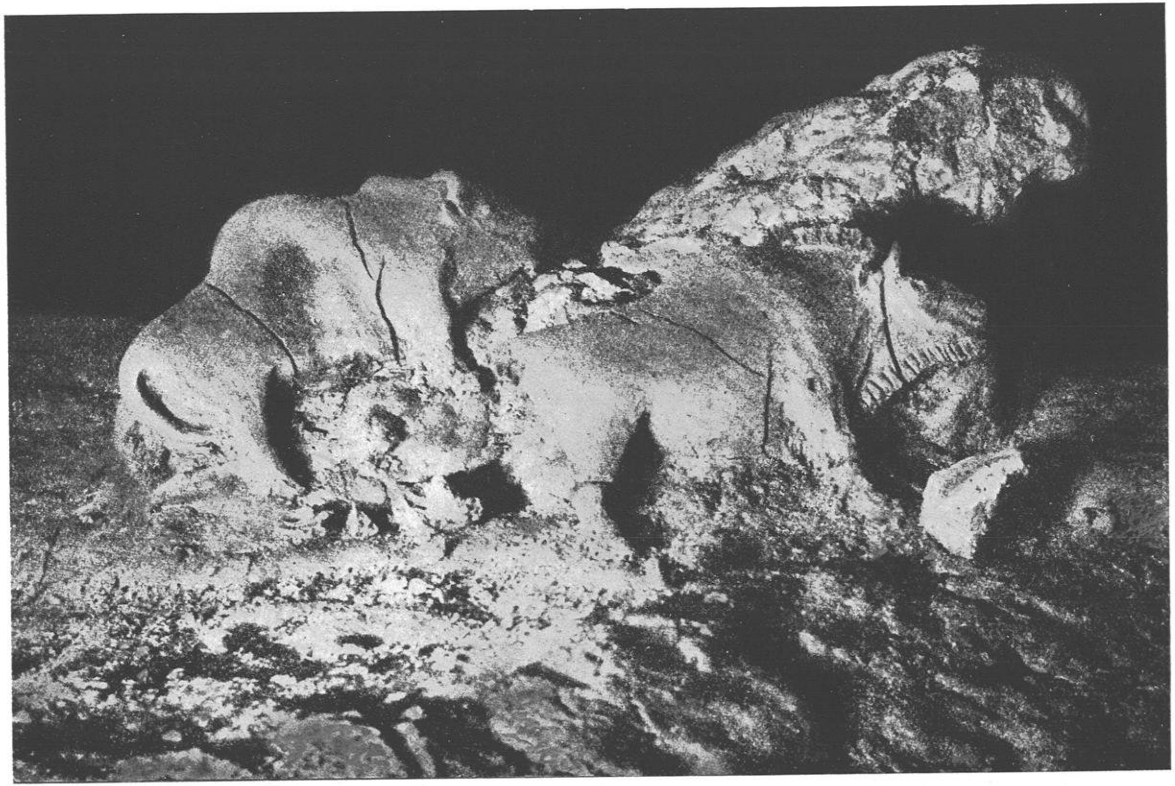
Many of these sketches are crude and roughly executed; but in others both drawing and workmanship are of a wonderfully high quality. The animals portrayed include the mammoth, wild bull, bison, cave bear, reindeer, stag, and at least two species of wild horse, as well as many others.

Many reasons force us to believe that these works of art —for such they are—were executed mainly for magical purposes and not merely to satisfy a budding esthetic sense or to record incidents in the life of early man. In the first place a great number, including some of the finest of them, occur in the innermost recesses of caves, almost inaccessible even today and quite invisible without the aid of artificial light. Evidently the artists did not intend them primarily to be seen and admired by their fellow tribesmen. Again, the animals represented include almost exclusively those upon which men placed their chief reliance for food; others, whose flesh was too tough or too unpalatable even for the strong teeth and stronger stomachs of the cave people, are very rarely seen. Occasionally the artist represented the subject of his drawing or painting with a dart sticking in it (see Figs. 13 and 62). The motive here was undoubtedly the same which, handed down through the ages, caused the medieval witch to thrust pins into a wax image of the person whose death she desired to bring about.

But although the cave artist had as his primary and perhaps only conscious purpose the insuring of a plentiful supply of food animals, his work is often so fine, so sure of itself, so full of energy and life and the close observation of nature, that in many cases genuine artistic feeling evidently inspired it (Fig. 46). The cave art foreshadowed in the development of this quality the great art of Greece many thousand years later; in the latter, too, the primary motive was magico-religious, yet it embodied the finest expressions of sheer beauty that the world has ever seen.

The Aurignacian artists depicted other classes of objects on the walls of caves, such as representations of human hands, either in silhouette or in outline. The noteworthy thing about these is the frequency with which they reveal mutilation through the cutting off of one or more fingers (see Plate 16). As we have seen, the same practice has been found to occur among certain uncivilized peoples of more modern days, the motive being to express grief or to secure the favor of the Unseen Powers. It may be that similar ideas induced the ancient Aurignacians thus to mutilate themselves.

PLATE 56



Bisons modeled in clay by Cro-Magnon artists, in the cave of Tuc d'Audoubert, southern France.
Photograph by Count Begouen

Hand in hand with this great art of the caverns went that of engraving and carving, in limestone, soapstone, ivory, bone, reindeer antler, and doubtless in wood. Among the works thus executed occur those statuettes of

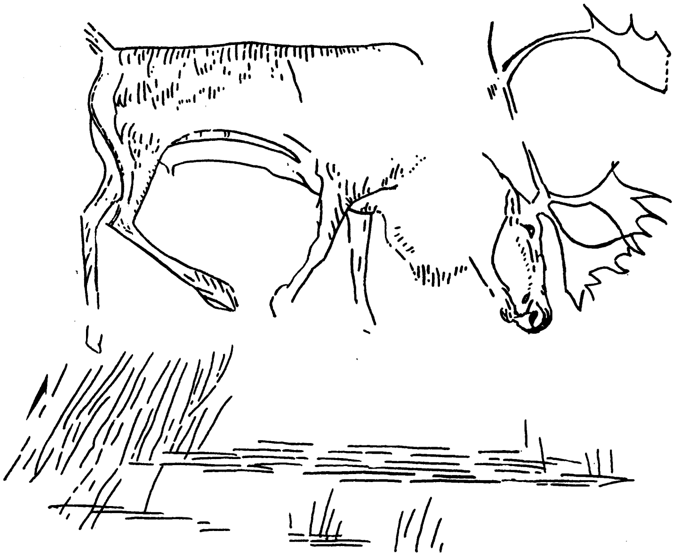


FIG. 46. Grazing reindeer engraved on a *bâton de commandement.* The lines in the foreground have been doubtfully interpreted as signifying a pool with vegetation. After Merck

very corpulent naked women, already mentioned in Chapter VI, which, in some of the physical peculiarities represented, recall the very ancient Bushman race of South Africa. These statuettes seem certainly to have had a religious significance. Perhaps they represent the first faint beginnings of the belief in a Great Mother Goddess of fertility and life and death which we find so widespread in much later times.

Generally speaking, in his attempts at delineating the human form the Aurignacian artist fell far short of the brilliant success which he achieved in the realm of animal portrayal.

Though we find a certain similarity between the burial customs of the Cro-Magnons and those of the Neanderthalers whom they replaced, the former made far greater use of red pigment, which they appear to have deemed absolutely essential to a properly arranged interment. They likewise buried with the dead circlets, necklaces, gorgets, and coronets of perforated shells; tools and weapons of finely worked flint; and supplies of food. Such funeral furnishings would appear to imply a lively faith in the survival of the ghost of the dead man, for a time at least.

Sometimes, it would seem, the Aurignacians painted the corpse itself red with mineral pigments which, as the body decayed, eventually worked through to the bones. At other times, like so many later peoples, they laid the dead away temporarily until the fleshy parts of the body decayed, after which they carefully cleansed, painted red, and once more buried the bones, this time for good.

This custom of painting the dead or their bones suggests that the living Aurignacians also probably painted themselves. If so, the practice undoubtedly had a magical basis, as did the war paint of the American Indians, for example.

The Solutrean Epoch

What finally became of the culture of the Aurignacian hunters and artists which we have briefly sketched in the foregoing paragraphs? In certain areas, especially in Italy, sheltered as it is against invasion from the north by the great rampart of the Alps, it seems to have survived without radical change for a long period. There it shows no sign of having been influenced by the Solutrean and Magdalenian cultures, and was ultimately replaced only by the Azilian type of human industry. The valleys of the Pyrenees and of northeastern Spain also probably served as refuges for some of the Aurignacian bands who fled thither, apparently before the Solutrean intruders slowly drifting in from the east.

The climate during the Solutrean epoch was in the main cold and dry, and much of the surface of Europe then consisted of treeless grassland over which swept in summer thick dust storms obscuring the sun, and in winter terrible cold winds and blizzards. Nevertheless, the Solutreans seem to have lived mainly in the open. Possibly they had developed some sort of habitation of skins stretched on poles, akin in principle to the tepee of the Plains Indians or the yurt of the Mongols. Of this, however, we can expect to find no direct evidence.

During the Solutrean epoch the animal life differed comparatively little, at least in the generality of its forms, from that of the Aurignacian.

In eastern Europe, especially in Poland and Hungary, remains of the Mousterian epoch, as already stated, are followed directly by those of the Solutrean. This rather indicates that the latter type of culture appeared in those regions before the Aurignacians had had time to work their way that far east. There seems, at least, to be no doubt that the Solutrean culture originated in the east and gradually extended westward, improving its technique of flint-working as it went. Its impetus, from whatever cause it arose, spent itself before reaching the lands bordering upon the Mediterranean Sea; for in these it does not occur.

At the beginning of the Solutrean epoch the new method of shaping implements which forms its special characteristic, that known as "pressure flaking," was rare and unimportant. Later on, however, it developed to a pitch never excelled during the Old Stone Age.

The flint implements of this period fall into two distinct classes. The first occurs in one form or another throughout the entire Upper Paleolithic and consists of single and double scrapers, drills, burins, retouched flakes, and the like. The second consists of the "leaf" types of flint blades, which characterize the Solutrean epoch alone and disappear entirely at its close. These, from their shapes, have been aptly called by the French archeologists the "willow-leaf" (narrow) and "laurel-leaf" (broad) forms (Fig. 47). The latter especially occur in great perfection during the Middle Solutrean, when they attain a marvelous perfection both of form and of technique—perfectly symmetrical, sometimes a foot or more in length, and worked down on both sides until in some instances they are actually translucent. The process by which the Solutreans achieved this result was that known as pressure or ripple flaking, whereby long, thin, parallel flakes were taken off right across both faces of the blade. As weapons, nothing else that man of the Old Stone Age achieved approached these leaf points, and they may well have played a large if not decisive part in the spread of Solutrean culture across Europe from east to west.

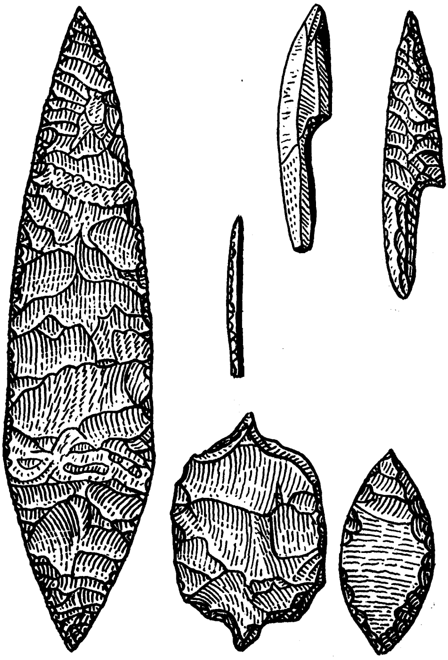
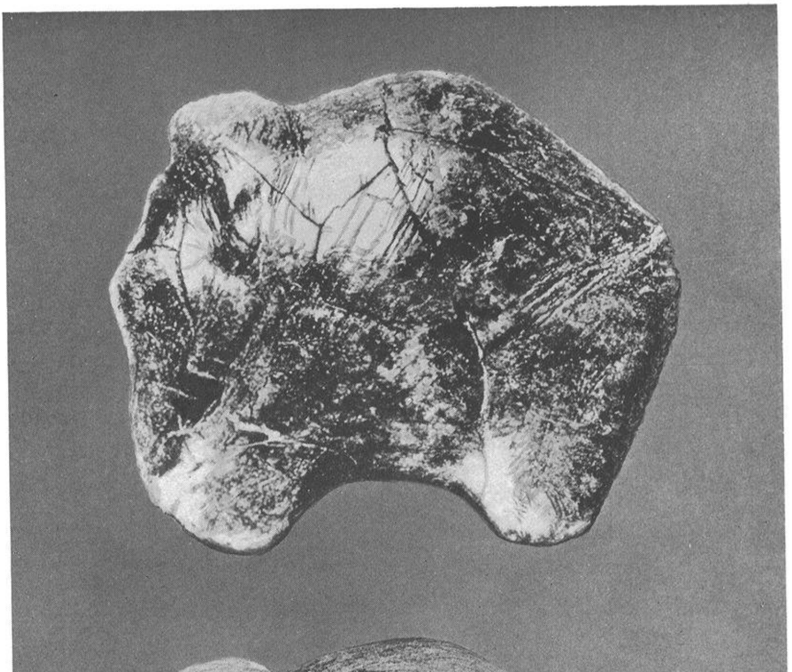


FIG. 47. Solutrean flint implements and weapons of fine laurel-leaf type. Above, two forms of shouldered point, perhaps earliest type of barbed weapon. After de Mortillet

In its more eastern and presumably earlier aspects, the Solutrean culture displays no implements of bone; but farther to the west, perhaps as a result of Aurignacian contacts, objects of that material, such as awls and smoothers, and others of reindeer antler, like the *bâton de commandement*, become numerous.

PLATE 57



Above, a mammoth carved from ivory from a Solutrean layer at Předmost, Moravia. After Maška. Below, a reconstruction drawing designed to bring out the details. From the *Illustrated London News*

During the Late Solutrean there appeared, more especially in southwestern France, a new type of flint implement known as a "shouldered point," which was made with a projection on one side. This is the first sign that man had come to realize the efficacy of a barb in holding a weapon in the flesh of a hunted animal. In the Late Solutrean we find, too, bone javelin points, and also bone needles pierced at one end, exactly like our own save in the material of which they are made. These show pretty conclusively that the art of fitting and sewing skin clothing had made still further progress by this time. In fact it is quite likely that during the greater portion of the Later Paleolithic, including the Solutrean epoch, man wore fur garments not unlike those of the modern Eskimo.

While the Solutreans far surpassed the Aurignacians in flint working, in art they fell far behind, so much so that some have doubted whether the Solutrean culture itself had any art at all. They suggest that the examples of artistic achievement belonging to this epoch represent rather the work of surviving Aurignacians who had mingled with the Solutrean intruders.

But whoever the artists were, the Solutrean epoch witnessed a considerable development of animal sculpture. A noteworthy example is a figure of a mammoth carved out of a fragment of ivory, found at Předmost, in Moravia, several feet beneath the surface of the loess soil, in an undoubtedly Solutrean layer (Plate 57). The carving of animal figures on the *bâtons de commandement* also underwent a great advance during this period. It is just possible that statuettes of naked fat women, usually regarded as peculiar to the Late Aurignacian, may also have been executed during the beginning of the Solutrean. If so, they, too, may well have been the work of Aurignacian survivors rather than of the Solutreans themselves. The latter may possibly have been primarily responsible for at least one class of decorative designs, namely, those of geometric and highly conventionalized type (Fig. 48).

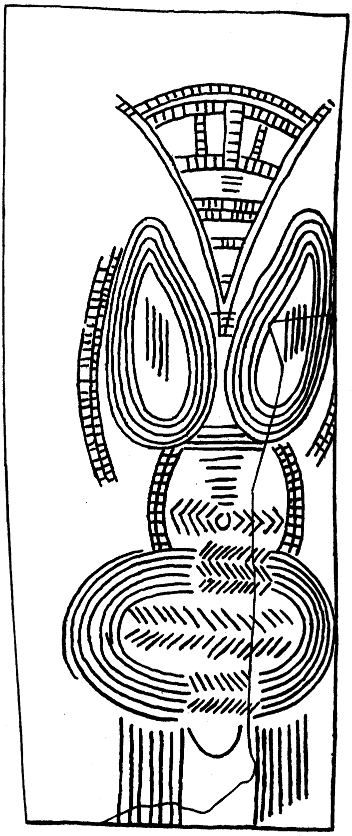


FIG. 48. Geometrical design representing a woman, engraved in ivory. The triangular head, the breasts, hips, and legs are indicated. From Předmost, Moravia. After Kříž

Ornamentation of this variety, as opposed to the more purely naturalistic designs of Aurignacian times, is distinctly east European. But whether they were Solutrean or not, undoubtedly these designs also possessed a magical significance.

As we have seen, the Solutrean culture appears to have reached western Europe from the east, perhaps as a result of actual invasion by a new, more warlike, and more efficiently armed people from the steppes of southern Russia or southwestern Siberia. The possessors of this culture seem throughout their history to have sought the lowlands rather than mountainous regions; also they depended for food chiefly upon plains-loving species of animals, notably the steppe type of wild horse.

Yet abundant signs indicate that the respective cultures of the Aurignacians and the Solutreans reacted upon each other in many ways. Maybe wherever the Solutreans penetrated, they constituted themselves a sort of ruling class or tribe exacting tribute from their predecessors, the Aurignacians, as the Iroquois Indians did from the Algonkins in America. Or they may simply have driven the Aurignacians into hilly or densely forested regions where they themselves, accustomed to life on the open treeless plains, did not care to penetrate. Numerous illustrations of a closely similar state of affairs might be drawn from the contacts between the Plains Indians and their mountain-dwelling neighbors.

In Solutrean times, also, men evidently revered, or at least feared, the spirits of their dead, for among the few interments of that period which have thus far come to light we find instances of stone coverings protecting bodies, which in some cases are specially prepared for burial and accompanied by numerous grave-offerings. One of the Brünn skeletons, for example, was colored with red pigment, as were many of the objects buried with it. These included perforated stone disks, ornaments of shell and bone and mammoth teeth, and a fragmentary ivory statuette, apparently of a man.

The Solutrean culture is usually considered to have persisted in Europe for perhaps a couple of thousand years, after which it came to an end, somewhat abruptly. The total disappearance of the Solutrean technique of flint-working suggests the withdrawal of a race rather than the decline of a culture. It seems probable that this disappearance resulted, in the main at least, from a change in climate. For there appears to have been an increase in humidity toward the close of Solutrean times which induced the growth of forests. These spread gradually over much of the steppe, rendering it impossible for the Solutreans any longer to continue their accustomed methods of hunting in western Europe, even had the troops of wild horses and other plains-loving animals been able to remain.

But as the forests slowly crowded out the latter, the bands of hunters who depended on them for a livelihood seem to have accompanied them farther and farther eastward, back toward the regions whence they had originally come. Probably the change in any one man's lifetime was hardly great enough to be noticed; and we must remember that in those days man possessed no means of recording past events save by oral tradition—literally through "grandfathers' tales."

Here we may recall the theory, already touched upon in Chapter VI, that the Solutrean hunters were the remote ancestors of the tall, narrow-skulled, fair people whom we know as Nordics and who in far later times overran, devastated, and conquered great portions of Europe and western Asia. Much further work needs to be done, however, before this hypothesis can be shown to be either true or false.

The Magdalenian Epoch

The Solutrean epoch, all investigators are agreed, formed only an interlude, although a fairly lengthy one as man looks on time. Immediately on its heels came the Magdalenian culture, whose rise seems fundamentally to have been connected with the re-emergence from obscurity of the Cro-Magnon race. It represents, however, by no means merely a revival of Aurignacian culture, but had a very distinctive character of its own. It has left traces from Spain to central Siberia, but does not occur, at least in its typical form, in Africa, in Italy, or in southern Spain. For these reasons some have thought that it originated in Asia. Others, however, like Obermaier, regard it, perhaps with better reason, as having arisen in the French Pyrenees, mainly out of the Aurignacian, but modified and stimulated by other cultural influences, including eastern ones.

Of two things at any rate we may be sure. One, that the Magdalenian did not develop out of the Solutrean, which it closely followed; the other, that it is associated principally with the Cro-Magnon race. The latter no longer attained the splendid physical proportions of early Aurignacian times. Osborn very plausibly suggests as a cause of this decrease in bodily size the severe climatic conditions which prevailed during Magdalenian times.

The Magdalenian culture appears to have arisen during

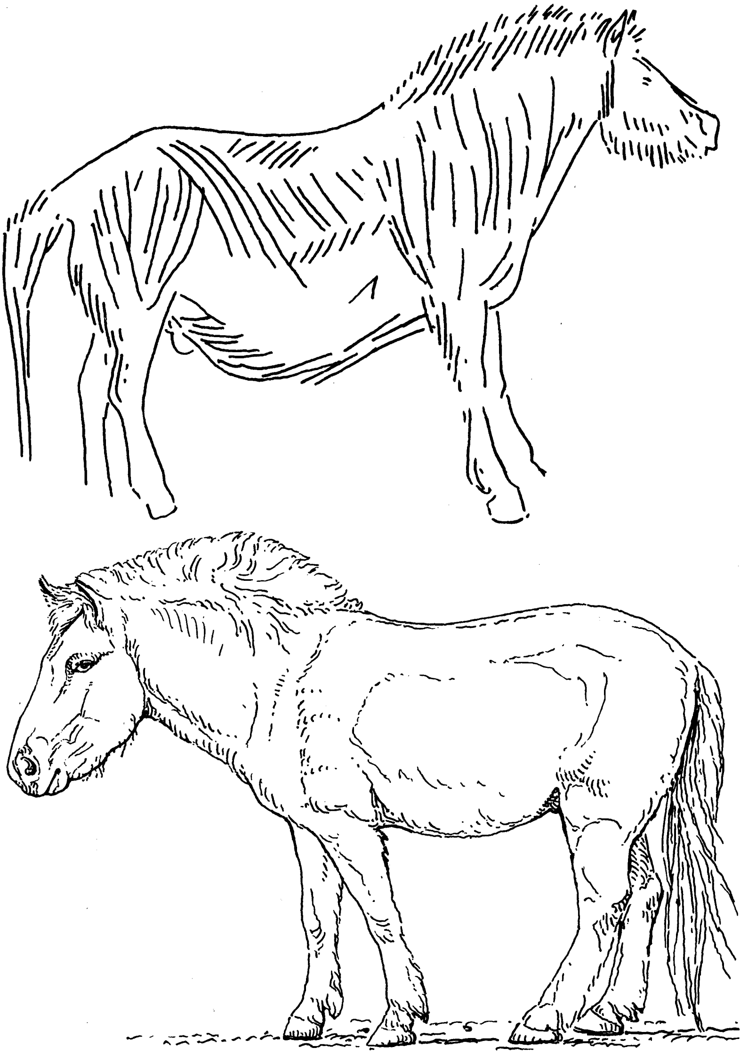


FIG. 49. Upper: Painted engraving of a horse from the cavern of Niaux, in southwestern France. Wedge-shaped mark behind right shoulder may indicate a spear or an arrow by which horse was "killed" as part of the magical ceremony. After Cartailhac and Breuil. Lower: The Mongolian wild horse, closely akin to those of the Old Stone Age, now in the National Zoological Park

the first of those three minor advances of the ice which occurred at intervals after the close of the last or Würm glacial stage. Osborn regards it as beginning about 18,000 years ago, although others have put it rather later. All agree, however, in regarding it as a comparatively long

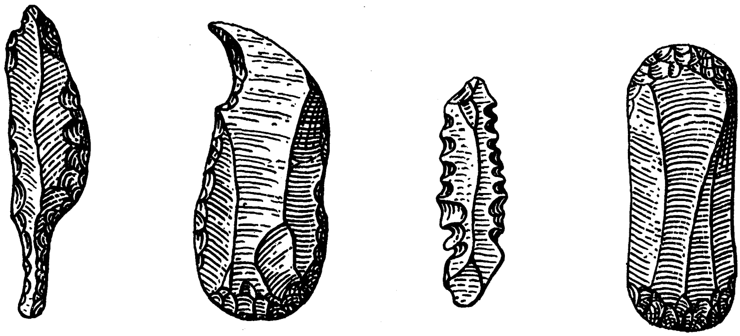


FIG. 50. Magdalenian flint implements, including a graving tool. After de Morgan

epoch, considerably longer than the Solutrean, and lasting altogether not less than 3,000 or 4,000 years. Most painstaking study, mainly by French investigators, has led to its division into three phases: the Lower or oldest, the Middle, and the Upper. Of these the first seems to have been at least as long as the other two combined.

With the gradual increase of both cold and humidity at the end of the Solutrean, the glaciers of the Alps, of Scandinavia, and of Great Britain once more advanced, although not by any means as far as they had done during the Würm or last really great glaciation. Nevertheless the cold and the heavy falls of wet snow compelled mankind to seek shelter in the mouths of caves or at least under overhanging cliffs. Forests gradually overgrew the lowlands of western Europe, interspersed with meadows and swamps, and around the borders of the greatly expanded ice fields bleak tundra conditions prevailed. This phase of the Magdalenian epoch is that of the Bühl postglacial stage in the Alps. During Middle Magdalenian times, a temporary retreat of the ice fields followed, and somewhat more genial climatic conditions returned. Finally, the second postglacial advance, known as the Gschnitz stage in the Alpine region, seems to have coincided fairly closely with the closing period of Magdalenian culture, bringing with it a cold, wet climate, although the snow line did not descend as far down the mountainsides as during the Bühl advance.

These climatic fluctuations naturally affected the animal life, although not in any radical way. Both tundra and steppe forms existed, including the reindeer and the horse, upon which the Magdalenians depended largely for food; although, of course, they only hunted them and did not bring them under domestication. The Magdalenians also knew the saiga antelope, distinctly a steppe animal; the musk ox, now a denizen of arctic North America; the bison and the moose, both closely related to existing forms; the ibex, the beaver, the wolverine, the lion, the wolf, the fox, and many others. The mammoth and the woolly rhinoceros still occurred in western Europe at the beginning of the epoch, although they disappeared before it was over. Thus the fauna was of a typical cold-loving type; for even the lion, which we think of today as

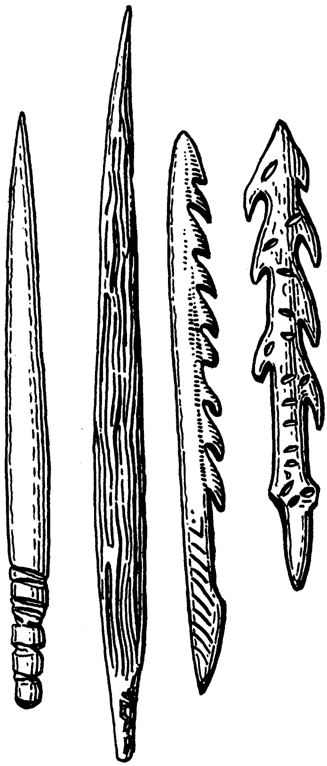


Fig. 51. Magdalenian bone and ivory points and harpoons. After de Morgan

a native of Africa and southern Asia, can become habituated to very cold weather, just as the tiger is nowhere so large and fine as in Manchuria and Siberia.

During the Magdalenian that loss of skill in stone-working, which seems to have begun with the increased utilization of other materials during the Aurignacian, further manifested itself. The period had none of the beautiful pressure or ripple flaking which characterized the Solutrean; but an extraordinary development of skill and artistic taste took place in the manufacture of all kinds of implements from bone, mammoth ivory, reindeer antler, and probably also from more perishable materials, such as wood and the horns of bison and wild cattle. The simple bone harpoon with ridges and notches, of the Early Magdalenian, evolved in time into a most effective weapon with rows of recurving barbs along both edges. Sharp javelins of reindeer antler bore deep grooves, whether to hold poison or merely to let the blood flow more freely we do not know. Scrapers for dressing skins, as well as awls, hammers, chisels, and stone and horn polishers, were made in profusion. The Magdalenians also produced the so-called *bâton de commandement*, often richly carved, no doubt in order to increase its magical efficacy.

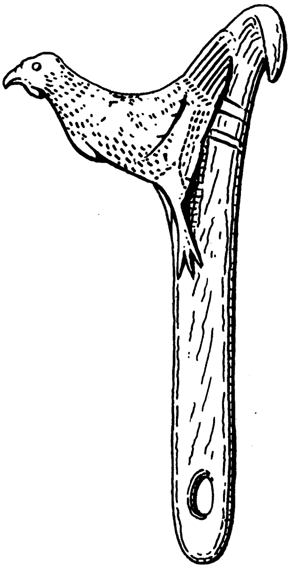
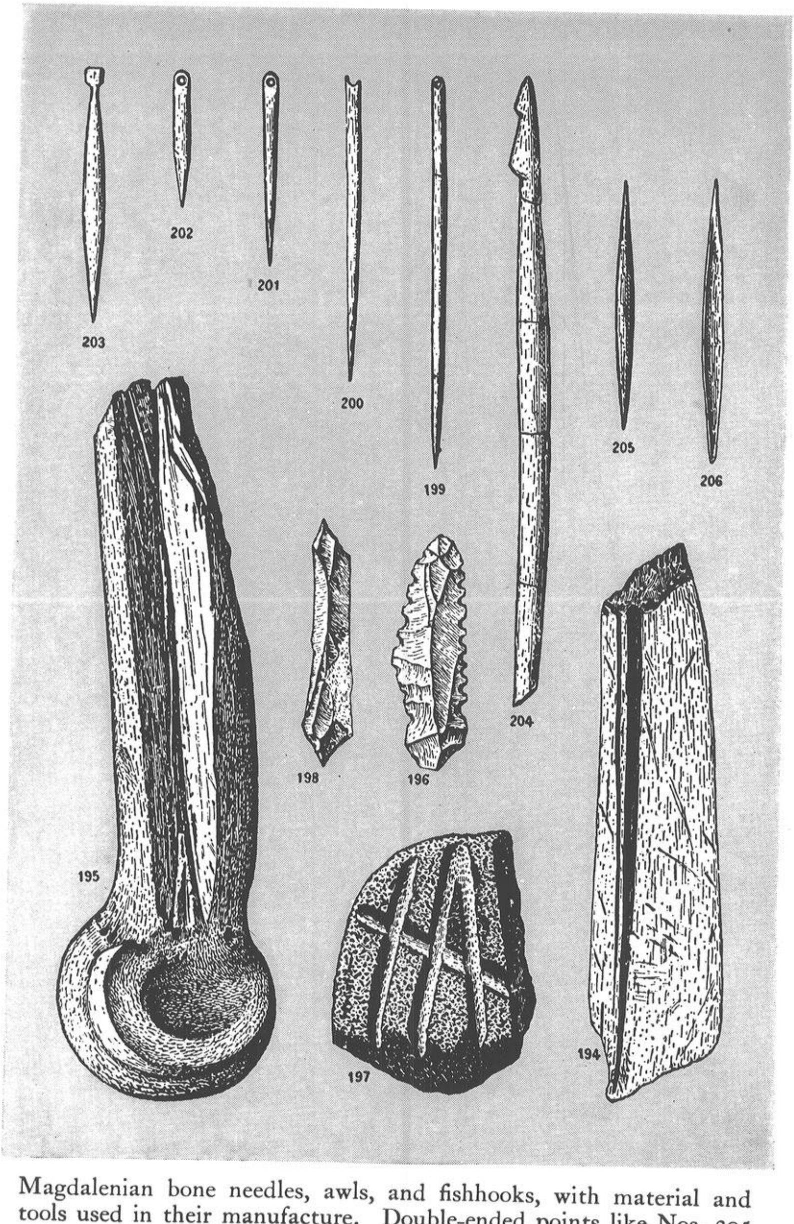


Fig. 52. Magdalenian spear-thrower of reindeer antler partly restored. Believed to represent a grouse or ptarmigan. After Piette and Breuil

Late in the Magdalenian epoch appeared the spear-thrower, exactly similar in principle to those still used by savage peoples in many parts of the world (Fig. 52). This

Musk ox. This animal, now found only in arctic North America and Greenland, during the Glacial Epoch inhabited northern and central Europe. In the National Zoological Park

PLATE 59



Magdalenian bone needles, awls, and fishhooks, with material and tools used in their manufacture. Double-ended points like Nos. 205 and 206 seem to have been used in fishing. After de Mortillet marked a decided advance in armament. It is possible, too, that the bow and arrow were known, although the evidence for this is necessarily indirect, since materials so little durable as those from which these weapons are made could scarcely be expected to survive. Very significant of the clothing habits of the Magdalenians is the abundance of finely made bone or ivory needles (Plate 59), pierced with eyes, which occur in deposits of this period.

Up to this point in our study of early man we have been able at the most only to infer the existence of artificial habitations of any kind. We *know* that during certain

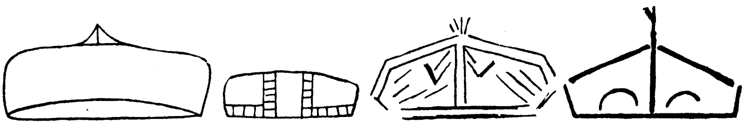


FIG. 53. Tectiform or hutlike designs from the caves of southern France and Spain, of uncertain interpretation; perhaps wild animal traps. After Breuil

cold periods he lived in the mouths of caves; and we can *guess* that under milder climatic conditions he may eventually have erected windbreaks, or even huts of some sort, in the open. But during the Magdalenian the evidence for the existence of such constructions becomes much stronger.

Thus the type station of La Madeleine, from which the Magdalenian epoch takes its name, is merely a long, shallow rock-shelter which of itself could hardly have afforded protection from the elements to such large populations as evidently camped there then. The inference is well-nigh irresistible that they must have built, along the sheltered area at the foot of the cliff, long lines of habitations of some kind. Moreover on the walls of certain caves, like those of Font-de-Gaume, in southwestern France, and of Castillo and Pasiega, in the extreme north of Spain, we find depicted designs which many investigators regard as representations of huts or cabins (Fig. 53), though others have interpreted them as pictures of traps for capturing wild animals. But in either case they afford pretty clear evidence that so advanced a people as the Magdalenians were quite intelligent enough to erect buildings of some sort. For that matter, they very likely knew how to construct both huts and animal traps.

The great artistic ability of the Cro-Magnon race which achieved such remarkable results during the Aurignacian epoch underwent a partial eclipse during the Solutrean. But in the Magdalenian it again shone forth more brilliantly than ever and reached a degree of excellence unequaled before, although sometimes foreshadowed during the Late Aurignacian. It culminated in the Middle Magdalenian. After that there came a sudden decline and eventual disappearance, for which various explanations have been offered.

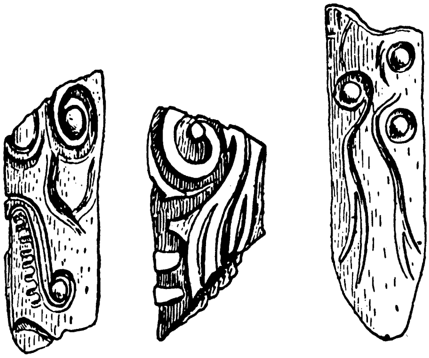


FIG. 54. Conventionalized designs carved on fragments of bone. From the cave of Espélugues, southwestern France. After Piette

Like the Aurignacian, the Magdalenian art falls into two distinct but nearly related divisions. The more impressive of the two is that found on the walls, ceilings, and floors of caverns. The other appears often as elaborate decorations on various objects, such as tools and weapons, particularly of bone and antler (Fig. 54). Nor can we doubt that carving in wood must also have been highly developed. It is quite possible, too, that the Magdalenians painted designs on animal skins, just as the Plains Indians did on buffalo robes.

The beginning of this great artistic development coincided, as we have seen, with a climatic phase in which life conditions were again very severe, driving people to rock-shelters and the vestibules of caves for protection from the increased cold and dampness. Thus, during the winters at least, there must have been much crowding together, and this invariably leads to active exchange of ideas and consequent rapidity of progress. This has always been so. Cities are invariably progressive, some-

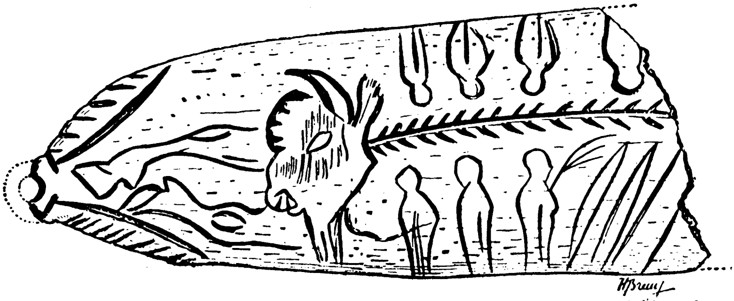


FIG. 55. A hunters' feast engraved on a bone pendant. The dead bison is shown partly dismembered, exposing the spinal column. From the cave of Raymonden, southwestern France. After Breuil

times even radical; while rural regions, where people are more scattered, are conservative and slow to change. Thus the words "pagan" and "heathen" meant originally nothing more than "villager" (*paganus* in Latin) and "dweller on the heath," for belief in the old gods still survived in the country districts long after the great centers of population had become Christian; hence, also, "rustic" or "countryman" became equivalent to "non-Christian."

Similarly in Magdalenian days, when people lived crowded together, and blizzards and deep, wet snow enforced long periods of physical inactivity, minds as gifted as those of the Cro-Magnons must have been stimulated to an exceptional degree. This would lead, as indeed we know it did, to progress in many directions, one of which was in the field of art.

This is not at all to imply that the Magdalenians were ever "artists" in the present-day sense. Like the Aurignacians, they usually executed their engravings and paintings in the remotest depths of caverns, in places almost incredibly difficult of access and in darkness hardly to be dispelled by the smoking torches and crude stone lamps of the ancient artists (Fig. 56). Such inaccessible recesses were never picture galleries or show places, but rather Cro-Magnon man's cathedrals and temples, where, far from the abodes of his fellows, he carried on his most sacred and awesome rites.

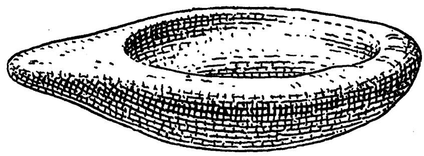


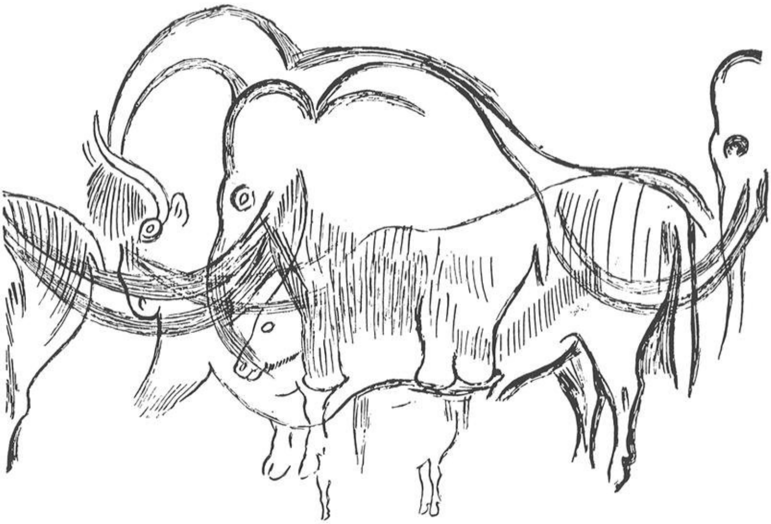
FIG. 56. Stone lamp from cave of La Mouthe, in southwestern France; perhaps it provided light for the cave artists. After de Mortillet

Great differences exist in the artistic merits of the various pictures, showing that some individuals had far greater talent than others. Nevertheless, the changes of style in this cave art follow exactly the same course wherever it occurs, even in the most widely separated regions. This can only mean that active communication and interchange of ideas was going on at this time throughout much of western Europe, at least among the medicine men.

One of the striking things about this cave art is the apparently purposeless way in which one picture is drawn over another, exactly as though the latter had not existed (Plate 60). Here we have one of the surest proofs that the motive underlying it all was magical and not merely esthetic, for it shows that after a given design had served its purpose in helping "make magic" it lost its interest. Earlier drawings meant nothing to later artists. Evidently Cro-Magnon man, like most savages to whom the ceaseless quest for food is the great problem of life, was a strict utilitarian. And like them, too, he doubtless hunted different animals at different seasons.

The cave artists employed several of the graphic arts—engraving, carving in low relief, painting in one or more colors, and modeling or sculpture. Not infrequently they

PLATE 60



Superposed mural frescoes representing horse, reindeer, bison, and mammoth. The designs were first engraved as above and then painted; the lower picture gives the final effect. After Capitan, Breuil, and Peyrony

combined two or more methods. They showed great ability in modeling figures in clay, like the two bisons in the cavern of Tuc d'Audoubert or the clay bear with a real bear's skull in the cave of Montespan. In fact they prob-

Fig. 57. Design of a herd of reindeer, engraved on the wing bone of an eagle. From the cave of La Mairie, southwestern France. After Capitan and Breuil

ably employed this method a good deal more commonly than its few surviving examples would indicate; for Cro-Magnon man had not learned to bake his clay figures, which therefore must usually have soon gone to pieces.

Of these various arts, engraving and painting especially characterized the Middle Magdalenian, when the latter

Fig. 58. A mammoth engraved on ivory, from the station of La Madeleine. One of the earliest and most spirited specimens of the later Old Stone Age art found. After Lartet

method in particular reached its height. The artist used ocher and oxide of manganese for pigments, grinding them fine in stone mortars and mixing them with some such medium as animal fat. They kept these paints in shells or in tubes made of the hollow leg bones of animals. What they used for brushes we have no means of knowing, but perhaps some sort of fibrous wood frayed out at the end. They painted mainly in red or black, or in both, but also occasionally used other colors.

Sculpture, which began in the Aurignacian, developed continuously to the Middle Magdalenian. That of animals, which seems to have had its rise in the Solutrean, reached its height in the Early Magdalenian. Nude human figurines were also executed, although these now tended to be naturalistic and comparatively free from the gross exaggeration of the Aurignacian sculptors. But representations of the human form during the Magdalenian epoch are rather rare and never rival the excellence of contemporaneous portrayals of animal life.

Of the different animals depicted, the mammoth, while it lasted, furnished a favorite subject, as did the reindeer, the horse, and the bison. Of the last-named creature it has been estimated that fifty representations occur for one of the wild bull. Birds are rarely shown, but fish are not infrequent (Fig. 59).

Representations of masked or otherwise disguised human figures point inevitably to the existence of some sort of ritual. They recall in particular the "hunting dances" of certain latter-day savages, in which the performers put on skins of animals of the kind about to be hunted and imitate their characteristic movements. Perhaps the most noteworthy design of this class so far found is one known as "The Sorcerer," or, as our frontiersmen would have said, "The Medicine Man." This was discovered a few years ago, deep in the cavern of the Trois Frères, in southwestern France (Fig. 60). It is placed high on the end wall in a most inaccessible position, from which it dominates the entire chamber, and is engraved, certain of its features being emphasized by the application of black paint. The figure, about two and a half feet long, is that

The best preserved Magdalenian painting of a bison in the caverns of Altamira, Spain. After Cartailhac and Breuil

of a man leaning forward and apparently dancing. Long hairy ears and the horns of a stag adorn his head, and a pointed beard seems to be indicated, while he also wears a horse's tail. We have here, no doubt, a representation of a witch doctor, or shaman, tricked out in all his savage

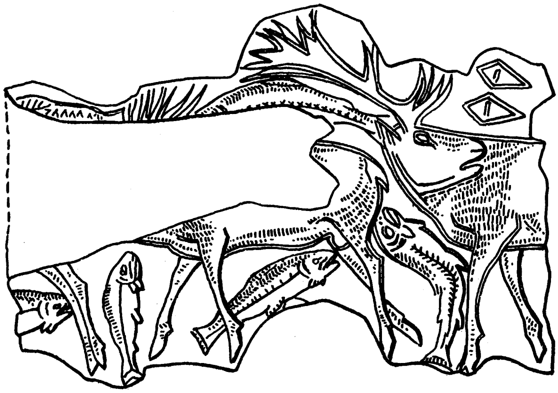


FIG. 59. Red deer and salmon, engraved on a piece of reindeer antler; scene may represent a herd crossing a stream as indicated by the fish. Marks in the upper right-hand corner may be the artist's signature. After Piette

regalia and stamping and shuffling about in some hunting dance. Since even back in the Aurignacian epoch man seems already to have conceived of supernatural beings as possessing human form, possibly we have here something of the same sort. The figure may not be the representation of any earthly medicine man but of some mythological concept—some "Divine Huntsman," invoked for aid in the chase. At all events it indicates that Magdalenian man had reached a point in the development of his religious beliefs quite equal to that of many modern peoples and in advance of some.

The care which he bestowed upon the burial of his dead further indicates this. Again we see the persistence of customs originating in Aurignacian times, if not indeed earlier still. Bodies were provided with necklaces, girdles, and pendants of pierced shells or the perforated and engraved teeth of various animals, among them the lion and the bear. Evidence of the custom of "secondary interment" already described is to be seen in the manner of

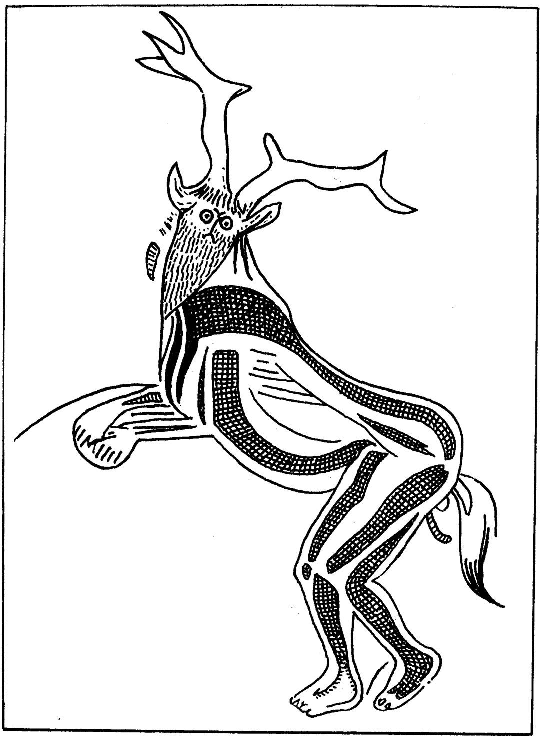


FIG. 60. The famous figure known as "The Sorcerer," partly engraved and partly painted in black, from the cavern of the Trois Frères in southwestern France. From photograph by Count Begouen

putting the disarticulated bones of the dead together again before this final burial. Thus the skeleton found in 1894 in the grotto of Les Hoteaux, in eastern France, had its thigh bones reversed, perhaps so that its ghost could not "walk." Often the remains are found covered with red ocher and accompanied by various implements. Sometimes the head is entirely separated from the body and buried by itself. In not a few cases, the leg bones have been found doubled up so tightly that they must have been held in this position by bandages of some kind, doubtless of skin thongs or strips. In the great cave of La Placard, in southwestern France, there came to light in a Lower Magdalenian layer several human skull-tops which had been cut off with some sharp implement. As these when found were carefully arranged in order, with the concavities turned upward, the inference is that they had been fashioned from the heads either of enemies or of loved ones, to serve as ceremonial cups or bowls (Fig. 61).

Evidently the Magdalenians had a well-established cult of the dead, perhaps even an actual ancestor worship, which undoubtedly exerted a profound influence on the life and thought of the time. Some modern investigators, indeed, believe that all religion may be traced back ultimately to beliefs and practices connected with the dead.

What caused the rapid decline of culture in the Late Magdalenian has not yet been fully explained. Perhaps, as Osborn suggests, the Cro-Magnon race had reached the end of a long cycle of psychic development—had, in other words, arrived at a point beyond which it could progress no further, and decline was therefore inevitable. Something of this sort has occurred repeatedly in the history of various civilized races, for no reason as yet apparent.

On the other hand, we know that, coincident with the close of Magdalenian times, great changes came over Europe. The ice fields once more retreated far up the sides of the mountains. Tundra conditions gradually disappeared, save in the far north. Although the climate was still somewhat colder and damper than now, forests once again won back the tundra land. Cold-loving species of animals, on which the Magdalenians had depended so largely for a living, withdrew as the conditions favoring their existence slowly changed. And the forms which did remain became more difficult to hunt successfully as the forests kept on increasing in density.

Indications, indeed, exist that at this time fishing slowly replaced hunting as the principal means of gaining a livelihood. From being an active, courageous hunter of large and often highly dangerous wild animals, Cro-Magnon man seems to have become a fisherman and a gatherer of shellfish.

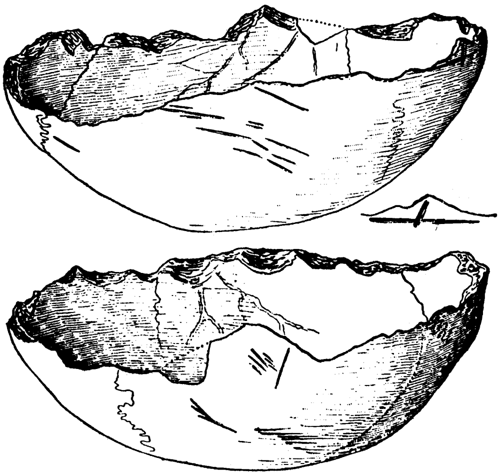


FIG. 61. Human skull-tops made into cups or bowls, probably for ceremonial use. From the cave of Le Placard, in southwestern France. After Breuil and Obermaier

It is likely, too, that about this time the ancestors of the widespread "Mediterranean" race of today began to invade southern and western Europe, coming from northern Africa. These people appear to have brought with them a type of culture more advanced in some ways than that of the Magdalenians. Perhaps they had a more closely knit social organization that enabled them to use their armed strength to greater advantage. Or, on the other hand, they may merely have appeared in larger numbers and simply swamped their predecessors. Their undoubted use of bows and arrows, perhaps with poison, may have had something to do with their superiority.

The Cro-Magnon race, however, did not die out entirely. Here and there, as skeletal peculiarities clearly show, it still survives, in a more or less mixed form, as an element of the populations of the present day.

The Capsian Culture of Spain

We must not close this brief account of the Old Stone Age without making some reference to human activities in Spain during that period. Enough has already come to light in that country to show that it played a part in the story of early man no less important than that of France itself. Nor is this at all surprising, for the Spanish peninsula has always served as a highway for the migrations back and forth between Africa and Europe of both races and cultures. This has been true throughout historical times, and now research is showing that it was also the case in the prehistoric period.

During the Ice Age the lowlands of Spain, owing to their more southern position, escaped burial under great ice fields like those which spread over so much of the Northern Hemisphere. Glaciers were formed in the mountains, but they did not flow very far down the valleys before they reached their melting point. Obermaier, our leading authority in this field, believes that the interglacial stages in Spain included phases when the climate was more humid and others when it was drier than that of the present. He thinks, too, that the vast accumulations of sand and clay which cover the lower slopes of many of the Spanish mountain chains were not laid down during the glacial stages but during the more humid interglacial periods.

Owing to its milder climate the older "warm" types of animal life, like the southern and the straight-tusked elephants, the Etruscan and Merck's rhinoceros, the hippopotamus, and the striped hyena, were able to survive far longer in Spain than in most parts of Europe. For the same reason the northern or "cold" fauna, including forms like the hairy mammoth, the woolly rhinoceros, the reindeer, and the musk ox, succeeded in getting no farther down than the extreme north of the peninsula.

So far Spain has revealed no traces of the Pre-Chellean culture, but Chellean and Acheulian remains occur in all parts of the peninsula, being traceable probably to an ultimate African origin. Mousterian implements, associated in Spain, too, with Neanderthal man, are also widespread. It will only be necessary in this connection to recall the various finds at Gibraltar already described (see Chapter VII).

In Spain, as elsewhere in western Europe, the Aurignacian followed the Mousterian. In northern Africa a culture already mentioned as very closely resembling, if not actually identical with, the Aurignacian, *viz.*, that known as the Early or Lower Capsian, followed. The lack as yet of actual skeletal evidence leaves us uncertain whether to ascribe the latter culture to the Cro-Magnon race, but several reasons suggest that it should be so ascribed. In the first place, the Capsians developed a style of art very distinctive in character, but unquestionably derived originally from the same source as that of the Aurignacians and Magdalenians; and the latter, as we know, has been found closely associated with the bones of Cro-Magnon man. Further, it has been stated that the Cro-Magnon type still appears among the Tuareg, an ancient "white" race now inhabiting the western and central Sahara Desert. It is also thought to have occurred among the Late Stone Age people known as the Guanches, whom Europeans found occupying the Canary Islands, off the northwestern coast of Africa, when they conquered that group some four or five hundred years ago. If these observations should prove well founded, they would establish a presumption that there was a Cro-Magnon strain, at least, in the blood of the Capsian invaders of Spain.

But the latter seem also to have included in their racial composition a very large element ancestral to the Mediterrean race already mentioned in connection with the Magdalenian decline. This stock was destined to form the basis of the population of western and southern Europe, during the Middle and New Stone Ages; and indeed, it still predominates in many regions of that area. A round-headed or broad-skulled element, coming apparently from Asia, was just beginning to appear here and there in western Europe at the very end of the Old Stone Age.

After the Aurignacian culture in most of Europe, as we know, came first the Solutrean and then the Magdalenian. In Spain, however, the two latter cultures appear only in the extreme north. In the rest of the peninsula matters took a different course. Somewhere about the close of the Aurignacian epoch in Europe, the Lower Capsian of northern Africa developed into the Upper Capsian, distinguished by its very small stone implements of geometrical shapes, its large bone needles, and its curved blades made from the shells of ostrich eggs. This Upper or Late Capsian spread over into southern and eastern Spain, where it succeeded the Spanish Aurignacian and flourished during the same period as did the Solutrean and the Magdalenian farther north.

The Upper Capsian seems to have brought with it a realistic and very animated style of art, in many respects strikingly like some of that which has been found in various parts of Africa in very recent years. It differed from the Upper Paleolithic art of the rest of western Europe in attaching great prominence to representations of human beings, and from these we can learn a good deal about the dress and weapons and the customs of the time. The men went about practically naked, although occasionally they are shown with what appear to be short breeches or trunks. They also sometimes wear fringed bands just below the knee and around the arms, as well as tall headdresses, apparently of feathers. Figures of women occur very rarely, and are almost invariably clad in rather long skirts, no doubt of buckskin.

The male figures frequently carry bows and arrows (Fig. 62), giving us the first indisputable evidence of the existence of that weapon, which was destined to play such an important part in the future history of mankind. Certain jackal-like animals portrayed in the rock-shelter of Alpera, in southwestern Spain, may possibly represent half-domesticated dogs; but this is exceedingly doubtful.

Despite certain dissimilarities, this Upper Capsian art of southern and eastern Spain seems to have been developed from the same sources which produced the Auri-

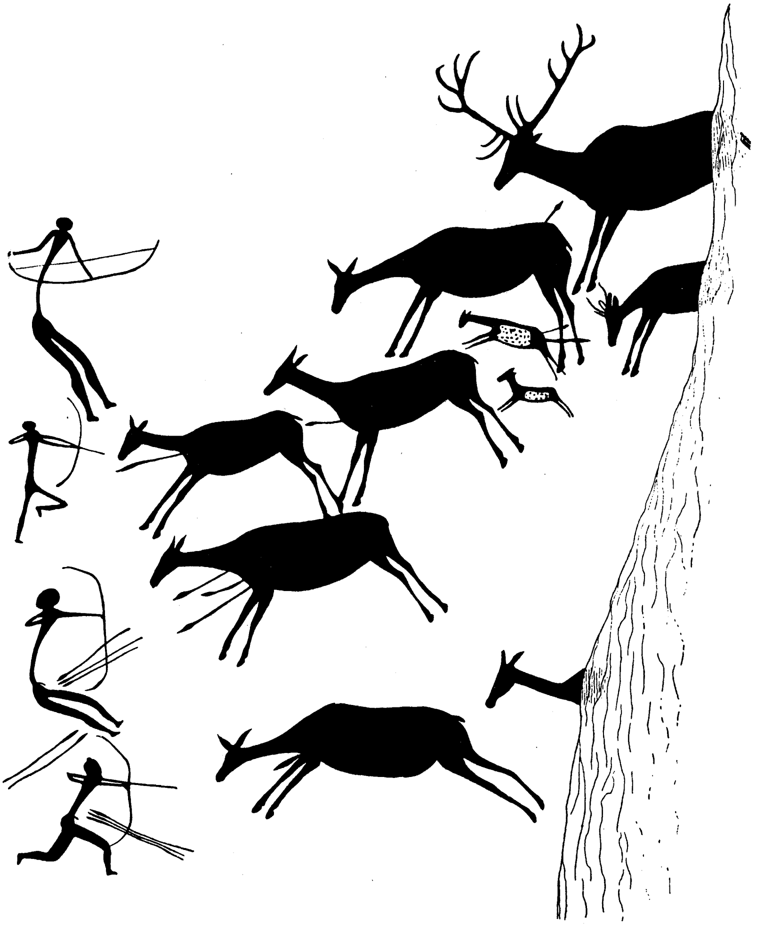


Fig. 62. A stag hunt. Capsian or Spanish art of the Late Paleolithic. Note bows and arrows and apparent feathering of latter. Painted in dark red in the "Cave of the Horses." After Obermaier

gnacian and Magdalenian art, and in response to the same psychological stimuli. That is, the animal figures were undoubtedly designed to obtain aid in the hunt or to bring about an increase in the number of food animals. Scenes in which human figures occur appear to have had as their motive the imparting of strength, swiftness, and

FIG. 63. Wounded warrior running away at top speed, probably drawn to bring about an enemy's defeat; painted in light red. From the rock-shelter of La Saltadora, eastern Spain. After Obermaier

courage to the warriors of the artist-magician's own tribe, or the weakening through spells and incantations of their enemies. The latter were accordingly depicted as running away, sometimes riddled with darts (Fig. 63), in the belief that when the actual combat took place the same results would be obtained through the power of magic.

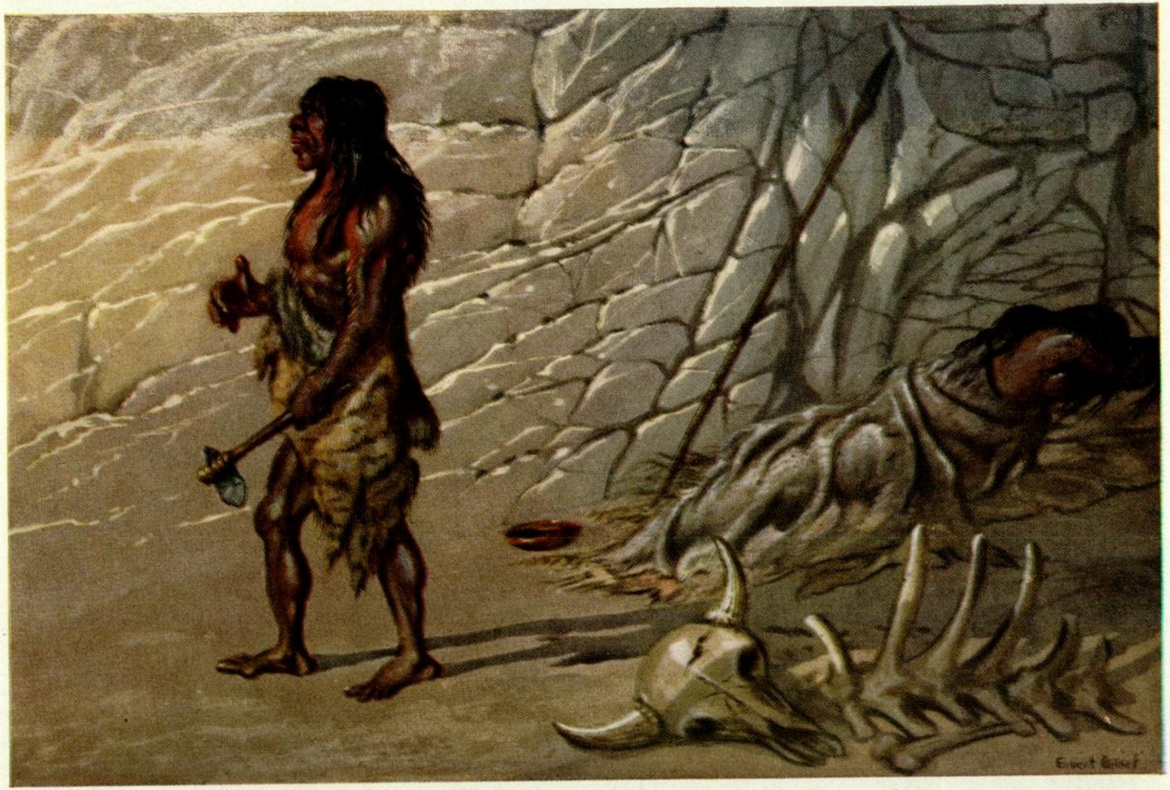
This eastern Spanish art, as it is sometimes called, is usually found in shallow and relatively open rock-shelters; for deep caverns, like those in which so much of the Aurignacian and Magdalenian art has been found, very rarely occur in this region. It came to an end with the close of the Old Stone Age itself, when the Capsian culture gradually developed into what is known as the Tardenoisian, belonging to that phase of human progress called the Mesolithic or Middle Stone Age, to be discussed in the next chapter.

With the end of the Old Stone Age, climatic conditions in Europe became more nearly what they have been ever since. Once again, after the close of the Magdalenian epoch, a minor advance of the glaciers took place, known in the Alpine region as the Daun, but it was far less severe than that of the Gschnitz, and still less so than the Bühl. Since then the changes seem to have been not so much in respect of temperature as in that of humidity; certain periods have been less moist and rainy than others.

But on the whole, conditions in western Europe once again became favorable to the growth of trees, which, undisturbed by man through long ages, often attained a very great size. From the end of the Old Stone Age down to comparatively recent times, much of Europe was covered with dense, impenetrable forest, the dark and awesome Urwald, or "Ancient Wood," of Germanic myth and story.

With the comparative amelioration of the climate, many of the animals familiar to the men of the Old Stone Age disappeared from western Europe. Some, like the mammoth and the woolly rhinoceros, had perhaps already found a temporary haven in northern Siberia, only in the end to die out altogether. Others, such as the reindeer, the musk ox, and the wolverine, still survive in far northern regions, where the climate today resembles that of Europe during the Ice Age. Doubtless these migrations of the accustomed food animals played a great, perhaps a decisive, part in the movements and modifications of the human populations of the time. For food habits of long standing are particularly stubborn things, and rapid and compulsory adjustments to changed conditions are ex-

PLATE 62



Life in the Stone Age, somewhat fancifully depicted. Pottery bowl shown, for example, is characteristic of the New Stone Age long after the cave-dwelling period proper had closed

ceedingly difficult to make. Witness the swift degeneracy and partial extinction of our Plains Indian tribes, due in no small measure to the extermination of the vast herds of bisons or "buffaloes," upon which they had been wont to depend.

We have come now to the end of the Old Stone Age in Europe. Its story outside of Europe is still a very disconnected one, rendered more difficult of interpretation, perhaps, by the absence in the warmer portions of the globe of the great time-scale of the Ice Age, with its alternating colder and warmer periods.

In discussing epochs subsequent to the Old Stone Age the mass of material forces us to lay greater stress on topical than on regional or racial studies, a course permissible in an attempt to describe the processes by which civilization has been attained.

CHAPTER XII

THE MIDDLE STONE AGE

For many years archeologists believed that when the Old Stone Age came to an end, not long after the close of the Glacial Period, there followed an interval during which mankind disappeared entirely from Europe. Only with the arrival of new races, bringing with them domestic animals, agriculture, pottery, and polished stone implements, was the Neolithic Period, or New Stone Age, thought to have begun. We know better now, thanks to later discoveries. In various regions of Europe, both north and south, the remains of cultures have come to light, proving that Europe throughout this intermediate period was occupied by human beings, in most cases the direct descendants of the later Old Stone Age races. Moreover, the culture of this time forms in many respects a true connecting link between those of the Old and New Stone Ages.

This transitional period is sometimes called Mesolithic—Greek for "Middle Stone." At its beginning, man seems yet to have lacked any implement capable of cutting down a tree. He still lived mainly by hunting and fishing and gathering wild berries and fruits. At first sight it might appear that he had actually retrograded in culture; for his life seems to have been a wretched one, not unlike that led by the savages of Tierra del Fuego, for example, or others among the least advanced of present-day races. Nevertheless he was making progress, and that in several important directions.

It appears, for example, that during this period he invented the stone ax, or rather hatchet, his first means of coping with the jungle (Fig. 65). We can in a measure realize the far-reaching importance of this invention if we pause to think what the ax meant to our own pioneer forebears in the settlement of this country. Man had not yet learned to grind and polish his stone implements but still chipped them out, although he gradually gave them better and more effective shapes. He accomplished the hafting often by splitting or boring the end of a stout stick or club and then inserting the stone blade in the cavity, where a binding of animal sinew or rawhide, by its natural shrinkage, held it in place with a grip almost as strong as iron. The familiar Indian tomahawk was an implement of this description.

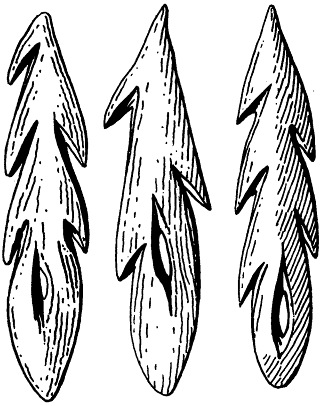


Fig. 64. Flat harpoons of red-deer antler, from the cave of Mas d'Azil. After Piette

To primitive man the added power which the ax gave him in his struggles with his environment seemed absolutely supernatural. The stone ax was "big medicine" and, like everything else which early man thought much about, was regarded as having a life of its own. The owner must be careful not to offend or misuse it in any way. He made offerings to it, talked to it, and handled it carefully and reverently.

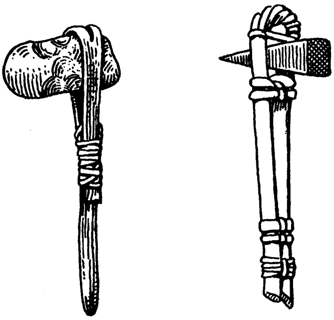


Fig. 65. Left, stone hatchet from eastern Australia, with polished cutting edge only. Right, iron hammer from the upper Congo River, retaining ancient hafting method. After Frobenius

The superstitious beliefs inspired by the early stone hatchet persisted far down into later times, and the ax remained a symbol of power and authority among certain peoples, even into the historical period. Thus beautifully polished examples in jade were symbols of kingly authority in Bronze Age China, while the ax, especially in its double or two-edged form, retained great ceremonial significance in ancient religious observances in parts of the Mediterranean area.

Throughout the long earlier periods, before and during the Old Stone Age, man sought refuge from the rain under overhanging cliffs, and from the cold inside the mouths of caves. Probably, too, he learned in time to erect simple windbreaks or lean-tos of bark or leafy boughs. And, as we have seen, certain designs of the later Old Stone Age in western European caves may represent huts or cabins; but with the advent of the stone ax it became a much simpler matter to cut down saplings and make huts roofed with leaves, bark, or skins, like those of so many savage tribes the world over, even today (Plate 63). Primitive man seems sometimes to have erected these for safety's sake among the branches of trees, on piles over water, or even on rafts moored a short distance from the shore. But further than this man hardly got during this middle period of transition.

While Middle Stone Age man can not claim the invention of the bow and arrow, which, as we saw, first appeared with certainty in the Upper Capsian, its use probably became general during the Mesolithic Period.

As with so many other discoveries of primary importance, we do not know when or where or how the bow and arrow originated. Probably some accident suggested them. It has been held that the idea came from the instrument known as the bow-drill, an implement used even today for drilling holes, kindling fires (Fig. 67), and the like. The invention may also have been made more than once, though this seems unlikely.

The use of the bow and arrow resulted in a vast extension of man's power over his environment. He could now bring down his game or his enemy at much greater distances and with far more precision than ever before. The

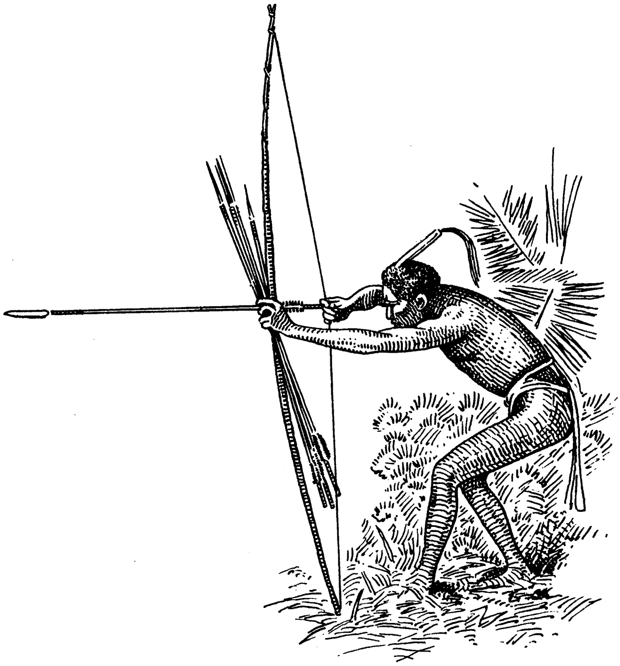


FIG. 66. Negrito using bow and arrow, Philippine Islands. After Frobenius

crude new weapon was one susceptible of vast improvement in many ways. As the long bow, the weapon of the English yeomanry during the later Middle Ages, it proved scarcely less effective than gunpowder in bringing low the pretensions of the haughty feudal aristocracy. As the compound bow, the terribly efficient weapon of the hordes of central Asiatic light-horsemen, who for two thousand years threatened civilization in almost every part of the Old World, it has wielded power no less great and decisive.

In the Mesolithic we begin to find the earliest crude examples of pottery. Men, or perhaps women, apparently already knew how to weave baskets, and it has been suggested that the coating of these with clay, to render them water-tight, may have led to the molding of the first rough

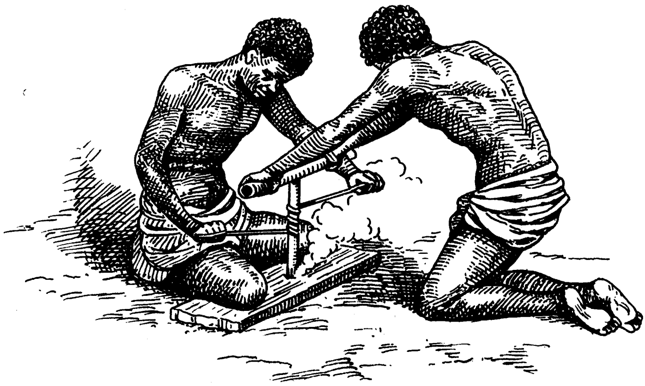


FIG. 67. Wooden fire-drill, Madagascar. A step in advance of this was to attach the ends of the cord to a bow. After Frobenius

pot. A stubborn, unreasoning conservatism, deeply imbued with superstition, formed one of early man's leading characteristics. Thus we find on fragments of ancient pottery, in many parts of the world, the marks of matting or basketry, made while the clay was still soft. To the primitive potter, a pot must bear basketry marks, or it would be unlucky. Later, these marks came to be regarded simply as decorations, and in time dispensed with entirely.

During this same transitional period man seems to have taken the first steps toward the domestication of the animals which have contributed so much to his progress. For it is then that the dog, by far the earliest of all domestic animals, first clearly appears associated with man.

We must not suppose, however, that early man caught and tamed the dog because he had reasoned out beforehand that that animal would be of any particular use to him. In order to take any conscious step in advance, man, both ancient and modern, must have the light of some previous experience to guide him. And hitherto he had known of animals only as something dangerous, to be avoided or else hunted and killed for their flesh and skins.

So the likelihood that dogs might be of use to man could not by any possibility suggest itself to the lowly savages of the Middle Stone Age. In fact, to this day, among a great part of mankind, the dog is nothing more than an ownerless scavenger and hanger-on about refuse heaps, otherwise only useful for raising an alarm at the approach of strangers. And that is what he appears to have been at the beginning of his long association with man. Some have said, indeed, that it was not man who adopted the dog, but the dog which adopted man. In some region inhabited by man during this middle period, a species of wild dog seems to have found the pickings better about the haunts of men than elsewhere. In turn its human hosts doubtless ate the dog when they could catch it. Then litters of its young would be brought into camp, where, if not wanted at once for food, their presence would be tolerated for a time. Given this opportunity, the natural play instinct of both puppies and young boys would inevitably assert itself just as it does today.

These habits of association once formed, in time groups of wandering hunters would naturally come to have their packs of half-domesticated dogs following them about from camp to camp. Valued at first merely as a source of food and for their usefulness in detecting the presence of lurking enemies, in time their aid in following game would be utilized. Thus man at length acquired a domestic animal.

Little if any evidence exists to indicate that the men of the later Old Stone Age had any means of traveling over the surface of the water. Their culture, in some respects so like that of the modern Eskimo, gives no hint that they had invented any form of canoe. It is true that they have left us drawings of various water-dwelling creatures, like the seal, the salmon, and the eel; but these are all such as could readily be speared from dry land or perhaps in some cases through the ice.

But in this Middle Stone Age, again, we find clear proofs that man was learning how to support himself and control his movements on the water. No doubt he could always

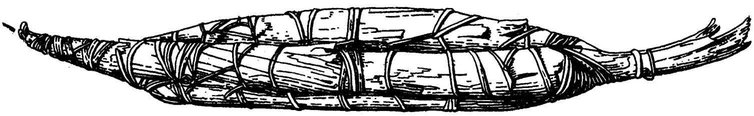
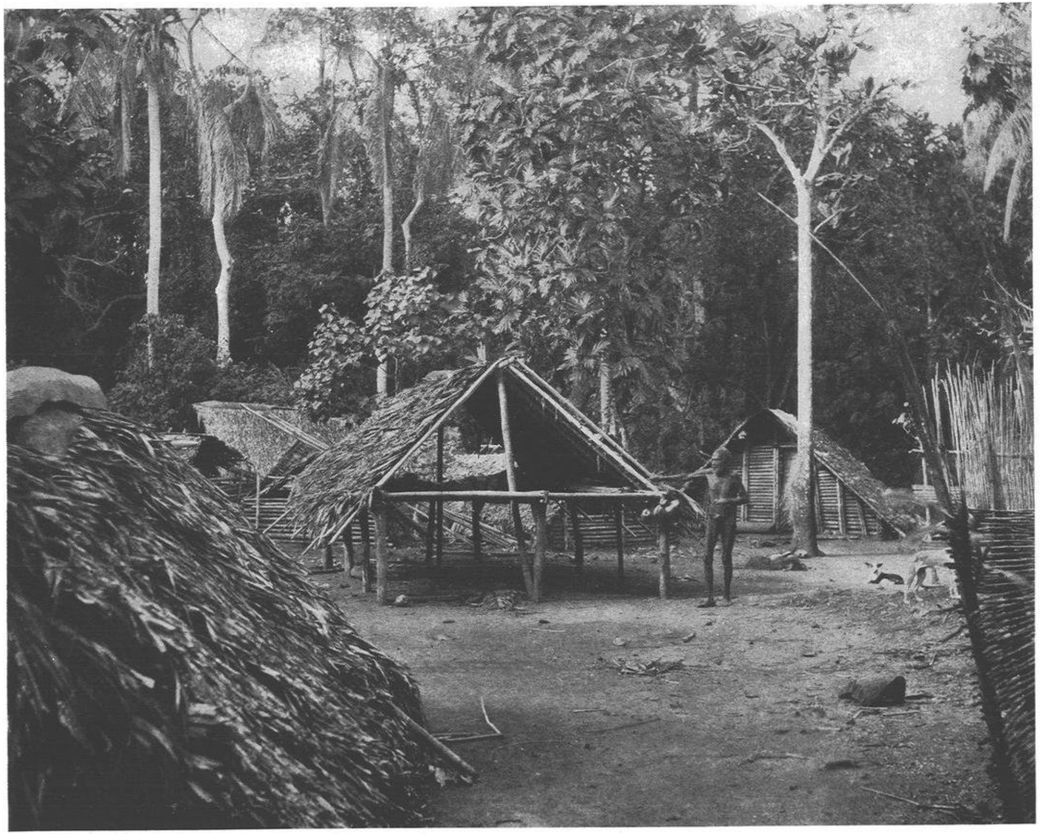


FIG. 68. Tasmanian "canoe" made of rolls of bark lashed together. After Ling Roth

swim; but hitherto he had been essentially a land dweller. Thus his conquest of the water was a step as momentous in its way as the conquest of the air is to us nowadays.

As with all the basic discoveries, we can only surmise the course of this one. Flood waters must often have carried off the camps of hunters and fishermen. The same floods undermined and floated away trees. His instinctive clutching of these would soon show early man that they could keep him from drowning, and even carry him with them for long distances. By pushing with a stick or spear in shallow water or by striking out with his hands and feet where it was deeper, he would learn that he could, in a measure, control their movements. Thus the idea of floats must have arisen. In time man learned to construct these for himself out of bundles of buoyant reeds, rolls of bark, and even tree trunks laid side by side and lashed together. Examples of the former have occurred in recent times among some of the more backward races, such as the now extinct Tasmanians; while the shores of the Baltic Sea have yielded traces of a raft big enough to support a floating village and implying a long previous period of development.



Simple thatched hut in the New Hebrides islands in the South Seas, typical of primitive man's early steps in house construction. Photograph in the Library of Congress

PLATE 64

Primitive bark canoes of the Australian aborigines. Bark canoes of various types are found in several widely separated regions

The canoe proper, made by hollowing out a log, largely with the aid of fire, developed early, perhaps suggested by the accidental use of a hollow tree trunk. Such a discovery might conceivably be made more than once, wherever trees grew near water; at least the well-nigh worldwide distribution of the dugout canoe suggests this. From

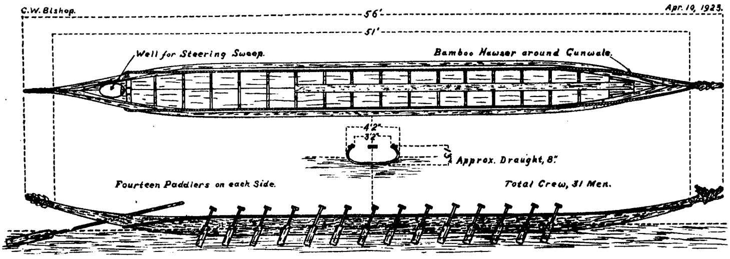


FIG. 69. Chinese dragon-boat today used only for ceremonial purposes, but employed in actual warfare in China, Burma, Siam, and neighboring regions until middle of 19th century

this improvement we can trace, step by step, the evolution of larger and larger craft, until we reach such triumphs of the shipbuilder's art as the ocean steamer and the battleship of the present day.

We still have an intuitive feeling that boats and ships are living things with characters and personalities of their own. That is why we give them individual names. To early man this idea was very real. He felt that by carving the likenesses of a water monster's head and tail at the bow and stern of his war canoe, he could impart to it magically the swiftness and ferocity of such creatures in a very real sense. The dragon's head and tail that ornamented the extremities of the old Viking ships and of modern Chinese "dragon boats" have had this for their motive.

To primitive folk in general, unfamiliar with the idea of traveling over the water, the sudden appearance of strange people, traders or enemies, skimming over the water in a fleet of canoes, must have brought the same feelings of superstitious awe as did the ships of early European explorers to the uncivilized islanders among whom they came.

As we have seen, man appears already in the Old Stone Age to have grasped the idea that he might increase his supply of food by his own efforts, although, so far as we know, he never got beyond the point of using magical means. The beginnings of true agriculture are most probably to be sought in this transitional period to which we must ascribe so many inventions of primary importance in man's further development. Of course, no abrupt change in the practice took place, and but little, consciously at least, in theory. We have learned today that the best way to succeed is by assisting nature. Primitive man tried to control her, for he had not yet reached the concept of fixed and invariable natural laws. For a long time, in consequence, he placed much more dependence on magical rites than on actual planting and cultivation. Not so many years have passed since our own immediate ancestors fully believed that, in order to grow best, seeds must be planted while the moon was waxing and not waning. The student of ancient man must never forget that man has had only experience to teach him; and he has often been very, very slow in drawing the right conclusions.

At first the primitive husbandman probably did little more than protect certain edible plants by clearing away weeds and keeping birds and animals from destroying them. Since man derived strength from eating them, they were thought to be imbued with "medicine" and therefore deserving of respect.

Some edible plants are even today only half domesticated; water cress and various berries, nuts, and fruits, for example, are still often gathered wild. Progress in agriculture, just as in everything else, has been so slow and uneven in different parts of the globe that we can still see today almost every one of its various stages in actual existence among this or that people.

From the very first, agriculture seems to have been especially women's work, due perhaps to two causes, one practical, the other theoretical. The men of any given group long remained hunters, fishermen, and fighters, activities which often took them away from home, so that they had no time to look after the rude clearings where the earliest simple crops were grown. The same sound reasoning led early women everywhere to become the burden bearers and drudges of the group, in order that the men might be ready on the instant, weapon in hand, to repel an attack by human or animal foes. Among savage peoples to this day the women insist upon bearing the loads and doing the drudgery in order that their menfolk may have their hands free at all times to defend them.

The other, theoretical motive which left the tending of the crops to women was that they, in some mysterious way, seemed to control all the vital processes. Just as they had the power of perpetuating the race, so, early man reasoned or rather felt, they must have power over all growing things. Not until long ages after, with the advent of the plow and of plow animals, whose management required a man's strength, did women really become emancipated from doing the bulk if not all of the field work.

We can not tell as yet what plants early man first began to assist in growing and in time to domesticate. On the whole, it seems likely that they were those which had edible leaves and roots. The distant ancestors of our radishes, turnips, cabbages, lettuce, and spinach would come within this category. Root and leaf crops have one serious defect—they do not keep well; but the various cereals contain as much or more nourishment, while at the same time they can be kept for long periods. Nothing approaching a real civilization could arise until man began to grow cereals, for only then could he lay up reserve stores of provisions and thus free himself from his ceaseless quest for daily food.

At the beginning of the Mesolithic Period man had not yet learned to shape his stone implements by grinding and polishing. Just when and how the change from rough to polished stone took place, we do not yet know. Some have suggested that the origin of planting had something to do with it. Rough and heavy stone hoes are known to have come into existence in more than one part of the world. Examples from North America are almost identical in form with others found in China. But wherever they occur they have one invariable trait in common—along their edges, where they have repeatedly come in contact with the ground, they have become highly polished. Man may have caught the idea of polishing and grinding stone tools from this, for some of the earlier stone hatchets have the edges polished, while the rest of the surface remains rough and merely chipped out.

Thus we find ourselves on the brink of the period usually called the Neolithic—the Age of Polished Stone. But the manner of making stone tools is not that which alone, or even mainly, distinguishes this stage of man's progress above those vastly longer periods which had gone before. The accumulated experience of the race, gathered haltingly, painfully, and with almost infinite slowness, was beginning to bear its well-earned fruit in a thousand advances.

How far, then, have we come? We began with man a naked, hairy savage, unarmed save for the teeth and nails with which nature had provided him and a certain cunning and slyness which enabled him to think just a step or two ahead of his most intelligent animal foes. In this condition he remained, with only the faintest trace of progress, for hundreds of thousands of years. But slowly his brain was developing. He was becoming more and more human, less hairy, less bestial of appearance, able to stand more nearly erect. Unconsciously and through the working of natural laws, he acquired the power of speech—of exchanging ideas with his fellow men and handing down by word of mouth, as well as by example, the results of his own experience to his children and grandchildren. Then he learned to use tools—sticks and stones—and, still later, to shape them into more efficient forms. Then came the use of fire, of string, and of skins for clothing.

These fundamentals comprised the sum of man's achievements up to the beginning of the Old Stone Age. During that period he made more noticeable progress, the tempo of advance increasing slightly toward its end, so that we see great improvements in the shape and variety of his tools and implements. During the Aurignacian and Magdalenian phases of his Old Stone Age life his artistic powers developed remarkably, though from different motives from those we understand.

With the gradual close of the Old Stone Age, we lose sight of some of the advances in culture which took place, although probably most if not all of them survived in parts of the world as yet unexplored by the archeologist. For it is important to remember the very uneven rate of progress in civilization in different regions of the globe and among various peoples.

Finally the Mesolithic or Middle Stone Age witnessed the development of many inventions of primary importance. Then, apparently, mankind first discovered effective means of making clearings and building huts and canoes. Crude pottery, a rudimentary agriculture, and probably the domestication of the dog also then first appear. Man still remained in great part a hunter and a fisherman, such as he had been for hundreds of thousands of years. But he had at last escaped from total dependence upon natural products. Henceforth he was able in ever-increasing measure to produce food for himself, both animal and vegetable.

CHAPTER XIII

THE NEW STONE AGE

To New Stone Age man we owe the development of true agriculture and especially of the growing of cereals, the basis of all later civilization. Where this first occurred we do not know as yet. Doubtless many peoples, once they had reached a certain stage of culture, took to protecting and cultivating and finally to sowing certain wild plants about them which experience had shown to be especially valuable for food. The American Indians, for example, almost certainly entered the Western Hemisphere as mere food gatherers, hunters, and fishermen. Yet by the time they became known to Europeans they had domesticated a great number of plants, embracing such important forms as maize, sweet and "Irish" potatoes, pumpkins, squashes, Lima and kidney beans, tomatoes, and tobacco, to mention only a few.

We have emphasized the great part which magic played in the life of early man and how its influence spread into the vast field of food production. We no longer think it necessary to fertilize our fields with the life-blood of human beings, but primitive man did so through many thousands of years. Only in the nineteenth century was this cruel practice stamped out in British India, and it still persists in certain backward regions not yet under effective civilized control. The custom seems to have arisen through that false association of ideas so common to the emergent human mind. Primitive man observed very far back in his history that life in some mysterious way depended upon the blood. The idea persisted even

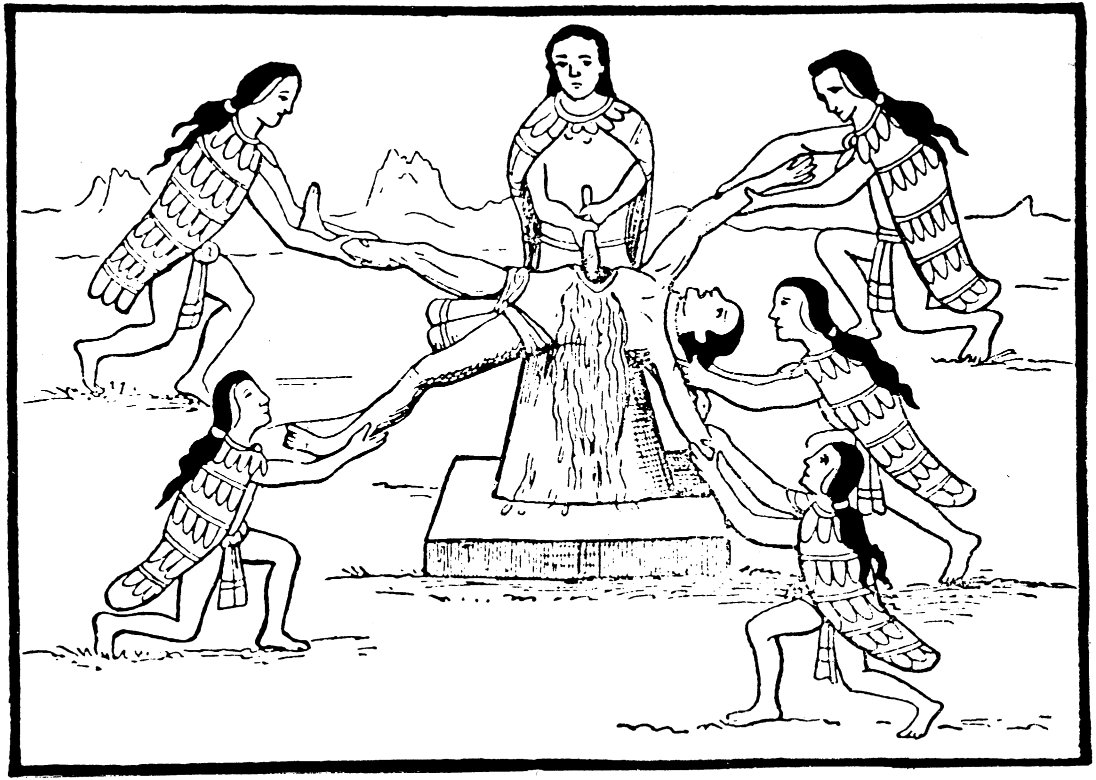


FIG. 70. Aztec human sacrifice. Many of the ancient Mexican ceremonies were intimately connected with agriculture
From Cronau's *Amerika*

among a people so comparatively high in the culture scale as the ancient Hebrews.

Especially when the spirits of cultivated plants, and particularly of certain cereals, came to be thought of as having human form, did the ceremonial shedding of human blood, often in very cruel ways, seem essential to primitive man. Sometimes the victim was regarded as the incarnation of the god himself. Many peoples had the idea of a dying god who gives his life for his people, and traces of it still persist in the folk tales and beliefs and customs of the peasant population of Europe and Asia. The Aztecs of Mexico carried it to an exceptionally high pitch of dramatic intensity, characterized by the most brilliant pageantry.

The offering of human sacrifices in connection with agricultural operations belongs essentially to the Neolithic stage of man's development. One of the causes which led to its abandonment in more advanced regions was the domestication of animals which could be substituted for human beings in these bloody rites. We see a reflection of this in the familiar account of Abraham and Isaac and the "ram caught in a thicket by his horns." The persistence of the custom in certain regions, like Mexico, probably resulted in no small part from the lack of suitable domestic animals.

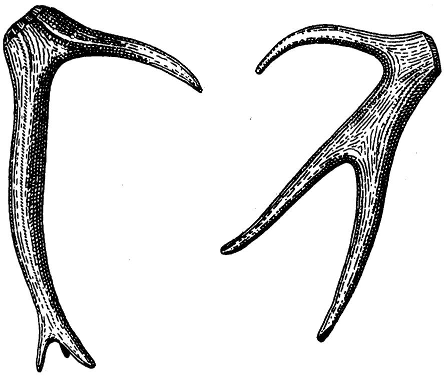


FIG. 71. Staghorn pickaxes used for mining flint in Neolithic times; that on the right was used with both hands. After Rutot

Among many of the more advanced planting peoples of the New Stone Age grew up the idea of a divinity called

Neolithic warrior, with tomahawk and dagger of stone, flint-tipped arrows, necklace, and plaited cap. Modeled by Mascré under the direction of Rutot

in later times the Great Mother Goddess, patroness of fertility and growth and bounteous harvests. Primitive man thought of her as having the power both to give life and to take it. Usually he associated with her in his worship her Divine Son, the latter very often one of those "dying gods" just mentioned. The Mother Goddess in those early times was commonly represented by crude images in which, to judge from later analogy, she was induced to dwell through the action of spells or prayers. It is of one of her more developed manifestations that the prophet Jeremiah speaks when he rebukes the people for burning incense and pouring out drink offerings to the "queen of heaven."

We used to think that mankind everywhere had passed through the same successive stages of development, first the hunting, then the pastoral, and finally the agricultural. We now know that this was not the case. Man began as a hunter and food gatherer, certainly, and in that condition he remained for much the greater part of his existence, until, in fact, a very recent era in his history. But he did not develop next into a herdsman or a shepherd. On the contrary, he became a primitive farmer or gardener, or rather his women did, while he himself remained a hunter, a fisherman, a tool maker, and a fighter.

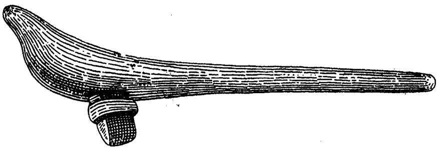


FIG. 72. Prehistoric stone hatchet from a Swiss lake village. The stone blade inserted in a sleeve of staghorn greatly reduced the liability of the wood to split. After Keller

The development of planting resulted, of course, in attaching man to the soil, to definite localities, and finally to specific plots of ground to an extent never found among savages in the pure hunting stage. Still clinging closely to the edges of the forest—for cutting down or even girdling trees with a stone hatchet was by no means an easy task (Fig. 72)—the primitive farmer finally acquired domestic animals in addition to the dog he had already had so long.

We do not know what animals other than the dog man first tamed, or how he did it, but we can make several pertinent deductions. First a set of conditions must have arisen which brought man and certain species of animals susceptible of domestication into especially close contact with each other. The plausible suggestion has been made that, as the west-central portions of Asia slowly dried out after the close of the Ice Age, both men and animals tended to be crowded more and more closely together in those areas which still remained well watered. Finally even these shrank until they became mere oases—islands of vegetation surrounded by vast expanses of desert and semidesert. Not only does drought tend to crowd all living creatures together about the water holes; it also robs animals of much of their wildness and instinctive timidity toward man. Thus, among the rest, those wild animals upon which man had largely preyed became less wild. Some such state of affairs may have led to the beginnings of domestication.

The process implies first a sufficient degree of intelligence to enable man to appreciate the advantages of having domestic animals at all. Then there must exist animals of species which can be domesticated. The lack of these over a great part of the New World supplies us with a fundamental explanation for the backwardness of the American Indian as compared to the European four hundred years ago. Finally, conditions must be such that the animals, after being half tamed and in a measure accustomed to the presence of man, can not easily escape from under his control and become once more truly wild.

The more we study early man, the oftener do we find instances in which he was governed by reasons totally different from those which cause us to do some of the very same things that he did. If asked why man domesticated cattle, we should doubtless reply without hesitation, "For their meat and milk and hides and for their labor as pack and draught animals." We should probably say also that chickens were domesticated for the sake of their flesh and especially their eggs.

But can we imagine primitive man, on seeing a herd of wild cattle crashing through the underbrush, at once grasping the possibility of using their milk for human food or their strength in helping his womenfolk to till the little garden plots in the forest? Or can we conceive of him as able to foresee the development of the wild jungle fowl, in the course of hundreds or perhaps even thousands of years, into the egg-laying strains that exist today? Such possibilities were not in the faintest degree apparent to any one on this earth in the days before the domestication of animals began or for long centuries later. Many of the most important qualities for which we now value animals did not exist at all when they were first domesticated and have been developed only by long-continued selective breeding.

Superstition, the great driving force in the shaping of man's actions in early times, played a very large and probably the leading part in the domestication of animals. Its influence in this direction had already begun to appear at least as far back as the later portions of the Old Stone Age. Those animals which played the most important rôles as sources of food came in time to be the objects of many ceremonial observances and eventually to be regarded as themselves sacred and especially fitted for sacrifice. From time to time man would capture individuals of these species and keep them in confinement to be slain at certain festivals, just as the ancient Mexicans used to keep prisoners of war, or as some of the peoples of northeast Siberia keep captive bears, for the same purpose.

Moreover, our distant predecessors felt that the possession of sacred animals brought good fortune to the group, and on this theory sacred bulls were kept in the temples of ancient Egypt, sacred horses in those of modern

Japan, and sacred white elephants in Siam. Sometimes early man regarded such an animal both as divinity and as victim—as a god dying for the benefit of his people—the idea that we found so widespread in connection with early agriculture. Such animals were eaten at the sacrificial feasts that their qualities might be communicated to the worshipers. To omit such sacrifices was regarded as an unspeakable calamity, portending terrible things.

And yet, as cultivation extended and the originally plentiful supply of wild animals decreased, it happened again and again that the capture of victims as they were needed became more and more uncertain, and sacrifices sometimes failed. To guard against this danger, man probably began to set aside the necessary animals, perhaps even in actual inclosures where he could protect them and prevent them from wandering, until in time they became half domesticated. As their numbers increased under these sheltered conditions, their sacred character came to have less importance and was finally confined only to particular individuals or to certain occasions. By that time we might regard the species as to all intents and purposes fully domesticated, although even then the chief uses to which they were put might differ widely from those of later times.

We can see this process of domestication at work among the stock-raising peoples of antiquity; and we can also detect its various stages actively going on today among certain peoples. Thus every one of the great peoples of ancient times—the Babylonians, Egyptians, Cretans, Greeks, and Romans, to mention but a few—regarded cattle as sacred. They are still held holy in India and to a less extent in China. Very many superstitious beliefs center about the herds of the great cattle-raising tribes of East and South Africa. Even the bull fight, now the national sport of Spain and her daughter countries, clearly had its origin in association with religion and especially with rites to insure plentiful harvests.

The Naga tribes northeast of the head of the Bay of Bengal furnish an excellent example of the steps in domestication. These still somewhat wild people have an animal of the ox kind, known as the gayal, or mithan, which they permit to roam and feed by day in the forests but which returns at night to the villages. They never employ it for labor, nor do they use its milk. But at religious feasts at which it is sacrificed ceremonially they eat its flesh. Thus we find the gayal now in a stage through which the ox proper passed thousands of years earlier on its road to complete domestication by the peoples of the New Stone Age, probably in western Asia.

The peoples dwelling about the great grasslands of the Old World, not unlike our own western prairies, hunted herds of wild horses for the sake of their flesh and probably their skins, just as the Indians used to hunt the bison. The finding at Solutré, in southeastern France, of the bones of something like 100,000 horses leaves no doubt of this use of the horse. To some of the nomadic grassland horse eaters, especially the ancestors of the primitive Aryan or Indo-European speaking peoples, the horse quite naturally became the one animal sacred above all others. It grew in time to be associated with the sun and with running water, and was sacrificed to these. Quite possibly, also, the custom of keeping individuals in captivity arose from the desire to insure a steady supply of horses for such sacrifices. Later the practice of milking the mares sprang up, probably suggested by the use of milk among neighboring agricultural peoples who already had cattle or goats.

At first, of course, man used the herds of half-domesticated horses only for food and ritual practices, just as he had used their wholly wild ancestors during the Old Stone Age. Their utilization in other ways, such as carrying or hauling loads and, much later, for riding, still lay very far in the future. We find traces of this earlier use of the horse as food animal, as tribal mascot or luck bringer, and as sacrificial victim, among nearly all the original horse-using peoples of antiquity, as well as among many of more modern times.

The feeling of repugnance to eating horse-meat that many people feel arose in a very curious way out of such early associations. So far as its natural qualities go, horse-meat is little if at all inferior to beef, and various races have habitually eaten it. It formed the principal food of some of the peoples of the Old Stone Age, and the later Huns, Mongols, and Tartars also ate it. Before Europe's conversion to Christianity, horse-meat was much eaten at religious festivals held in honor of the old pagan gods. Because of these associations with heathenism the early Christian missionaries forbade its use, as "meat offered to idols." Hence people gradually came to feel that there must be something repulsive in horse-meat itself, and many still have this feeling without in the least knowing why.

With all our machinery we moderns are in danger of underestimating the importance of domestic animals in earlier days. We think of them today mainly as sources of food, leather, and wool; and in large measure certain forms, such as the pig, the sheep, and the goat, have always been so. But others, especially the ox, the horse, and the camel, became chiefly important to man as animated machines, capable of doing his work for him far more effectively than he himself could do it unassisted.

Man's treatment of animals finds several rather interesting parallels in his treatment of man, whom perhaps it is not altogether incorrect to call also a domestic animal. All but the more backward races have passed through the institution of slavery. Before its development prisoners of war were killed, often with frightful tortures. Then it occurred to the more advanced peoples that they might do better to spare some and make them do the hard and disagreeable work. Thus slavery in its origin marked a great step in advance in the direction of humanity and belongs probably to the New Stone Age.

But man has also sacrificed human beings and even eaten them in connection with magical or religious ceremonies, just as he has done with animals. Mankind has rarely practiced cannibalism solely for food, however, but almost always has had the idea of deriving strength and

FIG. 73. Dog travois used by the American Plains Indians before they acquired the horse from the whites. After Wissler

courage from the flesh of the victim, or of propitiating cruel gods by offering human sacrifices and then partaking of their bodies in a communal feast.

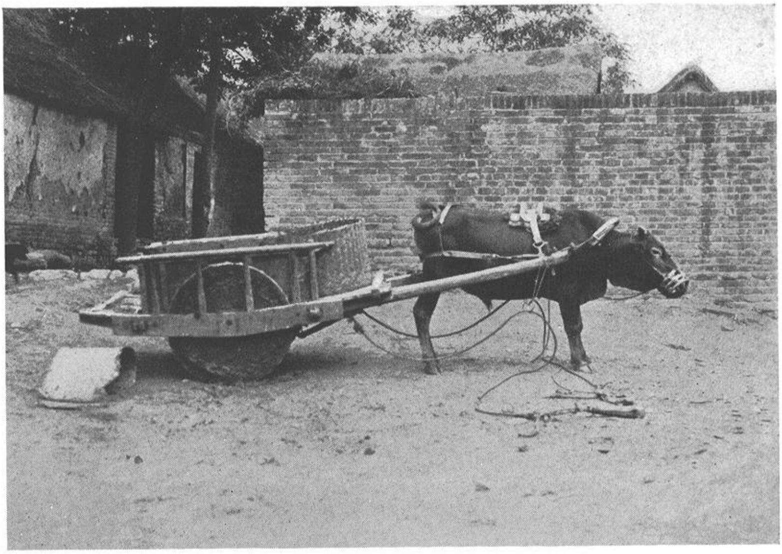
Man's first step in the use of animals for other than food or sacrificial purposes probably took place when he slung a burden over the back of an ox or a horse while shifting camp. It may indeed have been that some tired youngster laid his burden across his dog's back and thus first demonstrated that animals could be used for this purpose. The dog, in fact, was regularly used as a pack animal by certain American Indian tribes before they obtained horses from the Spaniards.

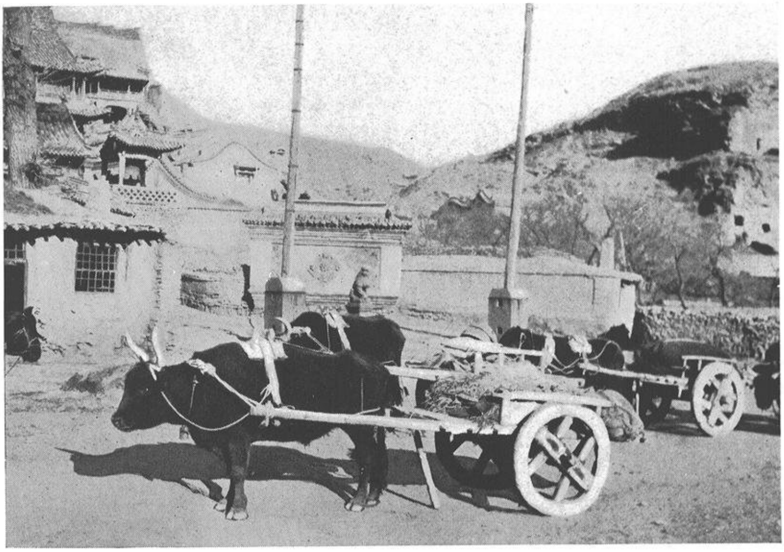
From early times man utilized various animals for carrying loads, among them, especially, donkeys, cattle, and camels, in the Old World, and llamas, distant cousins of the camel, in the New. Then some inventive genius, perhaps inspired by his own tendency to drag things he could not pick up, found that an animal could haul a great deal more behind him than he could carry on his back. This great discovery led step by step to the utilization of animals for drawing plows and carts.

Out of this idea grew that of the wheeled cart, the origin of which, however, fades out in prehistoric darkness. Probably some sort of sledge came first, some contrivance like the travois of the North American Indians—two poles lashed to the animal's sides, with the load placed on the part that trailed along the ground. From something of this sort must have developed a sledge on the order of the "stone boat" used by farmers for hauling loads of stones.

The inventive powers of Neolithic man in most portions of the world seem to have been unequal to producing the wheel in even its simplest form. The most advanced peoples of the New World, like the Incas, the Mayas, and the Aztecs, remained wholly ignorant of it before the white man came. Even the ancient Egyptians appear to have acquired it late—long after they knew the plow; and it did not reach southern Africa, northern Asia, and the Pacific area till late historic times.

In all probability the wheel was invented only once, most likely in southeastern Asia, and from that region it has gradually spread over the whole earth as we see it today. We may surmise that it developed out of the log roller which we still see placed under heavy burdens to ease them over the ground. To save himself the trouble of having to pick up rollers after the load had passed over them and then run around and place them on the ground in front of it again, some prehistoric inventor hit on the scheme of driving pegs into the under surface of his sledge to keep the roller dragging along between them as it turned. Next, to lessen the friction against the ground, the middle section of the log was cut away all around,





Upper: Primitive Chinese cart with two solid wheels and basketwork top, drawn by two bullocks yoked tandem

Lower: Chinese two-wheeled cart with built-up wheels, widespread before the invention of true spokes. Photographs by C. W. Bishop

forming an axle, and the primitive cart appeared in all its essentials—body, axle, and wheels. Even today we see in various parts of the world carts of this type, where a round axle, held in place between pairs of wooden pins, turns with the wheels (Plate 66).

In time man cut away part of the solid wheels to lighten the weight, and from this he advanced to the step of assembling them from separate pieces, although they still

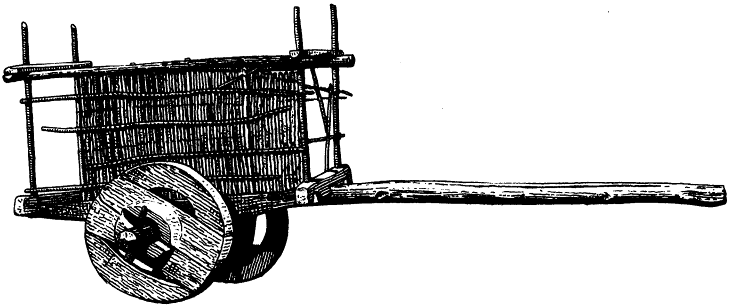


FIG. 74. Primitive Mexican cart, introduced from Spain. From specimen in the National Museum

remained attached firmly to the axle so that the latter revolved with them (Fig. 74). Long generations passed before true spokes, all radiating outward from the hub, were invented. In many parts of China today, for example, one sees a type of wheel in which the axle passes through a massive wooden construction something in the shape of a capital H, instead of true spokes as in Plate 66.

From the beginning man seems to have associated the wheel, and along with it the cart, with religious beliefs and practices. One of the earliest uses to which he put wheeled vehicles was to carry symbols or representations of the gods, on the march or into battle. We see proof of this practice in prehistoric rock drawings, ancient models of sacred cars, in the folklore and mythology of many peoples, and in the historical records of some ancient races.

Probably the use of chariots in war began in this way.

For the early rulers were priests and medicine men, that is, powerful magicians, as well as kings. We find them sometimes even regarded as gods, or sons of a god, and so too holy to set foot on the ground. Before carts were known attendants carried such rulers about in litters, both in the Old World and the New. Their presence was necessary at battles in order to insure good fortune to their own side. Their subjects did not expect them to take active part in the fighting, but to devote themselves to beating a drum or otherwise "making medicine," just as Tecumseh's brother, the Prophet, did at the battle of Tippecanoe already mentioned. The modern descendant of the primitive witch doctor's drum still remains part of the paraphernalia of war and until very recently was actually carried into battle.

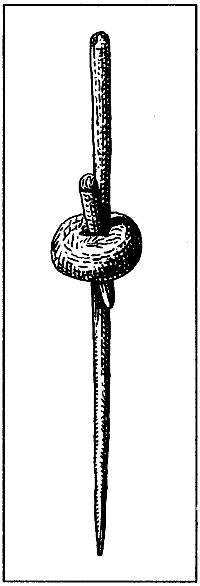


FIG. 75. South African Bushman woman's digging stick, weighted with a perforated stone. After Ratzel

Man of the New Stone Age took a great step forward when he yoked his animals to a plow. In carrying on the rudimentary agriculture of the early Neolithic Period, he used the digging-stick, a pointed implement sometimes weighted with stone, for turning up the soil (Fig. 75), and a crude hoe, at first merely a forked branch, but later equipped with a blade of stone, shell, or bone.

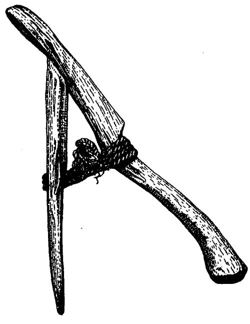


FIG. 76. Ancient Egyptian wooden hoe. After Petrie

Because of the superficial resemblances in shape between the hoes (Fig. 76) and the plows shown on the Egyptian monuments, people have deduced that the plow developed from the hoe. This, however, seems not to have been the case, for the working of the two implements differs fundamentally in principle. The hoe is dragged toward the operator, while the plow is thrust away from

Fig. 77. Caschrom, or foot-plough, used in the Isle of Skye, off the west coast of Scotland. Reproduced from a photograph by courtesy of Mr. E. Cecil Curwan

him. In its use, therefore, the latter recalls the primitive digging-stick, and the existence of several intermediate links seems to prove it the true ancestor of the plow.

An implement, called a *caschrom*, for turning up the ground (Fig. 77), is used in the islands of Skye and the

Hebrides, off the west coast of Scotland. This somewhat resembles a primitive plow in shape but is operated by one man, who uses it in much the same way as a spade. Closely similar implements have been reported from various other regions, both in ancient and modern times. These clearly constitute developments of the primitive

FIG. 78. Korean three-man spade, still occasionally used in remote parts of the peninsula

digging-stick on the one hand and forerunners of the plow on the other. They need, in fact, to make them plows, only the addition of a beam.

Apparently a still further step in the evolution of the plow is the so-called "three-man spade," still used in remote districts in Korea (Fig. 78). This consists simply of a heavy spade of crude form, with ropes attached by means of which two extra men add their strength to that of the wielder in thrusting it into the ground. What must have been a closely similar instrument, but worked by half a dozen men and probably coming nearer to making a continuous furrow, is shown on the Egyptian monuments (Fig. 79).

Apparently, then, certain peoples, still in the Neolithic phase of culture, had developed a crude sort of plow, drawn or jerked along by men or women. Perhaps their close association with the ideas of fertility and growth led man to use sacred animals, especially cattle, to help drag these early implements through the ground. In some such way the true ox-drawn plow of the earliest historical times must have developed.

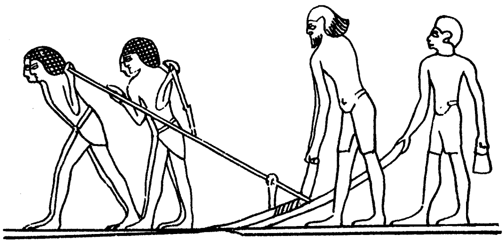


FIG. 79. Ancient Egyptian man-drawn plough. After Moret and Davy

Man had probably learned to make string, including thread and yarn of various degrees of fineness, well back in the Old Stone Age. Possibly then, and certainly during the following Mesolithic, he had learned to weave fibers of various sorts into matting and basketwork. From this it was but a step to the weaving of textiles. He had long since grasped the idea of cutting and fitting animal skins for garments, so when the superiority of cloth for this purpose became apparent, he could make the change without difficulty.

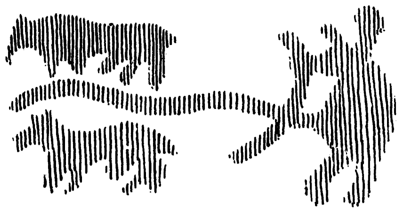


FIG. 80. Prehistoric Swedish rock engraving of plough and oxen. After de Morgan

Different parts of the world used different fibers for weaving: Europe, western Asia, and ancient Egypt used linen and wool; India, cotton; and southeastern Asia, hemp and silk. Some reason exists for the supposition that the cocoons of the silkworm were at first torn up and shredded and then twisted into thread before it was found that much longer and stronger fibers could be had by simply unwinding them. In most parts of the New World where clothing was necessary at all, skins continued to be used; but even there, in certain regions, weaving became known and reached finally a high degree of excellence.

Art had its beginning far back in the Old Stone Age. The earlier of the paintings and carved work found in the caves of southwestern Europe, authorities agree, date at least from 20,000 to 25,000 years ago. And doubtless even before that men and women adorned their bodies with strings of shells and teeth and bright berries, with various painted designs and possibly tattoo marks as well, to say nothing of bright feathers and the skins and even horns of various animals. But primitive man designed none of these primarily for decoration. He meant them for charms, to ward off evil or bring good luck. Every man throughout those long, dark ages doubtless had his "medicine bag" containing odds and ends of all sorts—bits of crystal, curiously shaped stones and knots of wood, dried portions of the bodies of animals and men—anything, in short, that drew his attention for any reason and seemed to him endowed with mysterious power. The virtue still attached by some people to a rabbit's foot or to the "hand of glory"—the dried hand of a man who has been hanged—is a last lingering trace of this very primitive conception.

Man made an advance upon this when he began to shape his charms artificially. At first, probably for long ages, he confined himself to selecting objects that bore a chance or fancied resemblance to a bird, an animal, or a human face, eventually increasing the likeness by a little pecking and chipping here and there. But during the Aurignacian and Magdalenian epochs of the Old Stone Age artists did real carving, much of it of a very high order, in stone, bone, mammoth ivory, and reindeer antler, and probably, too, in wood.

During the New Stone Age, also, men undoubtedly did much carving in wood, at least in certain regions. The Maoris, the Polynesian natives of New Zealand, when discovered by European navigators, were in a phase of the New Stone Age; and in the carvings on their canoes, the beams of their houses, and many of their wooden weapons and utensils, they had attained extremely high artistic merit. Doubtless New Stone Age man of prehistoric times likewise carved in wood.

Fig. 81. Necklace of leopard's teeth, Congo region, Africa. After Frobenius

We must not forget that many—probably the great bulk—of the materials used as a base for decoration in

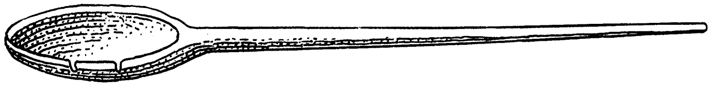


Fig. 82. Wooden ladle, from a Swiss lake village. After Keller

all ages have been of a perishable nature. How many, for example, of the wonderful Hawaiian feather cloaks, or the painted buffalo robes of the Plains Indians, or the carved totem poles of the Northwest Coast, will be left after the lapse of a few centuries? Hence, concerning the art of the New Stone Age in such regions as Europe, western Asia, and China, which left that stage of civilization behind

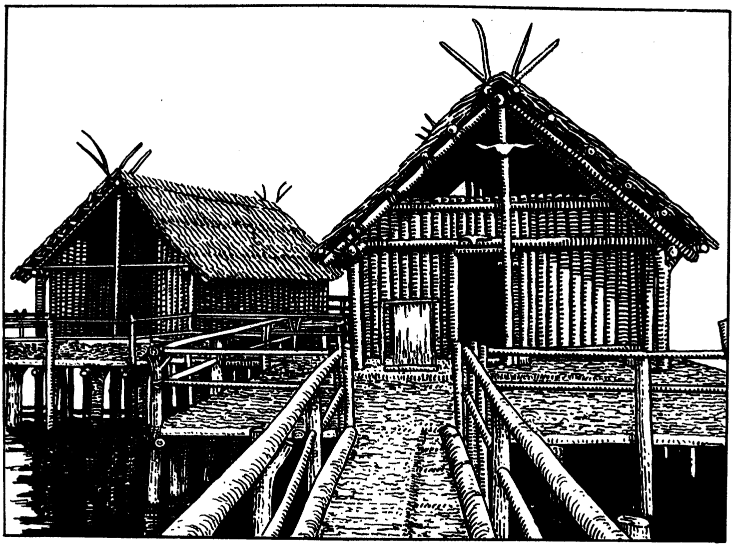
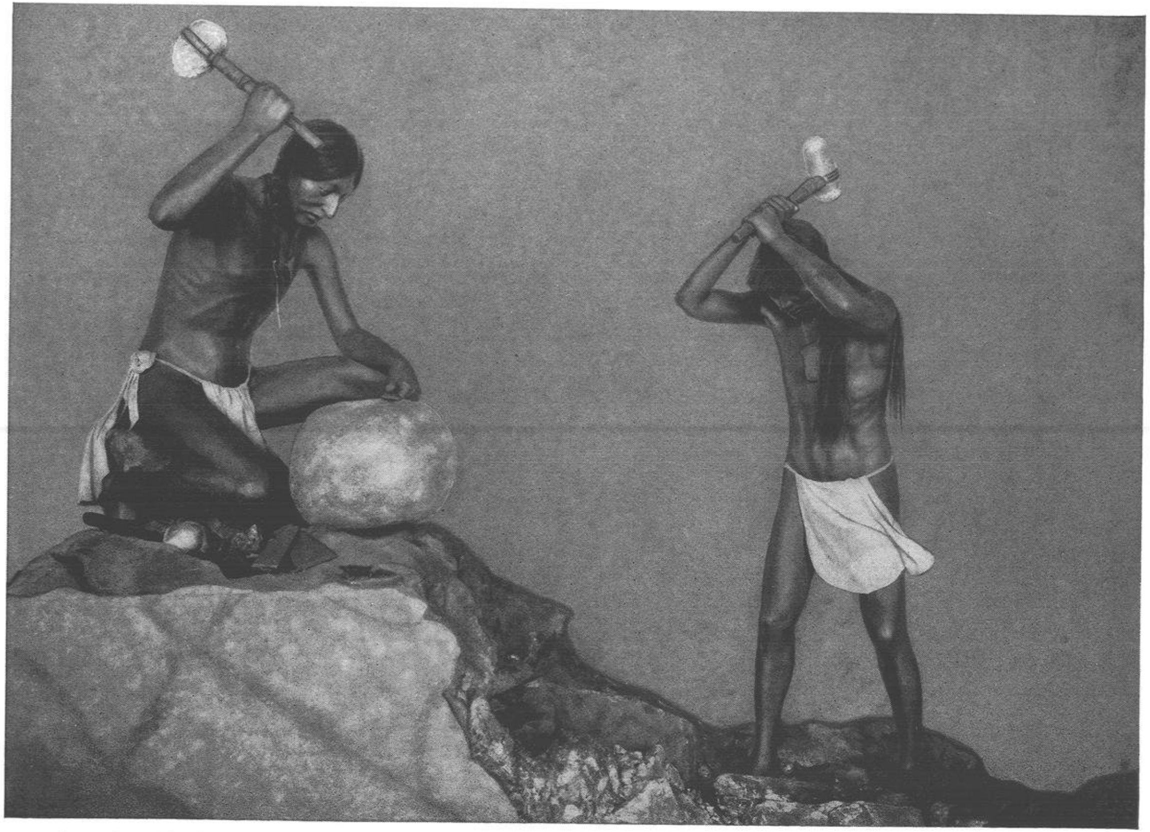


FIG. 83. Reconstruction of group of Swiss lake dwellings built out over the water on piles. After Schmidt

several thousand years ago, we can know only the comparatively little executed in such exceptionally durable materials as stone, ivory, or baked clay.

Real architecture first appeared during this same Neolithic phase of man's development. Men then learned to build not mere windbreaks or even huts, but groups of substantial timber houses with walls of bark or wattlework daubed with clay. For defense, they built their villages over the water (Fig. 83) or surrounded them with strong stockades made of logs set on end, side by side, in the earth. They also began to erect earthworks of various sorts—foundation platforms for temples and other im-

Simple type of loom used by certain American Indians



American Indians beating out copper, cold, with stone hammers. Group in the National Museum portant public buildings, earthen ramparts, and mounds in the shape of various living or mythological creatures, like the famous serpent mound of Ohio—these last, of course, connected with religious ceremonials. Then they commenced to make use of stone also for architectural purposes, first probably in the form of sacred emblems and symbolic pillars often connected with the worship of ancestors and with fertility cults; then for platforms, terraces, and tombs; and finally for actual buildings, often elaborately carved and decorated.

In the New Stone Age we must seek also for man's first employment of metals, destined later to play such a tremendously important part in human development. At first, he merely picked up nuggets of "native" gold and perhaps copper, and hammered and worked them into shape cold, treating them exactly like lumps of some sort of tough, soft stone. True metal-working, with all that it implies, came much later.

At the beginning of the New Stone Age man had advanced but little beyond pure savagery—the life of the food gatherer, hunter, and fisherman. Before its close he had learned, in the more advanced regions, to grow large and regular crops; to rear herds of domestic animals; to employ human labor, both free and slave, on a large and well-organized scale; to make excellent pottery; to weave fine fabrics; to erect stone palaces and temples; and, finally, to make the first tentative attempts in the working of metals. After remaining almost wholly at the mercy of its environment for many hundreds of thousands of years, man's genius was at last coming into its own.

CHAPTER XIV

THE AGE OF BRONZE

We divide the story of man's progress into successive "ages" for convenience only. In reality no sharp breaks separated one period from another. What actually happened was that somewhere, among some particular group of people, a new discovery, a new invention, would occur and then slowly spread until it became a permanent feature of man's heritage. Thus, during the New Stone Age, men began to notice and work with such metals as they found occurring naturally—nuggets of gold and lumps of copper.

Gold proved too soft and too scarce to serve as a suitable material for implements of everyday use. From the beginning man held it too precious ever to use for anything but ornaments, and, later on, as a medium of exchange. But copper, though not so widely distributed as gold, occurs in far larger deposits and is harder, two reasons which better adapt it for shaping into tools and weapons. Copper occurs "native," that is, in the metallic form, in different places both in the Eastern and the Western Hemispheres; for example, in the Lake Superior region of North America. We find accordingly that various tribes of Indians already made copper objects, including ornaments, axes, and spearheads, hammered out cold, before the white man came. Some areas, like Mexico, Central America, and Peru, had made still further progress, and there we find the ancient peoples practicing a true, albeit simple, metallurgy, including melting and casting.

In the Old World, a similar process seems to have begun earlier and developed much faster. This transitional period from the use of stone to that of bronze is sometimes called the Chalcolithic, from the Greek words for "copper" and "stone." Only very slowly did conservative man give up stone tools and weapons in favor of those made of metal, and for a long time he used both together, just as today we see the horse and wagon still employed side by side with the motor truck.

Mining began long before the use of metals. Even back in the Old Stone Age man dug for suitable lumps of flint out of which to shape his various tools and implements. During the New Stone Age he went much further, and learned to sink regular shafts and tunnels in the chalk deposits where flint occurs, using as his chief tool a pick made of a deer's antler with one tine or prong left on. Examples of these primitive ancestors of the modern pickax are not uncommon in ancient workings (Fig. 84). The development of mining for metals, once man had realized that they, too, could be obtained from the ground, presented therefore no difficulties, and we find ancient mines and heaps of slag in various parts of the world, to bear witness to the activities of the primitive miner and metal worker.

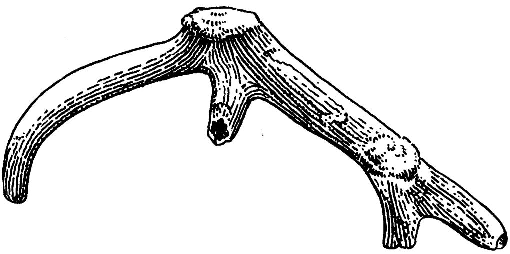


Fig. 84. Pick made of deerhorn, used by flint miners in the New Stone Age. From Grime's Graves, Norfolk, England

At first man classed the new material as a kind of stone, as the earliest implements of copper, especially the axes and daggers, clearly show; for long after they had come not merely to be hammered out cold, but actually cast in simple molds, they still kept the shapes of their stone predecessors.

Probably some accident led to the great discovery that heat would turn these curious stones soft and even make them run. A piece of gold fell into the fire and was melted; or a lump of copper ore was used along with other stones to make a fireplace, and turned soft in the heat. Nor should we ignore the probability that man, once he had reached a certain stage of intelligence, would deliberately make all sorts of experiments, just to "see what would happen."

Pure copper is much more difficult to melt and cast successfully than when alloyed with certain other sub-

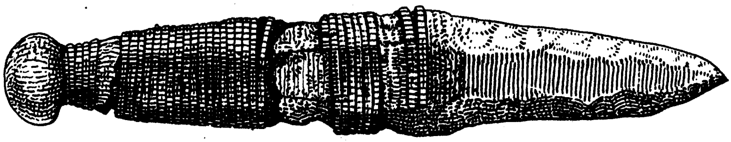


Fig. 85. Flint-bladed dagger from the Neolithic village of Vinelz, Switzerland. From MacCurdy, after Tschumi

stances. It happens that copper ores sometimes contain small quantities of arsenic, antimony, or tin, which when reduced will form natural alloys; so that chance no doubt led man to the discovery of how to make bronze. As one of the earliest alloys, man employed lead. Then he found that tin made a better one, and finally that the most satisfactory proportions were ninety per cent of copper and

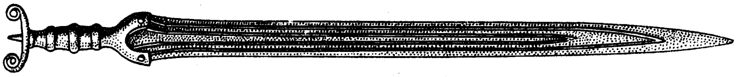


Fig. 86. Late Bronze Age sword, Switzerland. After Keller

ten per cent of tin. This discovery ushered in the true Bronze Age, and it led to more far-reaching developments than the making of superior weapons and tools. For tin occurs in quantity in only a few places, and the demand for it perceptibly furthered the great extension of trade and migration and war, both by land and by sea, which we now know took place during the Bronze Age.

Igorot group, Philippine Islands. The Philippine aborigines never had a true Bronze Age, but learned the use of iron from Asia within recent centuries. Group in the National Museum

The first metal workers used shallow open stone molds for the reception of the molten metal; but, with improvement in the technic of casting and the development of better alloys, they employed molds of earthenware and even of bronze itself, the forms and designs at the same time becoming much more elaborate. The "lost wax" process represents one of the later improvements in casting. An exact model of the desired object was made in wax, and coated thickly with clay. After the latter had dried and hardened, it was heated until the wax melted and ran out. Molten bronze was then poured in, and naturally took the shape of the wax, down to the smallest detail. This method obtained some very beautiful and striking effects.

Simple triangular daggers and axes and the halberd characterized the earlier part of the Bronze Age. The halberd consisted of a dagger blade mounted crosswise at the end of a wooden handle, and was essentially a sort of tomahawk with a pointed blade. In certain regions it came to be made of bronze throughout, handle and all, and sometimes with elaborate decorations. But more efficient weapons, the bronze battle-ax and sword and spear, eventually replaced it.

Out of the primitive flint-bladed dagger (Fig. 85), about as ugly and ineffective a weapon in a fight as the neck of a broken bottle, there evolved, first, the simple and short-bladed triangular copper dagger. With the invention of bronze this was lengthened and in time became a short, straight, double-edged thrusting and stabbing sword, ornamented in various ways characteristic of different localities. Also, the method of hafting—of joining blade and hilt—improved, until finally the ancient armorers cast the entire sword, including the hilt, in one piece. The earlier bronze swords were used only for thrusting and not for chopping, a stroke reserved for the ax. In time, however, the blade was widened toward its point to make a "leaf-shaped" sword, which could be used for slashing as well as thrusting (Fig. 86). By the time man had devised all these improvements he had learned the use of iron, which gradually crowded out bronze for the manufacture of weapons.

In hafting his spears at the opening of the Bronze Age, the armorer naturally copied the method in use with flint spears; that is, he split the end of the spearshaft and inserted and lashed fast the spearhead. Later on he fastened it with rivets. Eventually the bronze heads were provided with sockets into which was thrust the end of the shaft. We still retain both these ancient methods of hafting in some of our modern tools; for example, we use chisels with tangs and others with sockets, the latter especially for types of work where hammering on the end of the handle would be apt to cause it to split.

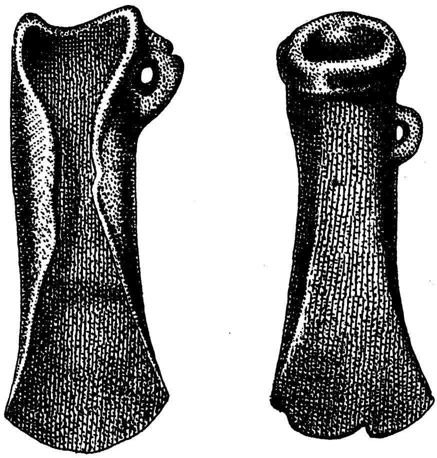


FIG. 87. Bronze axes cast with loops for lashing to the helve. After Keller

Bronze axes served both as tools and weapons; with them one might split either firewood or the heads of one's enemies. In the beginning they were hafted much as stone axes had been. Later in certain regions a sort of socket back of the blade was gradually developed (Figs. 87 and 88). Finally the plan of passing the helve through the ax head, just as we still do, was devised, apparently in southwestern Asia pretty early in the Bronze Age.

The men of some regions of scarce metal copied bronze battle-axes in stone—shape, perforation, and all. Sometimes, no doubt, it was just a case of the poor man copying the rich man's bronze battle-ax in a cheaper and more easily obtainable material. But from the beginning mankind regarded axes as mysterious weapons imbued with magical virtues, so they might easily have attributed the superior power and efficacy of the bronze battle-ax as a weapon to its shape rather than to the material of which it was made. Thus they would try to copy the former when they could not obtain the latter.

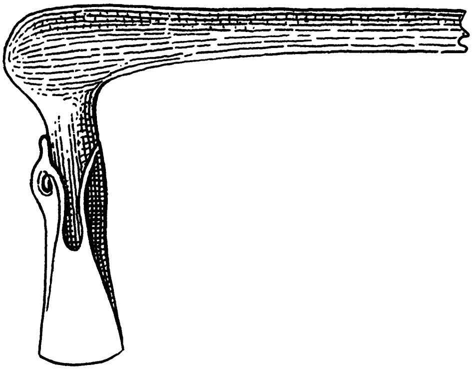


Fig. 88. Bronze ax with wooden helve; to illustrate the manner of hafting. From Switzerland. After Keller

During the New Stone Age men had to content themselves with armor made of leather, wickerwork, slats of wood or bone, and the like. But the introduction of bronze weapons brought with it both the need and the material for better shields, helmets, and breastplates. At first defensive armor consisted of little more than a shield, just as with many modern tribes of savages. Sometimes this was round and made of

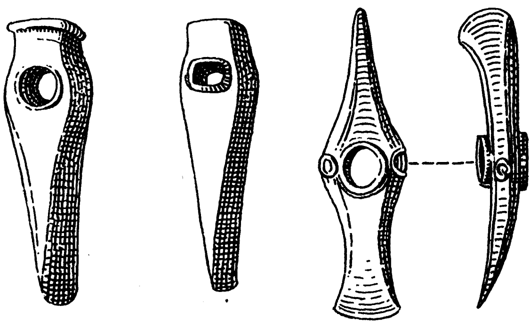


Fig. 89. Copper axes and combination ax-adz. From Hungary After Keller

boards covered with leather, with a knob or spike of bronze in the center, a type of shield especially characteristic of the British Isles and Scandinavia.

Then the leather or basketwork cap gave place to a helmet of bronze, often ornamented in various ways with horns, wings, or crests of horsehair. Bronze breastplates or cuirasses also were devised, first merely as overlapping bands or scales of metal sewed onto the leather jerkin, but later as complete suits of armor. Probably the demand for protection against the improved slashing swords introduced toward the end of the Bronze Age produced these. Greaves, or "shin-guards," of bronze completed the armor of the typical Bronze Age man-at-arms.

Goliath of Gath, whom David overcame, was such a warrior; the Bible story describes him as wearing a helmet, a coat of mail, greaves, and a "target," or shield, of brass, or as we should say today, bronze. His spearhead, however, seems to have been of iron. His boastful challenge to his opponent, "Come to me, and I will give thy flesh unto the fowls of the air, and to the beasts of the field," was characteristic of the way in which the champions of opposing armies used to defy and insult each other before starting to fight. The practice is not unknown between combatants today.

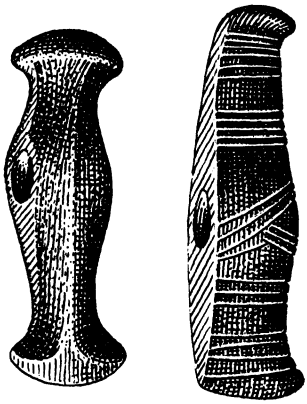


FIG. 90. Stone copies of bronze battle-axes, central Europe. From Childe

In some regions of cool climate, people wore woolen garments, consisting essentially of a tunic for both sexes, with trousers for the men and skirts for the women, while a long cloak served the purpose of the modern overcoat (Figs. 91 and 92). These articles were held in place by

Hopi Indian woman potter, Arizona. Basketwork support, in a measure, takes place of potter's wheel. From photograph in Library of Congress

girdles, belts, and fibulae, or "fasteners," usually of bronze, working on the same principle as our modern safety-pins. The types of fibulae differ in various regions and at different periods and so help materially in identifying the age and source of Bronze Age deposits.

The art of making pottery began, as we have seen, soon after the close of the Old Stone Age, perhaps as an outgrowth of basketry. It underwent steady improvement during the Neolithic stage of culture, which probably witnessed the first crude beginnings of that most useful implement, the potter's wheel. In making a clay pot by hand, the great difficulty was to turn it so that the potter—almost always in early times a woman—could shape it evenly all around. So someone had the clever idea of putting the ball of wet clay into a shallow basket or the hollow of a large piece of broken pottery, and then turning the latter around gradually as the vessel took shape. Later a disk of wood or stone, mounted on a vertical axis, replaced the shallow basket. The potter turned this with one hand while he molded the clay with the other, until it occurred to him to use his foot through the agency of a treadle. This left both hands free to shape the bowl, enabling him to produce truer and much more artistic forms. It is possible, indeed, that man invented the potter's wheel before the cart. At all events, it appears in ancient Egypt far earlier than the cart.

With the change from making pottery by hand to making it on the wheel, men came to replace women as potters, a substitution which seems roughly to have coincided with the beginning of the Bronze Age.

Few classes of objects are of more importance to the archeologist than fragments of broken pottery. For clay, once baked, is almost indestructible, while different periods and countries and peoples all have their own distinctive styles of shaping and decorating earthenware vessels. The earlier pots and bowls often bore simply the impressions of mats, basketry, string, or even the finger-nail, stamped in while the clay was still soft. Later on greatly elaborated shapes appeared, sometimes with ornamental designs in clay, incised, molded, or stuck on the outside, sometimes with smoothed or burnished surfaces. In certain areas, both of the Old and the New World, various designs, usually if not always of magical meaning, were painted on. Then vessels, in a few countries, were coated with glaze. The glazed earthenware dug out of old Chinese tombs, dating back to about the beginning of the Christian Era, often proves to have acquired wonderful iridescent hues much admired by collectors. True porcelain, the highest development of the potter's art, originated in China, where it was brought to perfection only during the past thousand years or so.

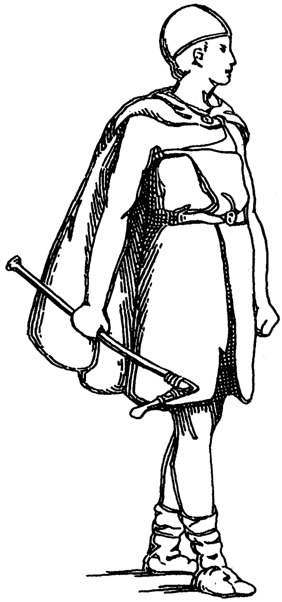


FIG. 91. Male costume of the early Bronze Age. Note the bronze ax lashed to its helve. From MacCurdy, after Muller

The use of bronze gave such life to trade as it had never known before. It increased commerce and the intermingling of peoples directly and indirectly. By its contribution to the rise in the standards of living it helped inspire the demand for new luxuries, which led enterprising and energetic peoples to branch out in all directions, trading, conquering, plundering, destroying. Homer tells us, for example, how the Bronze Age Greeks overthrew and burned the city of Troy. The demand for tin, essential to the manufacture of bronze, led to the establishment of peaceful trade relations with distant peoples. Amber, the fossil resin found especially around the Baltic Sea, held a prominent place in the luxury trade.

The peoples of more southern countries regarded it as a magic talisman possessing wonderful virtues and sought after it eagerly, as they did after gold, ivory, turquoise, pearls, fragrant herbs, and incense. The demand for such things, if it did not actually originate in the Bronze Age, at least greatly increased then, and in time resulted in drawing a large part of the ancient world into a single economic unit, linked together by caravan trails and sea routes extending in all directions.

The wheeled vehicle, though well known by this time, was used mainly in ceremonials, for war, and in farm work, and to some extent in local transport. In many regions the almost total absence of roads rendered impossible its employment for long journeys. The "through freights" used pack animals—donkeys, horses, mules, and oxen. They made their way often in long trains, over mountain ranges and across plains, by means of the footpaths which had come to seam them in all directions from far back in the Stone Age.

FIG. 92. Female costume of the Bronze Age found in an oak coffin in a grave-mound in Denmark. From MacCurdy, after Montelius

The camel, destined later on to become the most important caravan animal of all, was hardly known during the Bronze Age. Its use did not become general, and then only in certain countries, until the true historic period—about the beginning of the Iron Age proper.

Commerce by water became during the Bronze Age almost as important as that by land. Beginning apparently in the transitional period between the Old and the New Stone Age, man had developed different craft to support himself on the water. The simple dugout canoe occurred almost the world over. In the far north and in treeless regions, men learned to make canoes by building frames of wood and then stretching over them skins of animals or birch bark. The inflated skins of oxen and goats have also been used in various ways as floats.

Whatever the process of construction, however, the standard method of propulsion remained for a long time

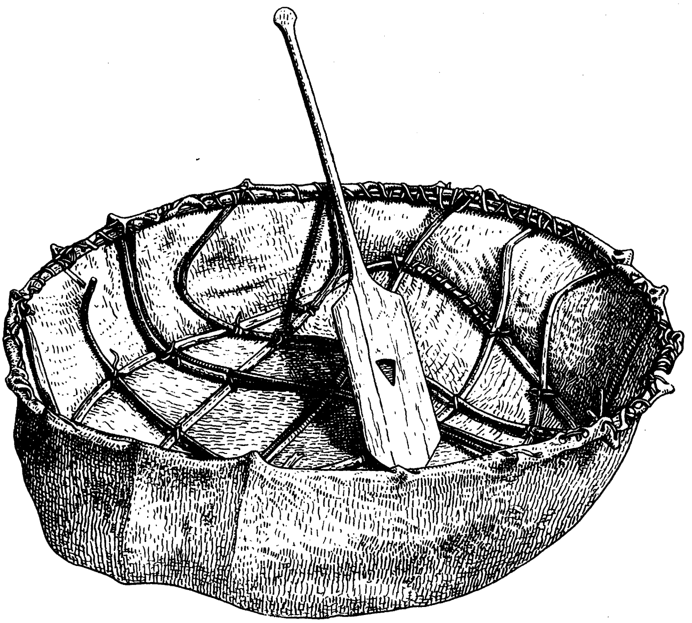
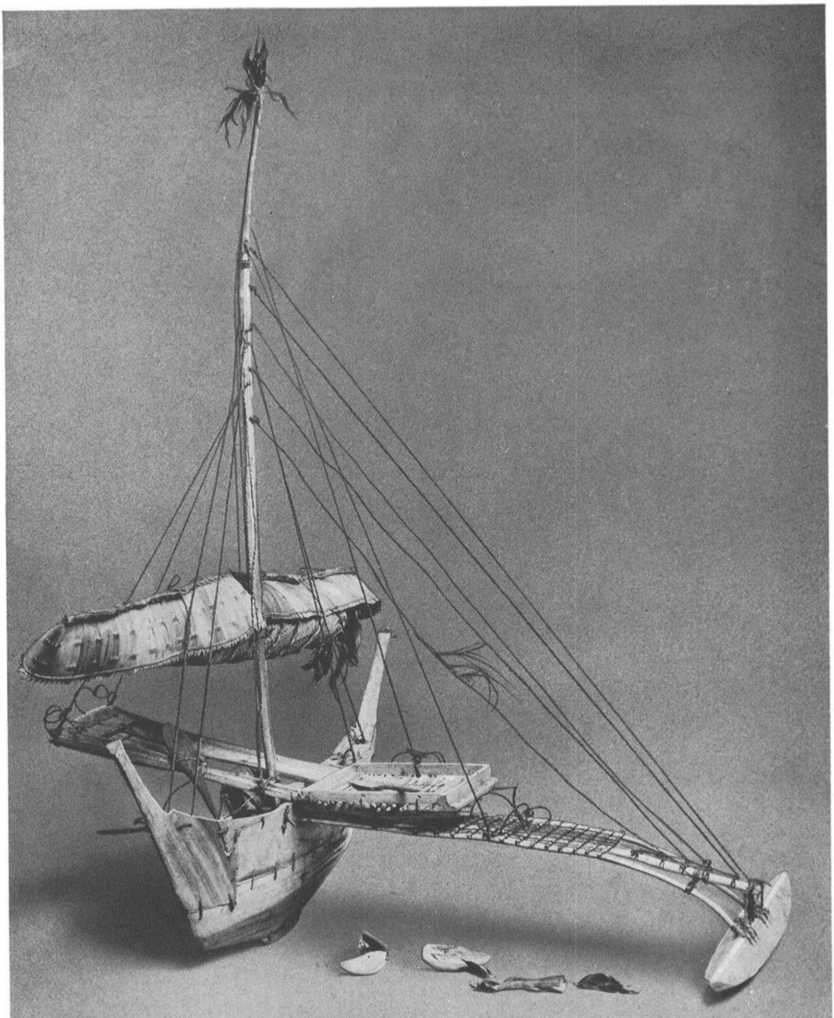


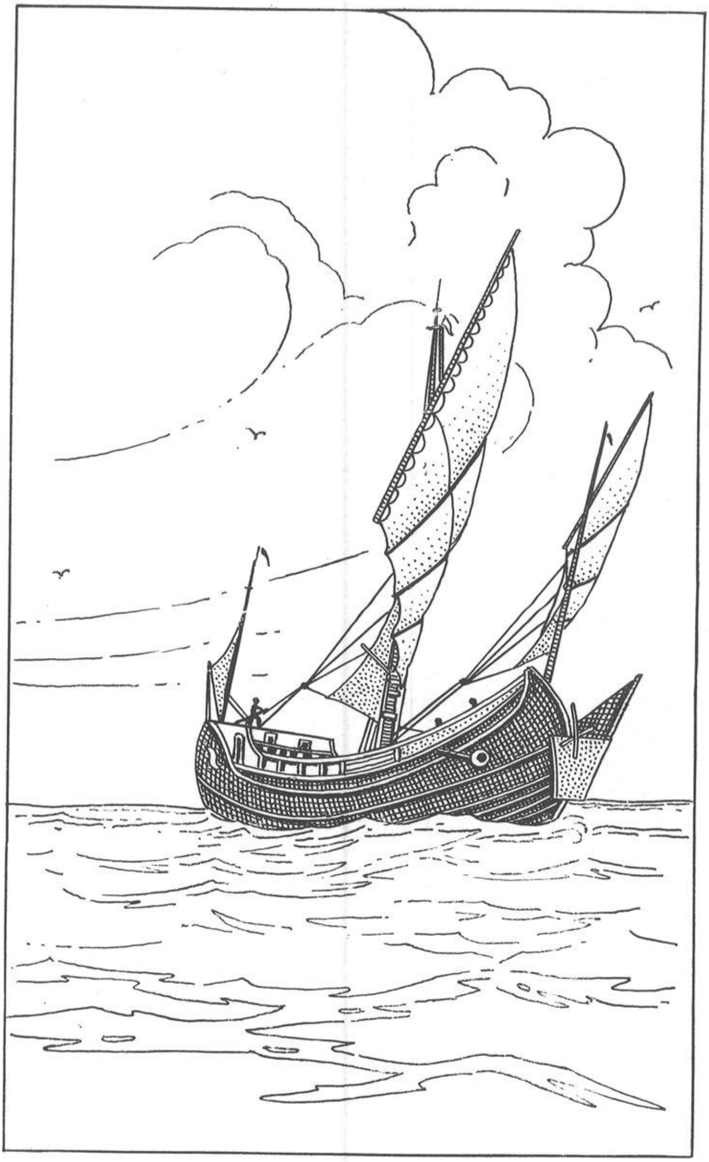
FIG. 93. So-called "bull-boat" of the American Plains Indians, used for crossing streams; a similar type of craft occurs in Tibet. From specimen in the National Museum

the same—a paddle wielded by a paddler sitting or standing with his face to the front. In this way considerable speed might be attained, especially for short spurts; but it wasted energy, for the paddler could not apply his strength to the best advantage.

PLATE 71



Outrigger sailing canoe; Caroline Islands, western Pacific. Model in National Museum



Chinese deep-sea fishing junk. The "eye" on each bow is a vestige of the time when a ship was regarded as a living thing. From a painting by I. A. Donnelly

Of course, canoes were also poled and towed, or "tracked"; but paddling represented the best means of propulsion that man could devise for many thousands of years. At length, however, some bright mind hit upon the scheme of using the boat itself as a fulcrum, and the oar was born. A very primitive form of rowing, in some ways intermediate between paddling and true rowing as we understand it, still survives in parts of China. Here the oarsman stands up, facing forward, just as in paddling, and wields an oar slung to an upright peg on the edge or gunwale of the boat. He therefore pushes instead of pulling his oar, and so fails to exert his strength to the fullest advantage. Another method, very common in Far Eastern waters and also used by the gondoliers of Venice, is that of sculling. Here the oar, instead of being held more or less at right angles to the side of the boat, is nearly parallel to it, and is moved to and fro through the water somewhat as a fish moves its tail in swimming. But, where the oarsman, facing backward, pulled at the oar instead of pushing it, he could "put his back" into his stroke, utilizing all his strength and weight to the best advantage.

Before man reached this stage of propulsion, however, he had taken another epoch-making step forward which greatly increased his mastery over his environment. He had invented the sail. So long as he could progress over the water only by means of his own strength, sea travel labored under a serious handicap. A large canoe or boat had to carry a numerous crew of paddlers in order to secure enough man-power. This meant more mouths to feed and at the same time less room for provisions and cargo.

But when some genius found that by raising a mat or piece of cloth on a pole he could sit at ease in his boat, guiding it by a stroke of the steering paddle now and then, while the breeze did all the work for him, the whole complexion of affairs changed. Then the crew could be greatly reduced, with a corresponding increase in the cruising radius and the space for goods of all sorts. Also men wore out, but the wind never did; the size of the sea alone limited the distance potentially traversable with the aid of the sail.

To the Bronze Age we owe, then, the type of craft, propelled by oar and sail, which remained in use until the application of steam to navigation, little more than a cen-

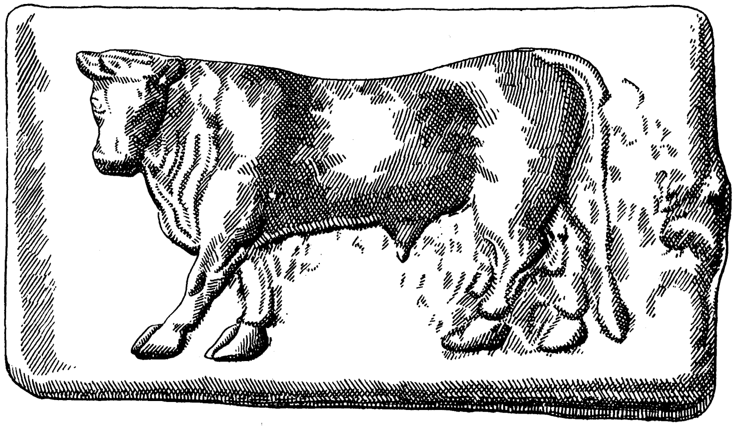


FIG. 94. Roman coin of bronze about 300 B.C. In still earlier times oxen were themselves a medium of exchange. After Hill

tury ago. Development in detail there was, of course, but the fundamental principle remained the same.

With commerce came money, another great step forward made in the Bronze Age. Trade in its literal sense had existed, of course, from the earliest times, ever since men learned that exchanging articles sometimes afforded a better way of acquiring desired objects than hitting their owner over the head and taking them away from him. Barter remained long in vogue and exists even today in certain backward regions of the globe. Nevertheless, the need of a standard of values came in time to be recognized. This function was fulfilled commonly by the ox. Thus a slave or a wife might be said to be worth so many oxen or cows. We find a trace of this ancient practice in our word "pecuniary," which comes from the Latin *pecus*, meaning a herd or flock. Later, in early historic times, the Romans used as a crude sort of money a rough ingot of bronze, stamped with the figure of an ox, sheep, or pig, recalling the time when these animals were themselves the medium of exchange (Fig. 94).

A fixed quantity of grain of one sort or another also served as a standard of values in some regions till recent times. The Japanese, down to the middle of the nineteenth century, computed incomes in bags of rice, each holding about five bushels.

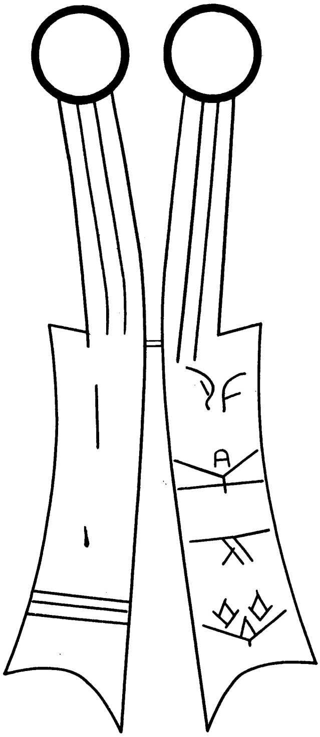


FIG. 95. Early Chinese knife-money of copper; about 650–250 B.C. After Lockhart

But the development of a true coinage resulted from the introduction of metal. Man soon realized that bronze objects—rings, tools, and weapons—provided him convenient objects to trade with; they were much in demand and in their very nature they came to be more or less standardized in size and weight and quality. Their use, which extended wherever the knowledge of bronze extended in late prehistoric times, represented, of course, only a special form of barter. You "swapped" a bronze ax or hoe or knife for so many furs or so much amber. But in time the weight of full-sized bronze tools and weapons presented difficulties, especially on a long trading expedition; so small models of the objects were cast to take their place. Thus token money was devised.

The ancient Chinese cast coins of this sort—models of knives and spades (Figs. 95 and 96)—in extremely thin bronze and continued their use until well into the historic period. And in parts of Africa hoes made of iron are still employed as a medium of exchange.

Likewise, expanding trade gradually developed systems of weights and measures whereby goods might be valued more exactly than by the rough-and-ready methods in vogue in earlier times. Often the unit of measurement was based upon the dimensions of some part of the human body; such were the foot, the span, the cubit, and the fathom. The feet or hands or arms of no two persons might be exactly alike, but this did not matter very much in those days. Precision in measuring did not come until much later, and even yet has not been fully adopted, even in civilized lands, so that we still continue to sell eggs by the dozen and not by weight, the only exact method.

But even with these improved means of buying and selling, commerce in the Bronze Age remained in what we should today consider a very undeveloped state. Owing to the primitive means of transport—the backs of slaves and animals on land and canoes or small ships on the water—only objects of high value and durability in proportion to their weight and bulk could be carried far or made to cover the cost of transportation. Such were gold, tin, ivory, amber, furs, and the like. Bulkier and heavier freight, like lumber, stone, grain, oil, or wine, could be moved only in small quantity and for short distances, on barges or rafts.

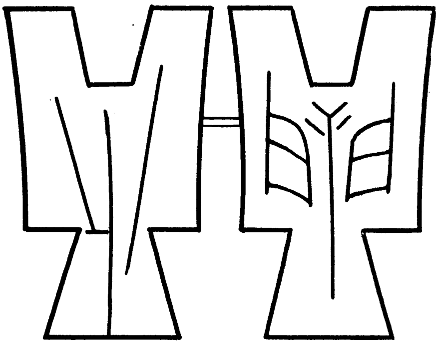


FIG. 96. Early Chinese hoe-money of copper; about 650–250 B.C. After Lockhart

Thus we know that the ancient Egyptians, for example, pretty early brought cedar logs for building purposes from Lebanon across the southeast corner of the Mediterranean Sea to their own treeless land. And rafts floated blocks of stone for statues or columns down the Nile and the Euphrates from the quarries to the places where they were to be used.

Man of the Bronze Age made remarkable progress also in art and architecture. He did not, apparently, accomplish much with sculpture in stone except in a few favored regions, notably that along the lower Nile; but at casting in bronze and decorating bronze weapons he displayed great gifts both in Europe and in Asia. Certain regions favored "geometric" designs—the spiral, frets, triangles, and rows of dots and circles. Others represented various animal and vegetable forms in certain characteristic ways. Sometimes the bronze was plated with gold or the objects themselves made of solid gold. The art of studding metal with precious stones was practiced and led in time to the development of enameling on metal and finally to the wonderful *cloisonné* work brought to an especially high degree of excellence in medieval China.

Of the so-called minor arts of the Bronze Age, the jewelry merits particular attention. This consisted largely of rings of various sorts—for the neck, arms, wrists, fingers, ankles, and ears—made not only of bronze, but of gold, silver, and even iron, at first very rare and regarded as a precious metal. People wore, too, necklaces of various materials, such as amber, ivory, and gold, as well as belt clasps, sometimes highly ornamented and studded with turquoise. For their hair they used combs of bronze, horn, ivory, bone, and wood. Also they lavished decorations on horse trappings.

The more advanced groups of mankind had by now progressed very far indeed beyond the cave, the windbreak, or even the thatched hut of earlier days. Man had learned, for one thing, that earth and stone made far more durable building material than wood. The stockaded village, like those once built by many of the American Indians and still in active use in various backward parts of the world, now gave place in certain regions to the walled town.

Doubtless this development was gradual. No one individual, however gifted, could have conceived the idea, all at once, of making even adobe bricks and of piling them,

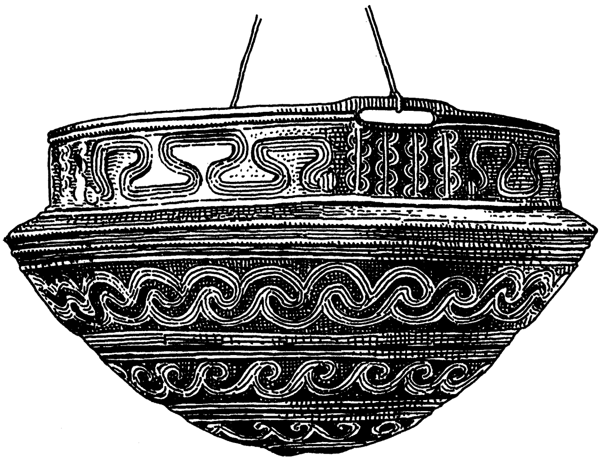


FIG. 97. Bronze vase with geometrical ornamentation and with rims perforated for suspension; Denmark, late Bronze Age. After Neergaard

one on top of another, to form a wall. We may surmise the probable course of events, beginning with the piling up of a little earth about the bases of the upright stakes forming the palisade, to give them a firmer support. Then it was found that by increasing the amount of earth, so as to form a mound with a stockade running along its top, an even better defensive work might be formed. Regions of scarce trees dispensed with the wooden fence and built the earthen mound high enough and steep enough on its outer surface to form an effective obstacle to marauders. In some cases, as at present in the villages of northern China, tangled masses of savage thorns surmounted the wall to make it still more difficult to scale.

As a further step men found that, by ramming down successive layers of earth between retaining frames of planks, they could make the mound much stronger and more durable. Sometimes they embedded logs and bundles of sticks in the clay to give it additional reinforcement. The original Great Wall of China, built about 210 B.C., but now almost entirely destroyed, was constructed in this way.

Finally someone hit on the expedient of making the clay into separate bricks and drying them in the sun, like the adobe bricks still so much used in our own Southwest. It seems curious, in view of the fact that the baking of pottery had long been known, that the hardening of bricks by baking them in kilns instead of by merely drying them in the sun should have remained so long undiscovered.

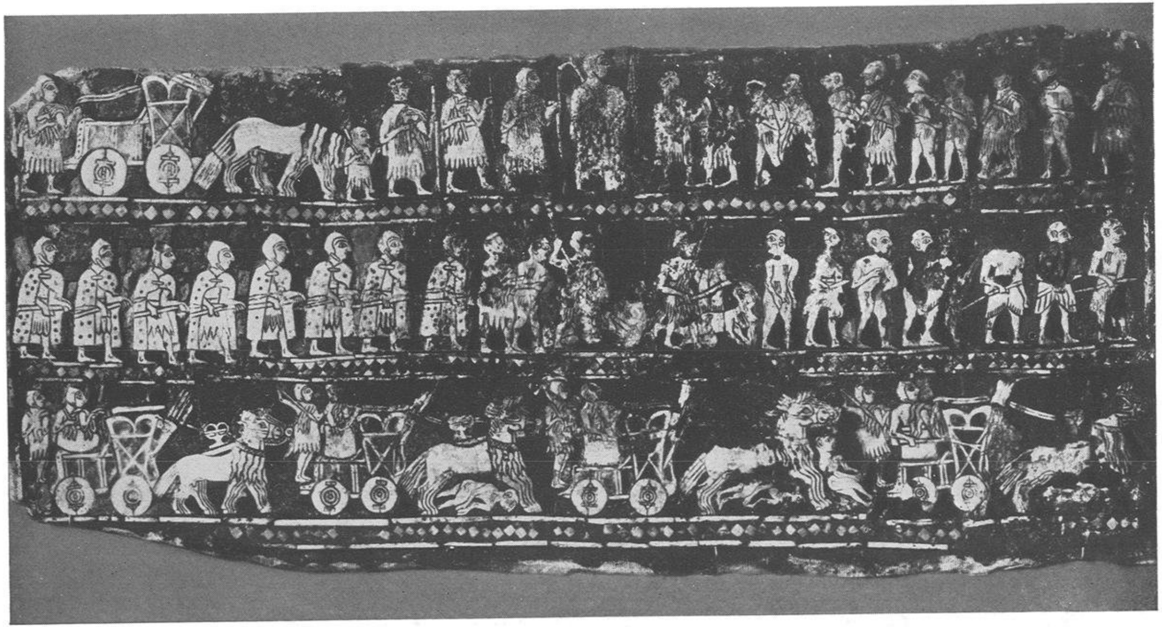
People undoubtedly used unshaped stones for various purposes, including that of building, even before the invention of bricks. Already in the New Stone Age, in some regions, huge rough stones had come to be used in various ways, especially in connection with the worship of the dead. Circles, avenues, and monuments, composed of single standing stones, sometimes of gigantic size, occur in various parts of the world, along with dolmens—tombs constructed of three or more upright stones supporting another which formed the ceiling of the funeral chamber. A great mound of earth usually if not always covered the dolmens, though this in some cases has since disappeared. The most famous of all these stone constructions is the "circle" of Stonehenge in England, which seems to have been connected in some way with the worship of the sun and to date from the Bronze Age. Here some of the stones, weighing many tons, had been transported long distances and shaped, dressed down, and provided with sockets and tenons for securing the capstones, involving an enormous amount of work. But we know that even in the New Stone Age man had learned to organize his labor and make the best possible use of the mechanical forces known to him. With endless patience and a large force of workers intelligently employed, he was capable of accomplishing tasks that excite amazement even today.

It seems to have been the development of brick construction-work that led eventually, in certain regions, to the use of regularly squared stones for the erection of walls and buildings. Stone columns were developed from the inspiration of wooden supporting pillars; and sometimes rafters and other architectural features, originally of wood, were later imitated in stone.

Wall decoration of various kinds began early, as far back, in all probability, as the New Stone Age, when men covered the "wattle-and-daub" walls of huts, plastered smooth, with designs of various sorts, mostly of a symbolic or magical nature, intended to bring good luck or to ward off evil.

The Bronze Age carried this much further, developing wall painting into a regular art. When stone walls came into use, as in early Egypt, they were covered with carved designs, known as reliefs, which almost invariably had some connection with religion. Sometimes they represented the triumphs of the kings, regarded as themselves actually gods, over their enemies. On the walls of the tombs of important people, they showed scenes of everyday life, intended through magical means to insure to the dead man the enjoyment in the next world of the same kind of existence he had known in this. Thus we find portrayed on the walls of Egyptian tombs scenes of worship, of war, of labor, and of sport. The designers did not at all intend these for the eyes of the survivors or of posterity; unquestionably not, for they sealed them up in the darkness of the tomb, as they supposed, forever.

The great number of new inventions which appeared in the Bronze Age found their application to war just as do ours today and with comparable results in the develop-



The standard, done in mosaic, from Ur of the Chaldees, showing very ancient Sumerian chariots with four wheels and drawn by donkeys. Courtesy of the University of Pennsylvania

PLATE 74

Assyrian king in his chariot, hunting lions; ninth century B.C. No collar, breastband, nor traces were used in antiquity. Photograph in Library of Congress ment of warfare. Thanks to bronze weapons and tools, the desultory sort of skirmishing between relatively small bodies of warriors which characterized the New Stone Age both in the Old World and in the New, gave place to regular armies, equipped and drilled in something approaching uniform fashion (Fig. 98). New means of waging war

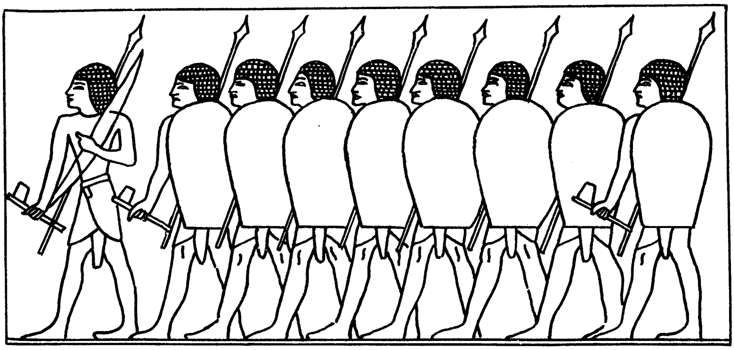


Fig. 98. Egyptian infantry, Eighteenth Dynasty (1580–1350 B.C.). The Bronze Age persisted in Egypt considerably longer than it did in southwestern Asia. After Moret and Davy

came into being, methods of conducting sieges of walled towns, ways of raising, feeding, and maneuvering bodies of men.

The most characteristic engine of war during the Bronze Age was the war chariot. We have already seen how the cart developed, and also how during the New Stone Age the peoples living about the wide-spreading grasslands of central Asia and eastern Europe had begun to domesticate the horse.

Now between these tribes, only a little more advanced than the Plains Indians of America, and the much more highly civilized peoples inhabiting the fertile river plains of southwestern Asia and Asia Minor, stood great barriers of mountains and forests and marshes, deserts and lakes and seas, such as man in the New Stone Age could scarcely traverse, at least in any large numbers. A time came, however, when the slowly drying climate little by little thinned out the forests and dried up the swamps and lakes left behind at the close of the Age of Ice; and then, with improvements in transportation and organization, contacts between the two great cultural regions became easier and more frequent.

Up to this time only the peoples of southwestern Asia and perhaps Asia Minor seem to have known wheeled vehicles. They do not appear in Egypt until much later, and they remained unknown in northern Asia, in Africa south of the Sahara, and throughout the Western Hemisphere, until a few centuries ago.

In the few regions where they were used carts and chariots long continued to be drawn by oxen—animals incapable of any great speed—so that the employment of these vehicles was restricted almost entirely to farm work and religious processions. Their only use in war was to carry to the field of battle images or symbols of the gods and the persons of the kings—themselves gods, priests, and medicine men combined. Unfortunately, the people who had invented the chariot did not as yet have the horse, the animal above all others fitted to draw it at high speed; and the people who had domesticated the horse remained ignorant of the chariot.

But why did not the energetic and warlike people of the great grassy plains ride their horses in plundering raids on the more civilized peoples to the south, just as the Scythians, Huns, Mongols, and Turks did far later? Strange as it may seem, though they had known the horse for tens of thousands of years, they had not yet learned to ride him. Hence, until they learned to yoke their horses in pairs to the chariots they acquired from their more civilized neighbors, they had no means of utilizing these animals for anything practical except their flesh, their hides, and perhaps their milk. The utilization of the horse for hauling and riding changed the whole course of history. Many of the problems connected with it have not yet been solved; but at least we know in a general way what happened.

Recent discoveries have shown that this use of the horse is connected very closely with the spread of the early Indo-European peoples, and that wherever they first appear in history they are found employing the horse and chariot as their principal instrument of war. Just as the early Spaniards in Mexico and Peru owed some of their

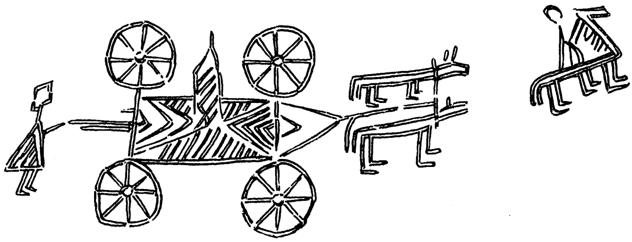


FIG. 99. Four-wheeled wagon. The two draft animals have been called horses but are more probably intended for oxen. Design incised on a clay vessel; Hungary, early Iron Age (900–500 B.C.). After de Morgan

greatest victories to their use of horses and the terror which the latter inspired among the Indians, so the early Indo-European peoples undoubtedly could ascribe much of their success to the speed with which they could maneuver on the battlefield in their war chariots, and perhaps even more to the panic which the latter inspired in their opponents. To people who had never had to stand up before one, a charge of war chariots, with the galloping horses and the rumbling wheels, the yelling men and the flashing bronze weapons, must have seemed a terrible thing. Those of us who have seen automobiles or street-cars bearing swiftly down on us can appreciate something of their feelings.

The grassland horse breeders, whom we can safely call Indo-Europeans—our own ancestors in speech and partly, too, in blood—must, through contact with their more civilized neighbors to the south, have gradually become familiar with the idea of using animals to draw carts of various sorts. Their long association with horses would in time suggest that these animals could pull a chariot far better and faster than the oxen or donkeys used until then. For lack of evidence we can not say as yet when this great idea was born, but we may be sure that to work it out fully took a long time. At length, however, armed with this new instrument of war, more effective in its way than the tank in modern times, the Indo-Europeans spread in all directions, conquering, organizing, and ruling as they went.

Thus the spread of the war chariot, drawn by horses attached to it with a yoke, neckband, and girth, affords an important clue to the movements of peoples in late prehistoric times. It appears in southwestern Asia shortly after 2000 B. C. and in Egypt a few centuries later. It was already in common use in Greece and central Europe about 1200 B. C., so it must have arrived there at least a century or two earlier. Gradually it spread westward until it occupied almost the entire continent. The peoples of northern Italy and France still employed it in the third century B. C., but abandoned it soon after. Caesar found the Britons using it in the first century B. C., while in Ireland it survived still longer.

In the Orient the history of the war chariot is much the same. The Aryans, who invaded India sometime in the second millenium B. C., had it. So had the Bronze Age population of southern Siberia. In China the war chariot and the knowledge of bronze had appeared sometime before 1000 B. C.

During the second millenium B. C., the use of the chariot for fighting seems to have spread outward in all directions from the grasslands of southeastern Russia and southwestern Siberia, until it had penetrated almost the whole of the North Temperate regions of the Old World. Then it gradually went out of use, unable to compete successfully with the later practice of fighting on horseback, a development which belongs mainly to the opening centuries of the Iron Age.

Effective history begins with writing, to the discovery, or perhaps better development of which we have now come. To understand how fundamental was this achievement we have only to imagine the situation today if reading and writing had never been invented.

For one thing, we should be utterly unable to set down and work out any mathematical problems, but would have to do them all "in our heads," no matter how long or how complicated they might be. The record of all discoveries in physics, chemistry, astronomy, medicine, or any of the other sciences, would have to be intrusted to our uncertain memories. If you were ill, the doctor would have to tell you by word of mouth what sort of prescription to get filled. Then you would have to tell the druggist what the doctor had told you, and the druggist would have to mix his medicines according to what he remembered of what you had told him.

Again, suppose we had to depend entirely for our knowledge of the past upon what our fathers told us they had heard from their fathers and grandfathers. It is easy to see how the memory of even the most important events would become distorted, run together, and confused. Instead of being able to say that George Washington, for example, lived in the eighteenth century and played a leading part in the founding of the United States, people, after a few thousands or even hundreds of years, would be wondering whether he lived in the eighteenth century or in the eighth. Was he a contemporary of Napoleon or of Charlemagne? And what was it that he did anyway? In time he would become a mythical figure, perhaps of supernatural power. Old bards and reciters of hero tales might even say that he caused the waters of the Delaware to divide and led his Continental troops across dry-shod. Finally he would be forgotten altogether.

All this may sound extravagant. But it is exactly the sort of thing that went on, century after century and millenium after millenium, through the whole long course of man's existence on the globe, down to a relatively very short time ago. If events and discoveries and facts of all kinds are better remembered today than ever before, it is entirely due to the art of writing.

To this day many peoples look upon writing as something uncanny or magical. We may smile at the story of the native sent by a missionary to a friend, with a note and a basket of fruit, who sat on the former while he ate the latter, so that the mysterious "writing" could not see what he did and tell on him. But that is just how early man looked at it.

Pictographs, or actual pictures of concrete objects, like men, animals, or plants, seem to have been the first step in the infinitely slow development of writing. Next came symbolic representation. A star, for example, might stand for a god; a battle-ax, for a king; three wavy lines, for water; and so on. Then the earlier pictures, gradually simplified out of all likeness to the things they originally stood for, became themselves symbols. Thus, to indicate an ox, people would no longer draw a picture of the whole animal but merely a sketch of its head—a triangle with two lines projecting from the upper corners for the horns. If a wild bull was intended, in the triangle would be drawn three sharp peaks, the symbol for a mountain, and it would then mean "a mountain bull." We call characters of this sort not pictographs but ideographs, because they are no longer pictorial, but represent ideas.

The next great step was to make these symbols stand not only for ideas but also in some cases for sounds. This seems to have been accomplished through a method like that used in the rebuses which we used to solve as children. The sentence, "I see you," to take a very simple example, might be indicated by a picture of a human eye followed by one of the sea and then the letter U. In other words, a symbol which originally stood for one thing would be used to mean something else having a similar sound but an entirely different meaning. Some forms of writing never got much beyond this, but remained an inconsistent even though systematized combination of pictographs, ideographs, and sound symbols. Chinese script is essentially an instance of this kind.

In other forms the principle of indicating sounds instead of ideas or objects gained ground, until there resulted a set of signs, each standing for a definite syllable—a vowel alone or a consonant and vowel. We call such a system a syllabary. The ancient Assyrians used it in part, as do also the modern Japanese.

The best system, because the simplest and most flexible, is the alphabet. Here the symbols stand for sounds and sounds alone, every consonant and finally every vowel having its own separate sign. But this development came only comparatively late in man's history, after he had passed through an extended period of experimenting with picture-writing, with ideographs, and then with halting attempts at representing sounds alone.

But long before the invention of the alphabet, man had begun to keep records. Although he had already long used a few very simple systems of writing, the dawn of history may be said to have occurred during the Age of Bronze.

The Mother Goddess of fertility and growth, the divinity characteristic of certain regions in the New Stone Age, gradually gave place during the masculine and warlike Bronze Age to the Sun or Sky God. The latter seems at first to have been represented only rarely if at all by images in human form, but rather by symbols, particularly the wheel and the swastika, and also by forms of the cross and representations of ships and of chariots, sometimes themselves bearing the sacred symbol of the wheel.

Human sacrifice, although still quite generally practiced, appears to have become less a magical rite to insure a plentiful harvest than an act of propitiation to turn away threatening calamity. Certain peoples during the Bronze Age seem to have substituted animals for human beings on such occasions; but there remained a sort of latent feeling that in so doing they were cheating the gods out of their just dues. Even in the early centuries of the historical period, in times of great national danger or dis-

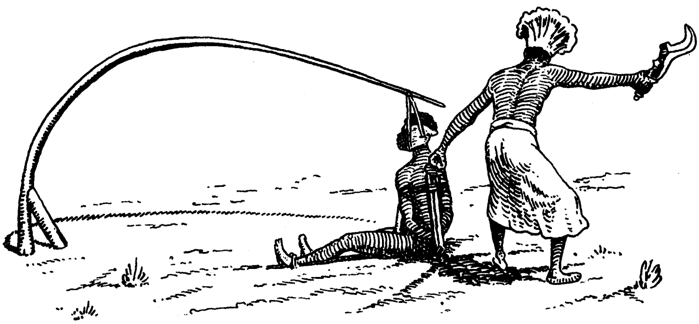


FIG. 100. Sacrifice of a slave, Congo region, Africa. After Frobenius

aster, terrified tribes sometimes sacrificed their children, their most precious possessions.

Thus we are told in the Old Testament that the King of Moab, as a last resort, "took his eldest son that should have reigned in his stead, and offered him for a burnt offering upon the wall." Again, when the Greek fleet destined for the siege of Troy was, according to the legend, wind-bound at Aulis, King Agamemnon sacrificed his daughter Iphigenia in order to secure a favoring wind.

The custom of burying or cremating with the important dead their wives and slaves and close companions also began to assume prominence, it seems, in the early Bronze Age. The victims sometimes freely offered themselves to accompany their beloved lord beyond the grave, to lead with him in the next world the life to which they had been accustomed in this. More often, in all probability, they had little choice, but followed their master to the tomb as a matter of course, like his chariot and horses, his weapons, and his other treasures.

Mankind as a whole has never passed through an Age of Bronze. Over by far the greater part of the globe men have either remained in the Stone Age, which, unlike the Bronze Age, extended over the whole world, or else they have gone directly from the Stone to the Iron Age. This statement applies to nearly all the peoples of Africa, of northern Europe and Asia, of the New World, and of the islands of the Pacific. The true Bronze Age, in fact, was practically confined to the North Temperate zone of the Eastern Hemisphere, where it occurred over a continuous area extending from Spain to China and from Egypt and northern India to Scandinavia and central Siberia. It began, apparently, in southwestern Asia, some six or seven thousand years ago; and in some regions, as for example in China, it lasted almost to the opening of the Christian Era.

CHAPTER XV

ANCIENT EGYPT, ASIA MINOR, AND CRETE

WE have now reached that point in our story where the keeping of written records begins. Heretofore, the lack of these has made it impossible to speak of definite countries or peoples, but at the most only of races and regions and general developments of culture.

The effects of the Ice Age did not stop at those regions actually encroached upon by the vastly expanded glaciers and ice fields. The influence of the latter upon climatic conditions extended far beyond their borders. Because of them the "storm belt" of rain-bearing winds now blowing off the Atlantic over Europe was then deflected far to the south, so that it blew across what is now the rainless Desert of Sahara. Future research will doubtless disclose the connection which must have existed between the glacial or interglacial stages of the European Ice Age and the "pluvial periods" which seem to have occurred during the same epoch in Africa. Be that as it may, we know that the Sahara, now largely a burning waste of gravel and sand, once formed a pleasant, well-watered region, with abundant rain, streams, grass, and trees. Teeming with wild beasts of all sorts, it presented a hunters' paradise to the men of the Old Stone Age, who have left their tools and weapons scattered about over its surface. But as the climate grew slowly drier, this abundant human and animal life died out or moved away in quest of water. They migrated, among other places, to the valley of the Nile, destined in far later times to be the home of a wonderful civilization.

ANCIENT EGYPT, ASIA MINOR, AND CRETE

Prehistoric Egypt

Many students believe that civilization began in Egypt. Recent discoveries, however, appear to indicate that southwestern Asia had on the whole the priority, although in certain respects the predynastic Egyptians were probably further advanced than any other people of their day.

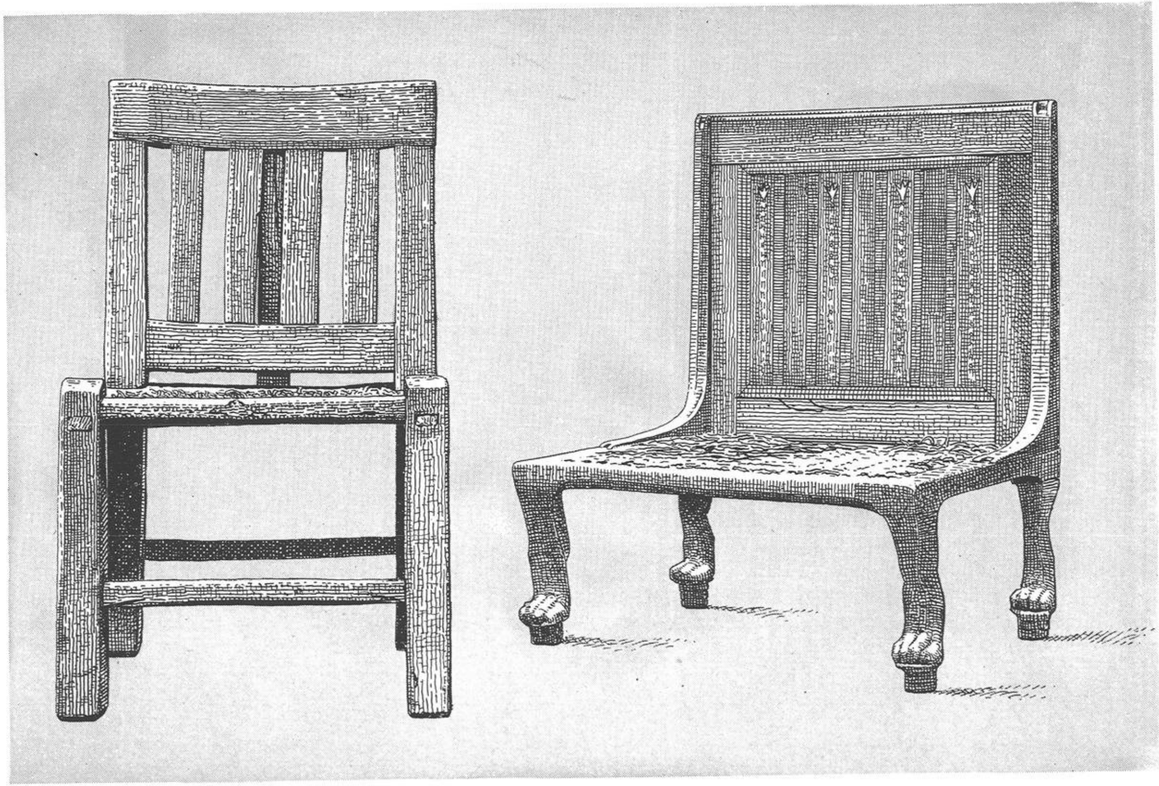
The truth is that human progress is a thing of such complexity that it advances very unevenly at various periods and in different localities. Furthermore, scarcely anything is so rare as a truly original idea or invention. People progress by borrowing, and isolated regions are practically certain to be backward. Egypt, while greatly favored by nature in many respects, was undeniably somewhat isolated. For she had come, in the course of ages, to be hemmed in by deserts on both the east and the west; moreover, she lay a little to one side of the great cultural areas of the late prehistoric period, so far as we know them. The current impression of the precocity of early Egyptian civilization rests perhaps on the fact that we know far more about it than we do about the civilization of other countries because the wonderfully dry climate of Egypt has preserved early remains of all sorts far better than they have been preserved elsewhere. Also the Egyptians resorted largely to stone for building, for inscriptions, and for pictures of everyday life; and stone, of course, lasts almost indefinitely.

The Nile, rising in equatorial Africa, flows in a general northerly direction through a narrow valley varying from ten to thirty miles in width, until at last it enters the Mediterranean Sea at the Delta. This, far back in the prehistoric period, formed a bay, a deep notch in the otherwise regular and almost featureless coast line. Long before the dawn of history, however, mud brought down by the Nile from the heart of Africa had filled it up. The great river at one time reached the sea through seven mouths; but these have gradually decreased in number as the filling-up process has continued, until now there are but two. The rest have dwindled into mere canals, not always navigable.

Long after the Ice Age, when the country on both sides of the valley had assumed nearly the same desert character that it bears now, we find the banks of the Nile occupied by people physically pretty much like those living there today. They resembled the race inhabiting most of the countries around the Mediterranean at the present time—a race of medium stature, with oval faces, black or dark-brown hair and eyes, and complexions varying from brown to a rather light olive.

These early Nile dwellers lived in scattered villages placed above the reach of the yearly inundations. They supported themselves partly by hunting the animals in the marshes along the river and in the jungles covering the higher ground, among others the elephant, hippopotamus, giraffe, okapi, wild bull, and various kinds of antelopes. But they carried on some planting, and in time began to make experiments in domesticating certain wild creatures about them, such as the cat, the greyhound, and the wild ass. The latter seems to occur only in northwestern Africa; the animals called "wild asses" which are found in other parts of the Old World are not really such at all. In time the donkey, or ass, became the common beast of burden.

At first the Nile dwellers seem to have been almost indistinguishable from most of the other North African peoples—not Negroes in any sense, but "dark whites," like their descendants, the modern Moors—who occupied the lands stretching indefinitely to the westward, toward the Atlantic. But at some uncertain date in prehistoric times they came strongly under the influence of peoples from the eastern side of the Red Sea. Invasions of the Nile Valley from Palestine or perhaps Arabia may easily have occurred more than once in prehistoric times, as they have since the dawn of the historical period.



Ancient Egyptian chairs. Some of the Egyptian woodwork has never been excelled for proportion, design, and finish

Probably through these contacts, the prehistoric people of the Nile Valley became possessed of certain other domestic animals, the ox, the goat, and the sheep. After their introduction into Africa, however, these animals quickly spread over almost the whole continent, profoundly altering the lives of its people.

These prehistoric or predynastic Egyptians grew barley, millet, wheat, and a wide variety of vegetables. They knew, too, the crafts of the potter and the carpenter, as well as how to make stone weapons and tools of beautiful workmanship. Vessels hollowed out of the hardest stone are characteristic of early Egyptian craftsmanship. No other country, in fact, developed stone working to such a wonderful degree. The strong conservative spirit which dominated the Egyptians may have contributed to their preference for stone, but we find the main cause in the scarcity or total lack of most of the useful metals in Egypt itself. The country has no native copper, tin, iron, gold, or silver. And without at least copper and tin a native Bronze Age civilization could hardly spring up.

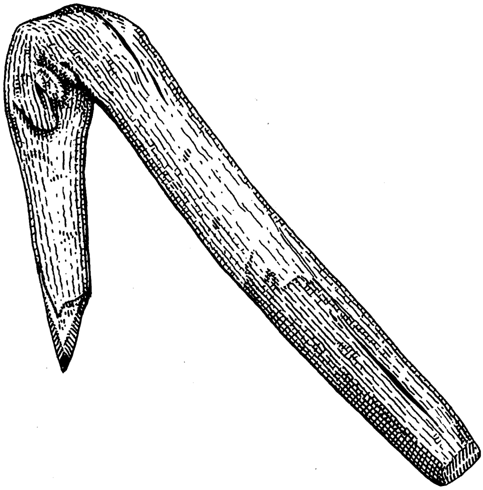


Fig. 101. Primitive Egyptian hoe, made from a forked branch. After Petrie

In time some copper was obtained from Sinai and more from the island of Cyprus, along with quantities of gold from the upper Nile. But copper displaced stone and bone very slowly in Egypt, which thus remained largely in the Stone Age long after Babylonia had begun to use bronze.

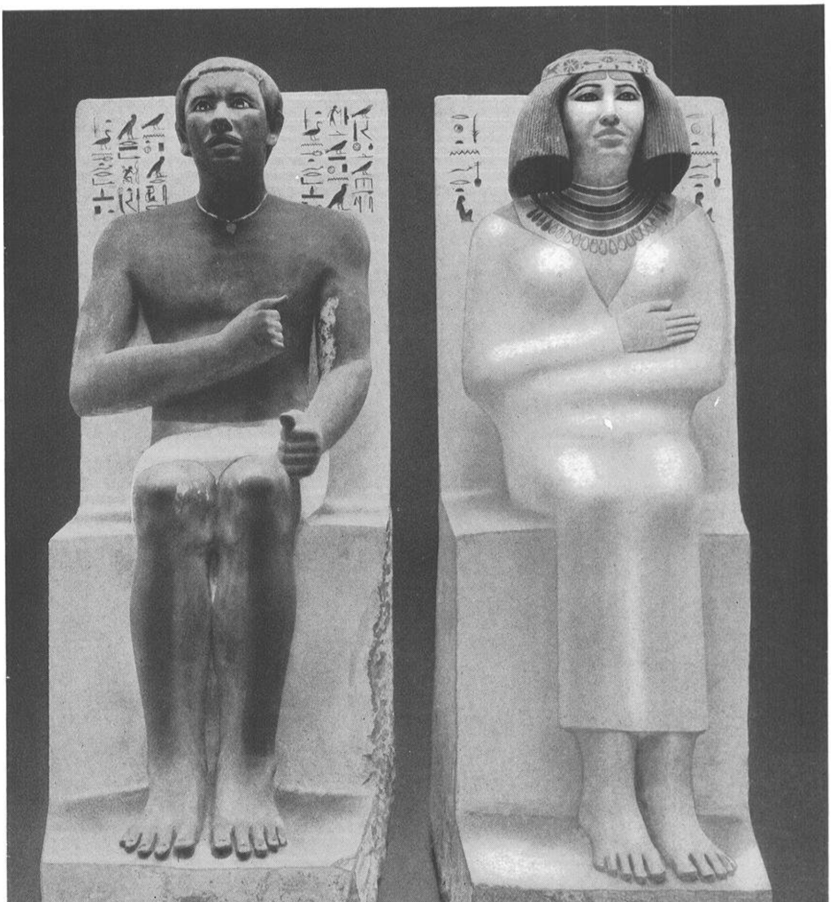
It seems likely that a true agricultural civilization in Egypt first arose in the Delta, where intercourse with other countries was easiest and where new ideas as well as new materials could be most easily introduced. The Delta, for example, first adopted that important aid to agriculture, a regular calendar, in the year 4241 B. C., which has therefore been called "the first fixed date in history." This calendar consisted of a year of twelve months, each containing thirty days, with five holy days added at the end, an arrangement in some ways even more convenient than our own. But the year actually exceeds 365 days by nearly six hours, so Egyptian dates revolved through a cycle of 1,460 years ($6 \times 1{,}460 = 8{,}760$ hours $= 1$ year) before returning to their original astronomical position.

During the Neolithic Period the scattered settlements of the dwellers along the Nile had gradually coalesced into small city states, of which there were roughly twenty in the Delta and as many others in the Valley. Later yet, although still in prehistoric times, these two regions came to form two kingdoms, known throughout history as Lower Egypt and Upper Egypt. Finally a king of Upper Egypt attacked and annexed Lower Egypt and united the two crowns, founding the First Dynasty. With this event history begins, although Egyptologists are not yet fully agreed as to the precise time when it occurred.

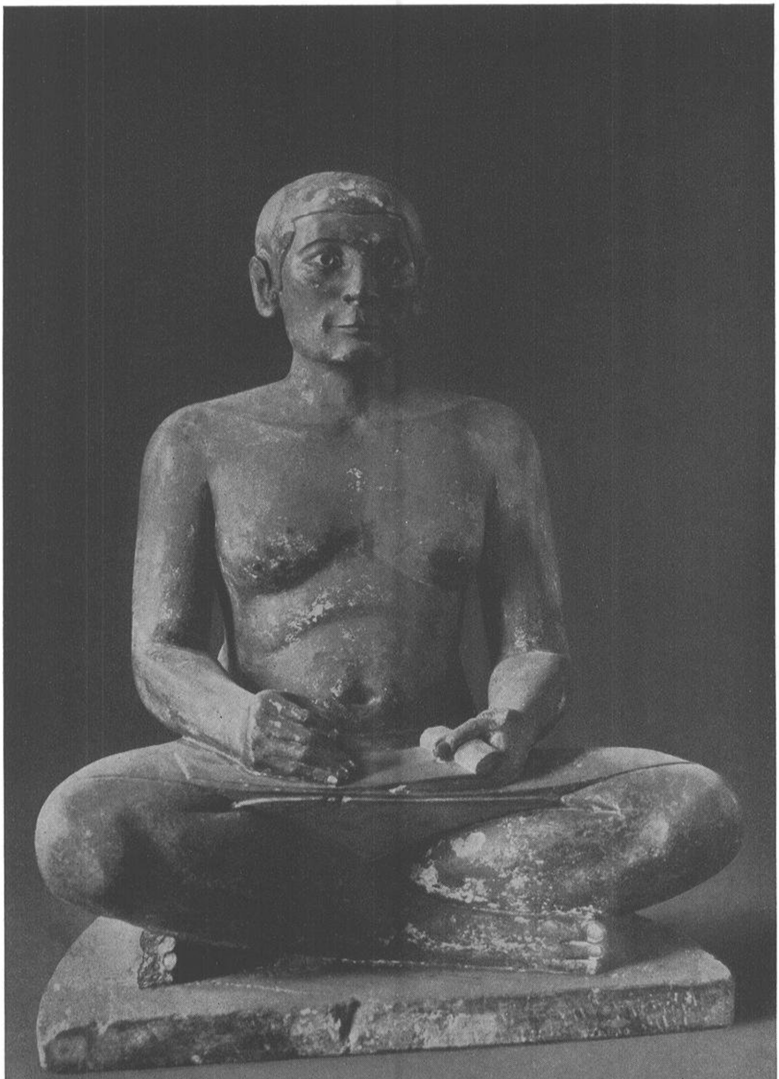
The Nile dwellers, of course, had long had boats and canoes, and they seem to have been using regular sails even before the close of the predynastic period. Some believe that the sail as it has existed in historic time was an Egyptian invention and that it spread thence to surrounding regions. Certainly the Egyptians very early had trade relations with countries across the Mediterranean and also far down the Red Sea.

Stone seems to have come into use as a building material for temples toward the end of the Second Dynasty. But

PLATE 76



Egyptian portrait statues. In the Cairo Museum. Photograph in the Library of Congress



Portrait statue of the scribe of an Egyptian king, indicative of the importance attached to education in ancient Egypt. Photograph in the Library of Congress from original in the Louvre stone implements did not definitely give way to copper ones until the Fourth Dynasty. This was the great pyramid age. The ancient Egyptians had come to believe their kings, originally glorified medicine men, to be gods—controllers of the weather, givers of harvests, and protectors of the people—whose welfare, therefore, they considered of first importance, both in life and after death. We miss the point entirely if we think of the pyramids merely as monuments to the pride and power of tyrannical rulers. They were meant to be eternal dwelling places provided for the spirits of the mighty dead, who in turn were expected to see to it that the security and prosperity of Egypt were assured. They were built, at enormous cost of time and effort, because the united feeling of the people demanded them as necessary to the common good.

The same sort of thinking led to the development of early Egyptian sculpture. People believed that the spirit of the dead needed a body of some kind to live in, just as it had animated a body of flesh during life. Hence they took particular care to make the face of the stone image an accurate portrait, that the spirit might recognize it.

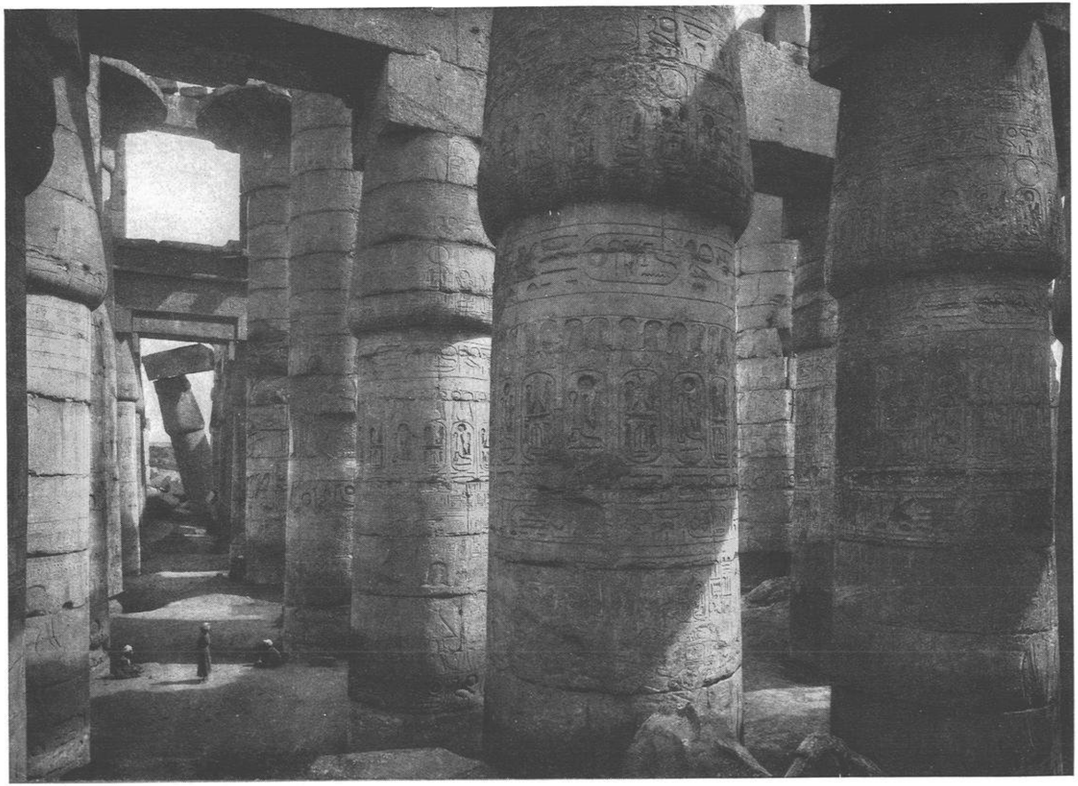
At first the ancient Egyptians considered that only the spirits of the kings really mattered much, and they built for them alone such mighty works as the pyramids. But gradually the notion spread that the souls of other people might enjoy an after-life if properly cared for by their survivors. We can see this idea springing up first among the nobles, the landowners, and court officials; later on it becomes general.

This steady widening of spiritual horizons led to the abandonment of such stupendous works as the pyramids and the gradual development of temples instead. But here, too, the genius of the Egyptians for the vast and the colossal asserted itself. In the ruins of Karnak and Luxor—the ancient Thebes—we have the greatest development of colonnaded architecture that the world has ever seen (Plate 78).

Mummification, also, developed as a result of this same interest in the welfare of the dead, thought to be linked very vitally with that of the living. The dry sands of the desert, without other preservative agencies, have kept for us the bodies of many of the old predynastic Egyptians of Neolithic times. Later on, corpses were intentionally embalmed, but not until long after Egypt had passed her zenith as a great power do we find the highest development of mummifying—in the Twenty-First Dynasty, about 1100 B. C.

The use of true bronze and of the horse and chariot seems to have been introduced into Egypt from Syria about 1500 B. C., probably by the conquering Hyksos, or "Shepherd Kings." In fact it seems likely that the ability of the latter to subdue the Egyptians and dominate them for a century or more sprang from their possession of these more effective means of waging war. The Egyptians very early knew iron, perhaps of meteoric origin like that used by certain of the Eskimo, but they did not make much use of it until later times, when Egypt, after falling a prey to the Ethiopians, Assyrians, Persians, and others, came to be ruled by the Macedonians, after Alexander the Great.

Thus we see that, for all her mighty achievements in architecture, art, and in certain other fields of human endeavor, Egypt lagged behind western Asia in many important respects. She had hardly yet begun to emerge from the New Stone Age when the two crowns, of Upper and Lower Egypt, were united. She had but just reached the Copper Age when the pyramids were built. She owed to western Asiatics the introduction of bronze and horses and chariots, about the sixteenth century B. C. The camel, now so widely employed in Egypt, appears to have been brought into general use there by the Assyrians or the Persians. Iron, too, was a late adoption in Egypt, paralleling its history in China, where, as already noted, the Bronze Age lasted almost down to the Christian Era. This, however, is no reflection on the ancient Egyptians.



The great colonnaded temple of Karnak, Egypt. The enormous stones were moved with the aid of but few mechanical devices. Photograph in the Library of Congress

PLATE 79

Example of Egyptian mummification. In the National Museum

On the contrary, the greater is the honor due them for their ability to accomplish so much with such comparatively poor means.

Southwestern Asia in Prehistoric Times

The only other region which, so far as we now know, can compete with Egypt in priority of civilization is southwestern Asia. Here, too, the Ice Age made its influence strongly felt, although the ice sheet itself seems not to have covered the extreme southern portions of the continent. We are only just beginning to find out a little about the men who lived there then. But that they did exist is certain; for they have left behind them records of their presence in the shape of stone implements. And lately, as we have seen, there has been found in Galilee part of the skull of a member of the lowly Neanderthal race.

When we come down to the period following the close of the Ice Age, our knowledge becomes slightly more definite. It now seems probable that the whole of southern Asia then contained a sparse population of hunting and food-gathering peoples belonging to the black-skinned races which we find today, in various forms, in Africa, India, and some of the islands stretching out to the southeast of Asia. Among them were in all likelihood both peoples of ordinary size and pygmies, or dwarf races, like those which today survive only in parts of Africa on the one hand and in the Malay Peninsula and the East Indies on the other. They seem never to have had to undergo the stern discipline of the Ice Age, and therefore retained many primitive traits, remaining essentially in the Old Stone Age. They were too few in number and too lowly in culture to influence later races very deeply.

The great changes which took place both in the climate and in the character of the earth's surface as the Ice Age passed gradually away occurred in southwestern Asia just as they did in northern Africa. A great deal of the land that had been either actually covered deep with ice, or else too cold and desolate for human habitation, became pleasant, fruitful, and inviting. Not only the Desert of Sahara, but also the deserts of Arabia and Persia were then fertile and able to support considerable populations.

The country later known as Babylonia at that time lay largely under water, the Persian Gulf running much farther up into the land than it does now. As the climate grew warmer, the two great rivers, the Euphrates and the Tigris, began to carry down mud from the slopes of the mountain masses to the north and northeast, and to deposit it as silt or sediment at their mouths, gradually building up the great alluvial plains later occupied by so many important peoples. This process has continued steadily down to the present, and the sites of several cities which we know were once on or near the water have been left far inland within historical times.

So far, in addition to the primitive Negroid hunters, of whom we can conjecture little more than the mere existence, we can distinguish three main groups among the peoples who in turn occupied ancient Babylonia. The first is that known, through one very characteristic type of remains found on their ancient sites, as the Painted Pottery People. They probably had some domestic animals, and they did a certain amount of planting; but they seem to have depended for their food chiefly upon hunting and to have made large use of the bow and arrow. They knew copper, at least, and so had already left the New Stone Age behind, though probably not very long before. It is thought that these Painted Pottery People entered Babylonia from the northeast, probably from the Persian uplands. What became of them we can not as yet say with any assurance; but they were most likely, in part at least, absorbed by the Sumerians, the people who next appear on the scene.

Some have thought that the Sumerians reached their historic home by migration from central Asia. In the past few years, however, there has come to light in northwestern

India a hitherto entirely unknown civilization with some close resemblances to that of the Sumerians. Again, they may have come from southern Arabia, where kingdoms now forgotten existed in ancient days.

At all events, when they first become known to us, we find the Sumerians already in possession of domestic cattle, asses, sheep, and goats, but without horses. They had a well-developed agriculture, carried on with the aid of the plow, and they used carts, both with four and with two wheels, drawn by oxen and asses.

Unlike their predecessors, the Painted Pottery People, the Sumerians seem to have made little or no use of the bow and arrow at first. They did wage wars, but on the whole they were a peaceful folk, engaged mainly in agriculture, cultivating especially the date palm, which supplied them with many of their simple wants in addition to food. This most useful tree made possible, in the opinion of some, their rise to comparative civilization. They lived in mud villages scattered about over the wide alluvial plains, often built on artificial mounds to be out of the reach of floods; partly, too, perhaps, to escape the swarms of insect pests that the marshes harbored. In time these villages with their surrounding lands united, as in Egypt, to form a number of small city states, ruled over by priest-kings who were often themselves regarded as in some sense gods or descended from gods. Objects of adoration in life, at their funerals large numbers of their guards and servants were slain and buried with them.

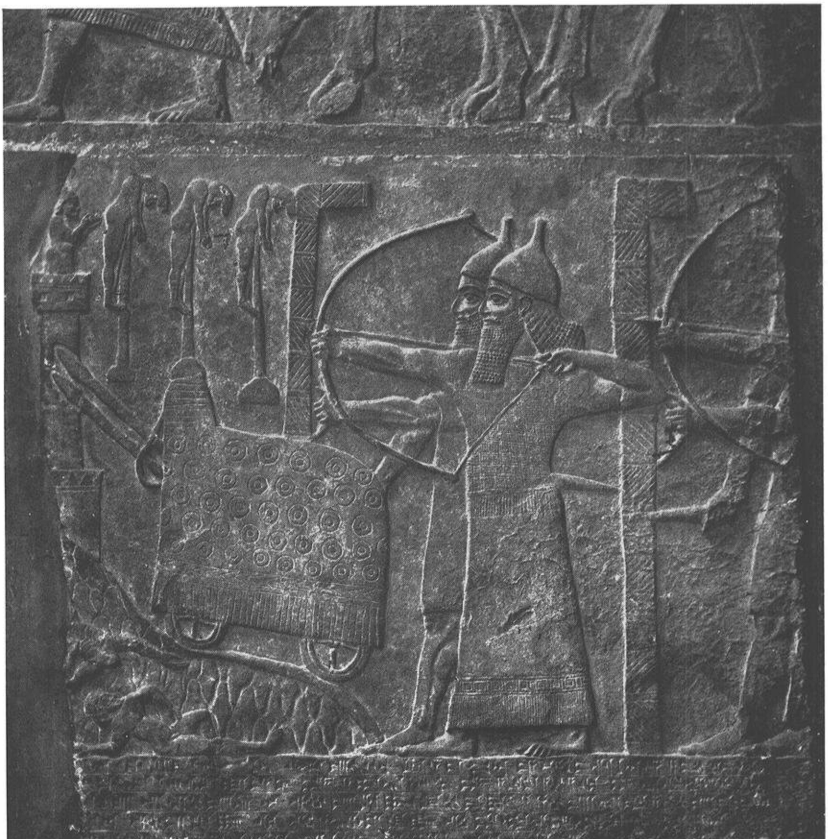
Owing to the total lack of stone in the alluvial plains of Babylonia, mud formed the great building material and came to be made into bricks, simply dried in the sun at first and only in later times baked in the fire. Sometimes in place of mortar, bitumen was used; a reference to this occurs in Genesis, xi, 3, where we are told that the builders of the Tower of Babel "had brick for stone, and slime had they for mortar." The Sumerians also wrote upon tablets of soft clay and then baked them hard.

Like the Painted Pottery People, the Sumerians learned to employ copper, and gold as well, very early, perhaps even before they arrived in Babylonia. Much of their work in these metals is of a high order and shows a well-developed knowledge of metallurgy. They made a sort of bronze by mixing the molten copper with lead; and they seem to have been the first to develop the socketed spear-head and the battle-ax with the helve passing through the ax-head. The Sumerians also early used regular troops, drawn up in ranks and equipped with huge shields and long spears, something like the famous Macedonian phalanx of much later times. The kings were carried to battle, probably as medicine men rather than fighters, in carts drawn by donkeys—the forerunners of the later horse-drawn war chariots.

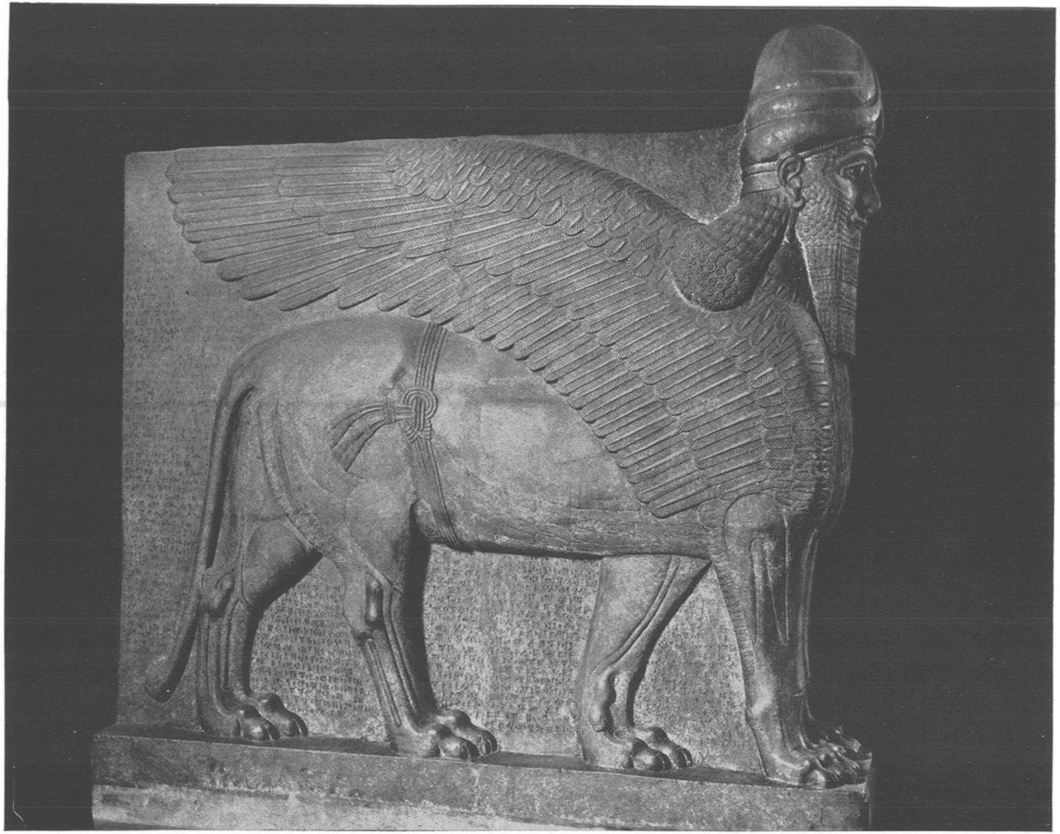
The development of agriculture naturally led to a great increase in population, which in turn gave rise to a need for more and more organization and joint action, directed by the priest-king rulers, in the defense of their fields and herds and in the making of canals, dykes, town walls, foundation mounds, and temples. Navigation, too, was developed; for water transport has always been easier and cheaper than that by land. For ages the peoples along the lower courses of the Euphrates and Tigris doubtless used simple floats made of bundles of reeds, together, probably, with dugout canoes. But later they constructed craft of a larger size, with oars and sails. There was a tradition, indeed, that the Phoenicians, that great sea-faring people of antiquity who lived in historical times on the eastern shores of the Mediterranean Sea, came originally from the Persian Gulf.

In time the Sumerians were absorbed by the Semites, peoples speaking tongues belonging to the same family of speech as ancient Hebrew and modern Arabic. There was much give and take in this process, and each people adopted many elements of civilization from the other. The Sumerian language, however, which belonged to a totally

PLATE 80



Assyrian troops besieging a city. An attendant holds a shield before each archer; a siege engine is battering against the walls; lower left, the casualties; above, three men impaled to terrify the besieged. Inscription below is in cuneiform writing. Photograph in the Library of Congress from original in the British Museum



Assyrian winged lion, which once flanked the gateways of a royal palace to frighten off evil spirits. Photograph in the Library of Congress from original in the British Museum different family, gradually died out of everyday use, being employed in later times mainly for religious purposes, somewhat as the Church in medieval Europe employed Latin.

The amalgamated peoples continued their progress in the civilized arts, and in time certain of their kings conquered the first "world empires" of which history tells. But these were rather small affairs, although their founders gave themselves such lofty titles as "King of the Four Quarters of the World." At the most they only occupied the valleys of the Two Rivers, occasionally extending from the Persian Gulf as far as the Mediterranean. And rarely did these early empires display any permanence, almost always falling to pieces soon after the death of their founders.

Man had not yet found out how to organize wide territories occupied by different peoples into a harmonious whole on a basis of common interest. Usually ancient peoples very naturally met this need of something in common to weld subject races together by extending among them the worship of the conquering king, whom his own subjects had all along adored as divine. This was done not out of pride or vainglory, but for the very practical purpose of making the head of the state a symbol of imperial unity. The various conquered peoples naturally had their own gods, to whom they continued to pay honor as of yore, but to the worship of these was added that of the ruler, as something in which all the peoples of the empire could unite.

At some unknown epoch in the prehistoric past another important domestic animal, the donkey, was introduced into Babylonia, apparently from the valley of the Nile. But not until much later, about the year 2000 B. C., do we first find mentioned that other even more useful animal, the horse. It seems to have reached Babylonia from the mountainous regions to the east. In the course of two or three centuries it revolutionized the whole conduct of warfare no less than did the introduction of gunpowder in the Middle Ages.

Of the origin of the horse-drawn war chariot we have already spoken. That it came originally from the great grasslands far to the north and northeast and that it was connected in some way with the rise of the Indo-European speaking peoples, to whom we ourselves belong, there seems no doubt. Perhaps some of its users came through the passes of the Caucasus Mountains so often traversed by invading armies; for it first appears, and at about the same time, both in eastern Asia Minor and in Babylonia, where it quickly sprang into favor. Its wonderful efficiency as a new engine of war insured that; for war often serves as a great promoter of progress. We should not be nearly as far along as we are in the mastery of aviation, for example, had it not been for the stern incentive provided by the World War. A couple of centuries or so after its introduction into southwestern Asia the use of the war chariot spread to Egypt, where, as we have seen, it thenceforth played a no less important part.

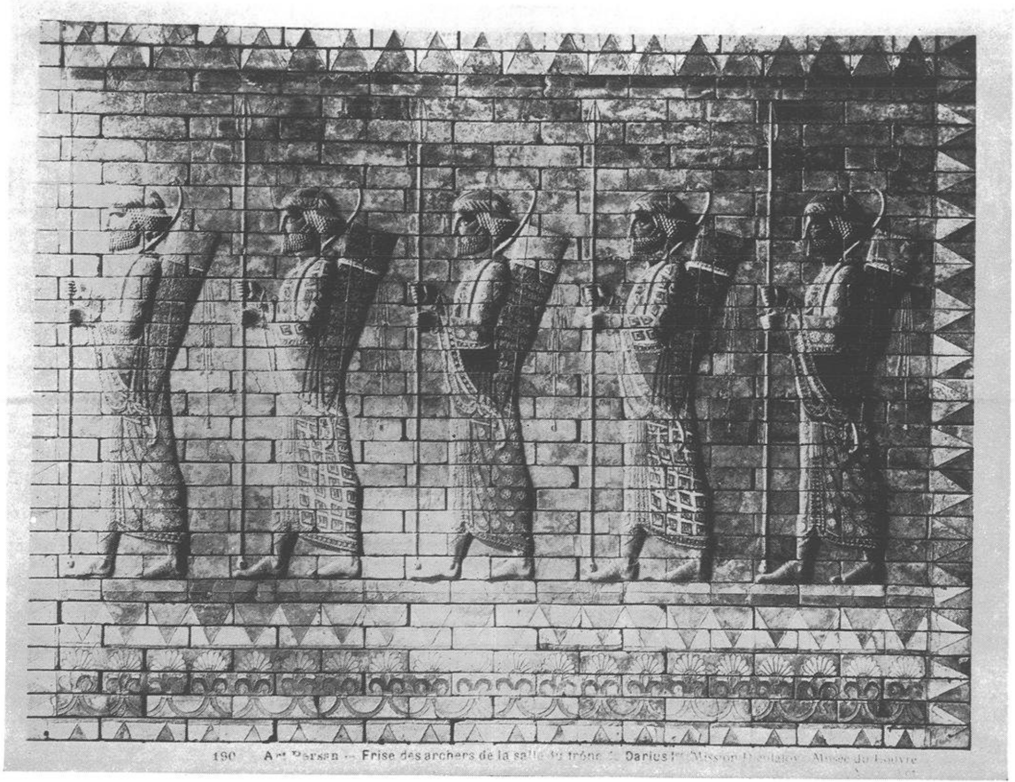
Iron, although known earlier, seems to have begun to come into general use toward the year 1000 B. C. At first only domestic tools were made of it, while weapons continued to be made of bronze; for bronze, as material for sword, dagger, or ax, is superior to untempered iron, which is too soft. Possibly the introduction or invention of effective iron weapons may have had something to do with the rise, about this time, of the kingdom of Assyria; for that country lay near some of the early great iron-working regions of what is now Asia Minor.

For several centuries the kings of Assyria, among whom were some very able men, dominated a great part of the Near East, even for a few years establishing their sway over Egypt, then in its decadence. They introduced many improvements in warfare, especially for the capture of walled towns. The battering-ram was perhaps one of these. The Assyrians, although great organizers for their time,

PLATE 82

Assyrian troops in battle, long before the invention of saddles and stirrups. Mounted attendant holds the archer's horse. Photograph in the Library of Congress from original in the British Museum

PLATE 83



Persian frieze of archers, wrought in glazed and richly colored brick. Photograph in the Library of Congress from original in the Louvre were characterized by ruthless cruelty to the conquered, and they ruled almost entirely by terror. The atrocities described in their records, or portrayed in their art, are savage beyond words. Neither men nor women nor even children were spared from torture; dismembering, blinding, burning, impaling, and flaying alive were the regular accompaniments of their warfare.

Yet in spite of their barbarity in war, in art their achievements were far from primitive. The reliefs sculptured in stone or hammered in bronze on the walls and gates of their palaces throw a brilliant light on the life of the time and do not lack merit in drawing or even in composition. Probably the most widely known examples of the art of the Assyrians are the enormous and majestic winged bulls and lions of stone with which they flanked the approaches to the thrones of their kings. These, like the grotesque lions seen guarding Chinese gateways today, were not primarily decorative but were designed for the very practical purpose of scaring away evil spirits (Plate 81).

About the time that most civilized races had left the Bronze Age far behind and iron had come into general use, the two great Semitic kingdoms, Assyria and Babylonia, were overthrown by Aryan-speaking peoples, the Medes and the Persians. A combination of causes explains the superiority in war of the newcomers over their older and much more civilized foes: Abler leadership; a better military organization; more homogeneous national armies, united in passionate devotion to their kings by ties of blood, language, and faith, all contributed. Considerable credit, however, should also be given to their more extensive and effective use of a new method of fighting—by companies of horse-archers.

The Assyrians had such units, but they seem never to have developed them, depending rather on their infantry and the old and cumbrous war chariots. About such troops swarms of light and mobile mounted bowmen could hover, shooting them down from a distance until the survivors became so disorganized that a final charge could easily break and scatter them. Here again the Indo-Europeans, for such were the Medes and Persians, showed themselves preeminently horsemen. Herodotus tells us that they were taught, from their youth up, three things: to ride, to shoot, and to speak the truth.

The Aryans still walled their cities mainly with sun-dried mud; but they learned to use glazed and colored burnt brick, with which they formed façades depicting processions, warriors, and the like (Plate 83). From Egypt, which they also conquered, they seem to have borrowed the use of the column. From Asia Minor they learned the use of regular coined money, which the Babylonians and Assyrians had not known. Last, but very far from least, it appears to have been the Persians who popularized through the western world the humble but exceedingly valuable hen, originally a native of the East Indies.

The Persians not only enormously extended the limits of the older empires which they had won; but they devised greatly improved systems of organization, communication, and administration. Much of the older civilization they necessarily adopted; but there was little that they did not improve upon, and the debt which the modern world owes to the Persian Empire is incalculable, although often unrecognized.

Ancient Crete

The civilization that thrived so in the fertile valley of the Nile and the no less fertile river plains of Mesopotamia found an equally propitious soil on an island in the Mediterranean, and it is to Crete that we must turn next. Here sprang up from simple Neolithic beginnings a civilization in many ways of a very high order, the first of those that can be called distinctively European, the forerunner of Grecian culture.

Crete possessed an especially fortunate situation for such

Ancient Cretan vases. Note the excellent octopus and floral designs. Photograph in the Library of Congress

PLATE 85

Cretan bath of terra cotta. Drawn from a photograph in the Library of Congress a development. Blessed with a climate on the whole delightful, and lying in the midst of the most beautiful of seas, it was within easy reach of the great civilized regions both of western Asia and of Egypt. In general mountainous, its highest peaks approach or even exceed 8,000 feet above the Mediterranean. There are deep ravines, in some of whose clefts snow remains the year around; and caves, where religious ceremonies were once held. In ancient times there extended over the island forests of cypress and chestnut and oak, in which roamed wild cattle, goats, and other animals.

Crete has thus far yielded no traces of the men of the Old Stone Age, nor of the transitional period which followed. The island seems to have been discovered and settled only during the New Stone Age, perhaps 7,000 or 8,000 years ago, by men of the same physical type as the bulk of the Mediterranean races which we have already described.

Neolithic man in Crete seems to have subsisted mainly on his herds and flocks, and only in a minor degree on agriculture. However, he knew from the first how to make coarse pottery, and he used knives not of flint but of obsidian, or "volcanic glass," brought from the neighboring island of Melos.

Even during their New Stone Age the Cretans were in contact with Egypt, and it may have been from the latter that they learned the use of copper. Thanks to their position, they could rather easily procure tin from central Europe, and they were not long in developing a most remarkable Bronze Age civilization, based essentially upon their maritime trade with other lands. Hence they built up the earliest distinctively naval power known to us. The influence of the sea was strikingly reflected in their lives and particularly in their art.

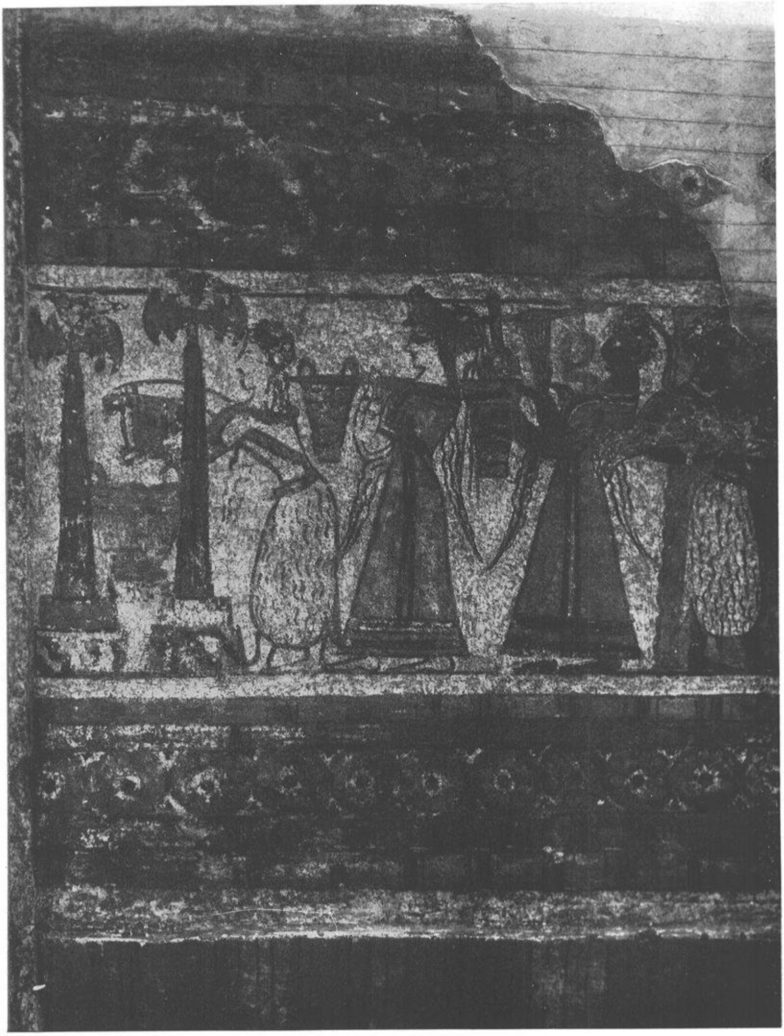
For the most outstanding characteristic of the Cretans was their artistic sense. Here they seem to have been far less rigidly bound by their religious ideas than were the

Egyptians and others, and in consequence gave freer play to their feeling for the beautiful. This is clearly shown by the pottery, the bronze objects, the jewelry, the carved ivory, and especially the painted wall fragments that have been dug up on the sites of their buried towns and palaces and temples. On all these we see naturalistic representations of men and women, of bulls and goats, of dolphins, flying-fish, and tentacled octopuses, of the lily and crocus, the tulip and the rose (Plate 84). There are also graceful spirals, which seem to have come to the Cretans from the north or perhaps from the east.

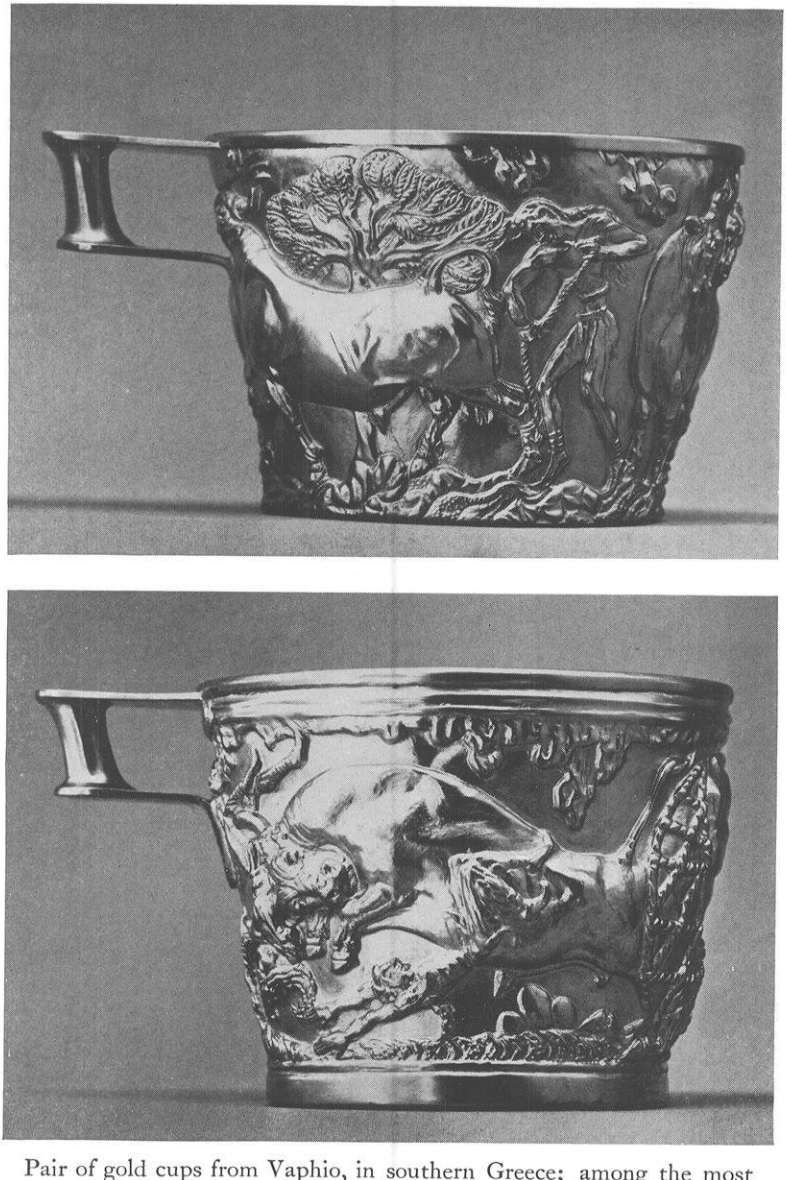
In architecture they betrayed an almost equal genius. They learned in time to build houses of adobe brick several stories in height, with windows and doors, the latter equipped with regular locks. To their palace-temples, for they were both, monumental stairways and rows of stately columns gave dignity and even grandeur. Their systems of drainage remained unequaled in any land until within the past century.

The chief divinity of the Cretans was the Great Mother, who ruled over birth and love and death. The serpent and the dove were among her emblems, and in her worship priestesses and women in general played a predominant part. Scarcely second to the cult of the Mother Goddess were those of the Bull and the Double Ax. In connection with these, huge bulls were baited by unarmed youths and maidens, and legends told among the Greeks long afterward seem to hint darkly of human sacrifice—of enforced tribute from conquered peoples of boys and girls to be gored to death by the savage sacred bull.

Among the Cretans we find strong contrasts in the matter of dress. The women's costumes curiously resembled those of medieval Europe, with long skirts pleated and flounced, richly embroidered and gaily dyed (Plate 86). The men, on the other hand, wore only a kilt, as in the neighboring parts of Africa. Both sexes in cold or rainy weather wrapped themselves in long cloaks, and



Ceremonial procession of Cretan women; from a decorated sarcophagus.
Photograph in the Library of Congress



Pair of gold cups from Vaphio, in southern Greece; among the most splendid of surviving remains of very early Greek art. Photograph in the Metropolitan Museum of Art, New York City they were alike fond of jewelry, bracelets, and rings. Priestesses and priests wore skins, undoubtedly a survival from earlier days.

The warriors protected their heads with conical helmets topped with plumes and sheltered themselves behind enormous leather shields which took the place of body armor. The latter, together with the small round buckler, was imported from Asia by way of Cyprus in the fourteenth century B. C., not very long after the introduction of the horse and chariot, apparently from the same quarter. For weapons the Cretan fighting man had the bronze sword and spear and the bow. The army, though small, was apparently well organized; but they placed their main reliance on the navy, which suppressed pirates and held invaders at bay. How secure the Cretans felt as long as their navy was kept up is shown by the fact that they stopped building substantial fortifications after the sixteenth century B. C.

Although the Cretans seem to have traced their descent through their mothers and not their fathers, they came in time to be ruled over by priest-kings, who every nine years had to renew their "medicine" through secret and awful ceremonies. Earlier, perhaps, as among so many peoples, after ruling for a fixed period of years, possibly nine, they were put to death and replaced by a younger man whose magical force was as yet unexhausted. These priest-kings and their temple-palaces seem to have given rise to the legend of the famous labyrinth and its grizzly occupant, the Minotaur, part man and part bull, who devoured a yearly tribute of youths and maidens.

As yet we are almost wholly dependent on archeological evidence for what we know about the wonderful Cretan civilization, whose very existence was almost unsuspected until a few years ago. Yet it has left an abundance of written records, mainly on clay tablets, if these could only be read. The way in which the old Babylonian, Egyptian, and Hittite records have been forced to yield up their secrets encourages us to hope that sooner or later the Cretan writing also will be deciphered.

The Cretan civilization in time spread to the north—to Greece and the islands of the Aegean Sea. It represented the highest development, in most ways, to which the

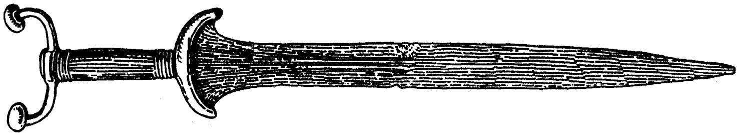


FIG. 102. Dagger or short sword with both blade and hilt of iron; early Iron Age (900–500 B.C.), from Hallstatt, Austria. After von Sacken

Bronze Age ever attained in any land and was at its best about 1400 or 1500 B. C. But its downfall was already at hand. The Indo-European peoples were on their way.

One branch of these, the Achaean Greeks, had already settled in Greece and adopted elements of Bronze Age civilization coming originally from Crete. But after them came another branch of the Greeks, known as the Dorians, also from unknown regions to the north. These, although apparently wielding stout iron swords (Fig. 102), were otherwise far ruder and more barbarous than their predecessors. They swept over the island, devastating it from end to end, destroying the capital of the Cretan sea-kings, Knossos, apparently by a surprise attack, toward the end of the second millenium B. C. The brilliant Bronze Age civilization of the Cretans disappeared, although portions of the people escaped to other lands. A related group, the Pelesati, probably from Asia Minor, known to us as the Philistines, found refuge in Palestine and gave that country their name.

But though the Cretan civilization was dead, its influence still survived. Crete was in a very real sense the forerunner of Greece, and through her of modern Western civilization.

CHAPTER XVI

OTHER CENTERS OF CIVILIZATION

Early developments of civilized life did not take place only in the lands around the eastern end of the Mediterranean Sea. Certain fertile river valleys of India and China also played a part in the same great movement. These areas shared with the former the fundamental elements upon which their progress was based, including domestic animals, cereals, wheeled vehicles, the plow, and bronze.

Ancient India

Seas and the loftiest mountain ranges on earth mark India sharply off from the rest of Asia and the world in general. The northwestern corner has proved most often the contact point with the outside world. Here, in the regions on both sides of the Indus River, as recent excavations have shown, there had grown up, apparently before 3000 B. C., a settled agricultural civilization closely resembling that of ancient Babylonia, with which, indeed, we know that it had at least trade relations. The men of this area used both stone and copper implements, the latter mostly hammered into shape but occasionally cast. They knew bronze though it was scarce, perhaps because the tin necessary to make it was hard to get. Also, they used silver, gold, and lead. That they were peaceful is suggested by the fact that few weapons have been found. They made both sun-dried and baked bricks and built regular towns, with houses, temples, and palaces. They manufactured pottery, plain, painted, and even blue-glazed, and they engraved seals on hard stone.

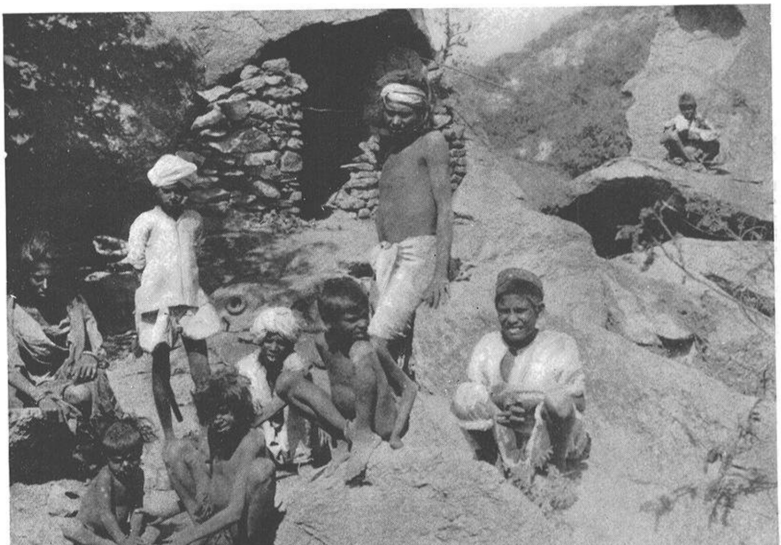
This ancient Indus Valley people knew the elephant, the rhinoceros, the lion, and the tiger, although we do not yet know whether the first-named animal was tamed. Among domestic animals they had the ox, the water buffalo, the sheep, the pig, and, of course, the dog. They did not have the horse, which seems to have been brought in much later by the Aryans. The cart, apparently drawn by oxen, was in use, and almost certainly, too, some form of crude plow. Moreover, these people employed a form of writing on the whole not unlike that of earliest Babylonia.

The discovery during the past few years of this hitherto wholly unknown culture constitutes a triumph of archeological research only second, perhaps, to that of the discovery of the Cretan civilization. We do not know its ultimate fate as yet, although the excellent Archeological Survey of India is yearly extending our knowledge of the ancient past of that wonderful land. It seems certain, however, that many of the advances made five thousand years ago in the Indus Valley, especially those in agriculture, still survive in the life of the present day.

The next great factor known to have played a part in the development of civilization in India was the Aryan invasion, as to the date of which scholars are not yet fully agreed; but it probably took place at some time during the second millenium B. C.

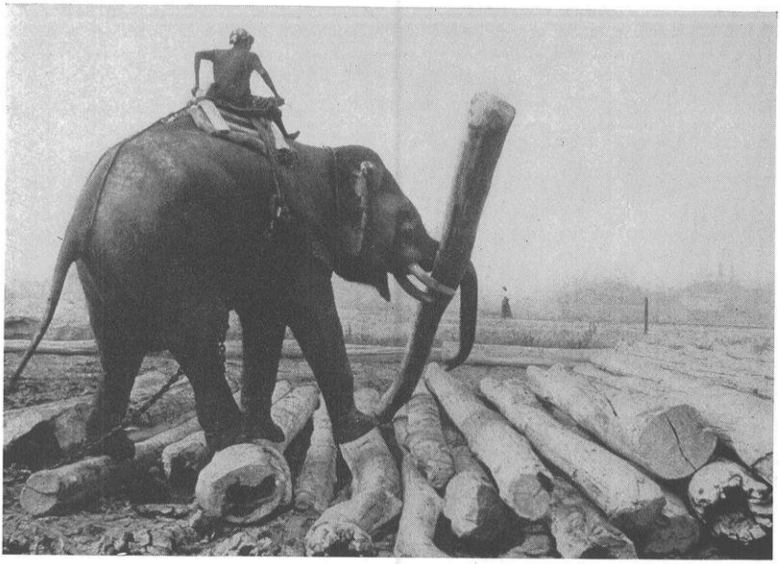
The Aryan-speaking people who pushed through the mountain valleys from central Asia into northwestern India were closely akin to the ancient Persians. Like all the Indo-European peoples wherever we first find them, they were warlike, energetic, and aggressive, and soon established themselves firmly in that part of the Indus Valley known as the Punjab, the "Land of the Five Rivers." When they arrived there, they already had come to use copper or perhaps even bronze, which they may have acquired from Mesopotamia before they invaded India. Again like all the early Aryan peoples, they were great horsemen, though they had not yet learned to fight on

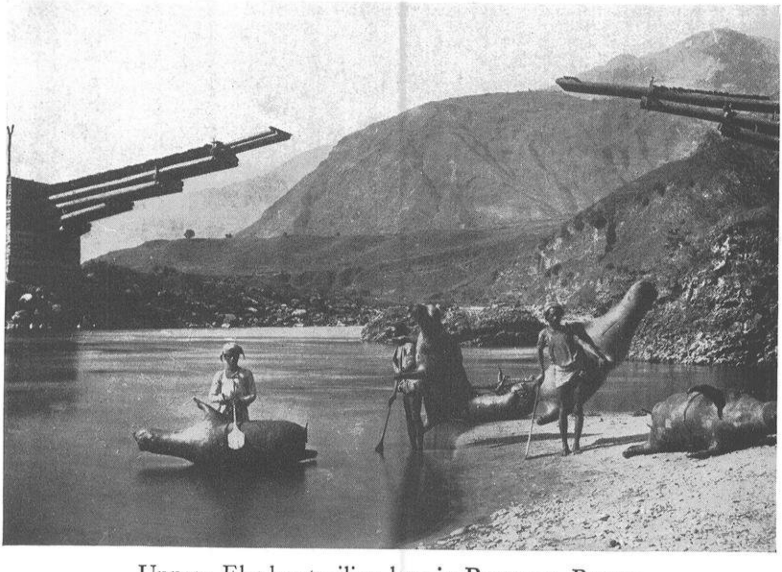
PLATE 88



Upper: Potter of modern India molding his wares. Note the primitive form of the potter's wheel

Lower: Poorer-class habitation of modern India, built of rough stone against a huge bowlder. Photographs in the Library of Congress





Upper: Elephant piling logs in Rangoon, Burma
Lower: Inflated ox hides used as floats, northwestern India. Some Assyrian monuments show same use of skins. Photographs in the Library of Congress

horseback, but used chariots. They also offered horses at their most solemn sacrifices.

The original Aryan-speaking races who settled in northwestern India in time became modified, partly through climatic selection and partly through mixture with the darker-skinned peoples they conquered. Yet there, as elsewhere, they succeeded in imposing their language upon their subjects. As a result, over nearly the whole vast region of northern India today, in sharp contrast to most of the south, Aryan languages are spoken, although the people remain almost wholly of pre-Aryan blood.

Thus sprang up, in the valleys of the Indus and the Ganges, the type of civilization which grew in time to be distinctively Indian. Great cities arose, built for the most part of wood and defended by massive wooden stockades. Tame elephants came to be employed largely in war. The chariot, just as in other lands, went gradually out of use with the development of cavalry. Iron appears to have been introduced about the eighth or ninth century B. C. and to have spread rapidly.

What became of the earlier type of writing in use in the ancient Indus Valley culture remains unknown, but another form seems to have been brought in from western Asia by traders somewhere around 500 or 600 B. C., and to have been gradually adapted to the writing of Sanskrit and other Aryan tongues.

Meanwhile an active development of civilized life had been going on in western Asia. Great monarchies had arisen, accompanied by an intense activity of war and trade, some of whose influences we can trace in regions far removed from their source. Finally on the ruins of the earlier kingdoms, embracing all their former territories and much more besides, arose the mighty Persian Empire, extending from southeastern Europe and Egypt on the one hand to the confines of India and central Asia on the other. The organizer of this vast power, Darius the Great, invaded and annexed the Punjab region of northwestern India toward the end of the sixth century B. C. The new province quickly became known as the richest in the Persian Empire. Herodotus tells us that it paid a yearly tribute of three hundred and sixty talents of gold-dust, equivalent to between five and six million dollars—an enormous sum for those days.

The Persian Empire exerted a very great influence upon India. It inspired the Indians to use stone as well as wood in architecture and sculpture. The Indian courts borrowed much from the stately ceremonial and elaborate etiquette surrounding the Great King, as the Persian ruler was called. Trade was extended and the machinery of government developed. In a word, India underwent at this time a great advance in all that goes to make up what we call civilization. Persia lost political control over northwestern India in less than two centuries; but her influence as a civilizing agent went on spreading.

About two hundred years after Darius's time, northwestern India again fell victim to invasion and conquest, this time by Alexander the Great (326 B. C.). This event, however, although it had some little political effect, influenced the civilization of the country but slightly. In the realm of sculpture, perhaps, it made the deepest impression. The Indians before that time undoubtedly had something in the way of carving, especially in wood, but not much exists to show that they had begun to represent their gods in realistic form, human or otherwise. They seem rather to have used symbols, like the wheel and the swastika. After Alexander's time, however, sculptors came from western Asia, trained according to Greek ideas, and they left a lasting impress on the later religious art not only of India, but of China, Japan, and various other Eastern lands as well.

A few years after Alexander's death, a certain military adventurer named Chandragupta Maurya established in the valleys of the Ganges and the Indus the first great Indian Empire. Although undoubtedly influenced by the career of Alexander, the new ruler seems to have taken for his model the great Persian Empire which had been affecting Indian civilization so strongly for more than two hundred years.

From various sources we learn a good deal regarding the organization of this realm, which from the surname of its founder is known as the Maurya Empire. It lasted for over a century, and its third ruler, Asoka, is remembered to this day as the great patron and supporter of Buddhism. His connection with the latter faith has often been compared to that of the Roman emperor Constantine with Christianity. Of the two men, however, Asoka seems to have possessed by far the finer character. For uprightness, sincerity, tolerance, and humanity, this Indian emperor who reigned twenty-two hundred years ago seems worthy to stand beside the noblest rulers of history. Buddhism, founded over two centuries before his time, had acquired a certain following among the peoples of northern India; but it was Asoka who enabled it to become a great world faith, penetrating far beyond the limits of the Indian peninsula. Under him India became a source of enlightenment and progress for a large part of Asia.

Apparently the great extension of trade under the Maurya Dynasty first brought those countries comprising what we know as Indo-China into direct relations with the world civilization of antiquity. These contacts were no doubt mainly by land, but there exists some reason to believe that the use of sea-going ships, already long known in the Mediterranean, the Red Sea, and the waters to the west of India, spread to the eastern shores of the Bay of Bengal and possibly to the islands of the East Indian Archipelago about this time.

Ancient China

There still remains to be described one other great civilizing center in the Old World, the region which we now call China.

Very little archeological research has as yet been undertaken in that country, particularly in connection with its early periods. We know enough, however, to justify us in trying to reconstruct the main outlines of its story, which parallels closely the course of events in the other great river valleys we have been studying—those of the Euphrates and Tigris, the Nile, and the Indus.

China proper falls naturally into two main divisions, a northern and a southern. The latter is rugged, in parts even mountainous, and covered with a network of perennial streams, while the former, on the other hand, consists of a great alluvial plain bordered by hilly regions. Here there extended, in recent geological ages, a shallow sea, which gradually filled up with the earth brought down by various streams, particularly the Yellow River, known, on account of its terrible floods, as "China's Sorrow." Over all of China, north and south alike, there once stretched a vast expanse of forest, interspersed, where the rivers had not yet completed their work of filling in, with wide marshes, swamps, and lakes. Remnants of these still exist.

There is some reason to believe that southern China, in times much more recent than the Old Stone Age in Europe, was occupied by a race of Negritos—curly-haired pygmies like those still existing in out-of-the-way regions in the Philippines, New Guinea, and elsewhere. In time this race was exterminated or absorbed by successive waves of brown or yellow-skinned peoples coming from regions farther north—the ancestors of the present-day population—who brought with them a simple, undeveloped form of New Stone Age culture akin in its main features to that which once overspread a large part of the globe. The invaders built huts, used implements of polished stone, and made a coarse gray pottery marked with impressions of matting or basketry. They also practiced a sort of rudimentary agriculture, supplemented by hunting the game with which China at that time swarmed, and fishing in the streams well-filled with fish, turtles, and other creatures. These Neolithic Chinese seem to have been organized in clans tracing descent through mothers instead of fathers and to have practiced a sort of nature worship accompanied, as so often elsewhere, by human sacrifice.

Near the very end of the New Stone Age there appeared in northern China a type of painted pottery quite different from the coarse kind already known. This type of ware occurs also in various other parts of the world. In some regions, as in the southwestern United States and in Peru, there can be no doubt of its independent development. In the Old World, however, painted pottery has been found, together with a whole group of other culture elements, along a belt extending from China on the east to Europe on the west. In this case an ultimate common origin seems possible. As one recent investigator has put it, the idea, at least, of painted pottery was in the air, although in each locality it underwent a largely independent development. Ancient man in China did not adopt it very widely and in time its use died out, while the older and much more widespread coarse gray ware continued to be made down into historic times.

The agricultural peoples inhabiting central Asia between 3,000 and 4,000 years ago had a well-developed Bronze Age culture, and it seems most likely that from them the ancient Chinese learned the use of that metal The archeology of southern Siberia and Turkestan is only beginning to be investigated, mainly by Russian scholars and explorers; but these have already discovered enough to suggest, at least, how the ancient Chinese came to possess a civilization so strikingly similar in its fundamentals to those which once flourished in western Asia.

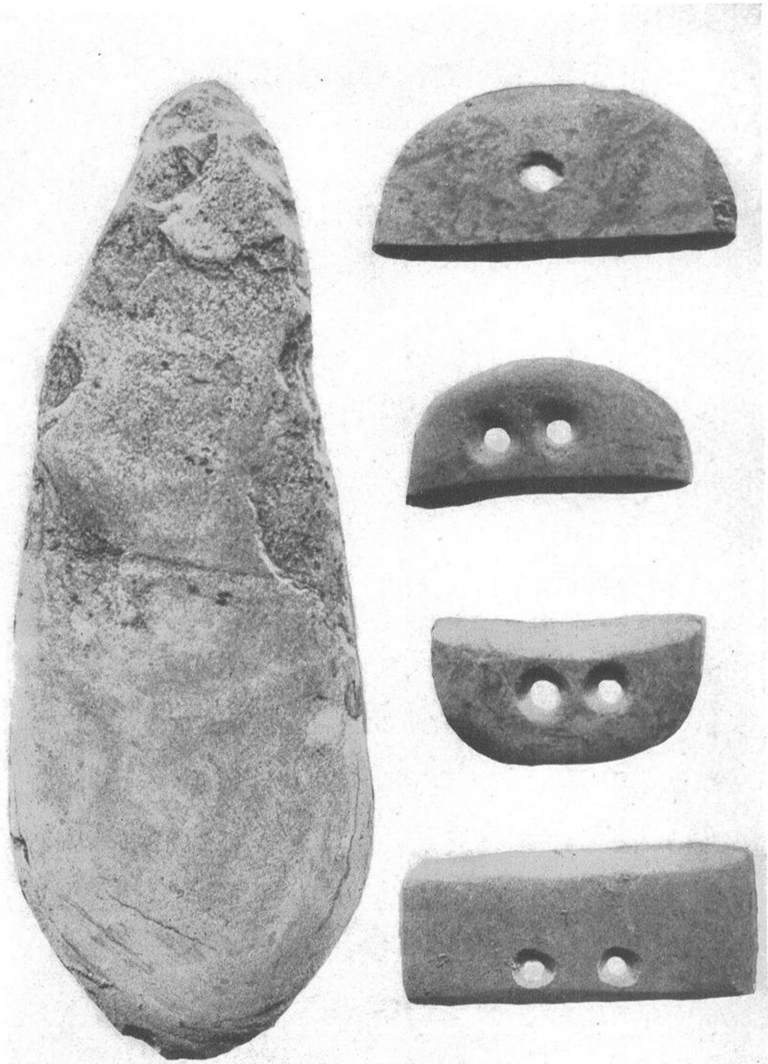
It seems clear that the Chinese, after independently developing a high type of New Stone Age culture with a social organization composed of chiefs, nobles, and common people, acquired from their neighbors to the northwest numerous elements of a still higher civilization. In many cases, doubtless, they did not import the inventions themselves (peacefully or otherwise) so much as the concepts underlying them. These, finding in the Chinese mind a fertile soil, took root easily and developed along independent lines.

Thus we find many inventions, processes, and ideas, which we know underwent a long evolution in the West, appearing quite suddenly on Chinese soil, fully developed. An instance will illustrate this point. In the West we find a regular series of weapons, beginning with the Neolithic flint dagger and passing step by step, through various copper forms, into the fully developed Late Bronze Age sword. China contains no trace of this evolution. There we find appearing all at once highly finished swords cast in one piece with the hilt, as they were cast in the West only toward the very close of the Bronze Age. We must infer that the ancient Chinese did not invent bronze swords for themselves, but got the idea already fully developed from their neighbors.

The knowledge of bronze reached China as one element of a whole culture complex—a well-developed civilization. Far down into historical times, however, this type of culture, although of extraordinary brilliance, remained almost exclusively the possession of the upper classes, who used bronze weapons and war chariots in fighting. A very rigid type of family organization headed by the father, through whom descent was traced, characterized their social system. Northern China came to be occupied by a multitude of little city-states not unlike those of earliest Babylonia, each of which was ruled over by a princely family, as its religious as well as its political head, whose ancestors were among the chief divinities worshiped. The land belonged to the princes and nobles, much as it did in medieval Europe.

The masses, on the other hand, long remained in much the same condition in which they had existed during the

PLATE 90



Stone hoe and knives, neolithic China. Note how the polishing of the hoe is confined to the lower portion of the blade. Photograph by courtesy of Mr. Peter J. Bahr

Bronze sacrificial vessel of the Chinese Bronze Age, for use in the worship of ancestors among the feudal nobility. In the Freer Gallery of Art, Washington

New Stone Age. They went on living in their own clan villages and tilling the soil, a large portion of the produce being turned over to their masters and landlords. Ancient Chinese writings state specifically that the common people had no part in the ancestor worship of the aristocracy. They undoubtedly kept up, however, the practice of their old nature worship, with its belief in magic, and we know that the far more civilized ruling classes put down human sacrifice only with difficulty.

Again, just as in Babylonia, the numerous small city-states tended to coalesce into larger units which came in time to form in northern China a sort of loose confederacy, with a priest-king at the head regarded as in some way related to the Sky God. In fact, down to the very end of the Empire, in 1911, the real title of the Chinese Emperor was "The Son of Heaven."

The historical period in China only begins about 1000 B. C., and records continue very scanty and full of gaps for some hundreds of years longer. Legendary accounts exist of early emperors and dynasties reaching back even before 2000 B. C., but the researches of modern scholars, largely Chinese themselves, have stamped these as unworthy of credit. Our first actual written accounts, of a very fragmentary nature, relate to certain kings of the Shang Dynasty who ruled about the end of the second millenium B. C.

An invasion from the west overthrew this dynasty shortly afterward. Some of the new rulers seem to have been great conquerors who extended their authority beyond the valley of the Yellow River. But the power of the royal house soon dwindled, and by the eighth century B. C., the country had come to be divided into a number of practically independent states. These states, held together only loosely by a common culture and a vague allegiance, more religious than political, to the "Son of Heaven," waged incessant wars among themselves and against the surrounding barbarians. That part of China south of the Yangtse River remained uncivilized and almost unknown.

Most of the art of Bronze Age China is typified by geometric forms of a symbolic nature, which undoubtedly were based on designs already in existence in that country during its New Stone Age. These seem to have been originally carved on wood or molded on pottery. Their sacred and magical character led to their retention for the decoration of weapons, ornaments, horse trappings, and the great bronze sacrificial vessels used in connection with the ancestor worship of the feudal aristocracy (Plate 91).

During the earlier part of the Chinese Bronze Age, the ownership of land formed the basis of wealth. Trade was carried on by barter, eked out with the use of cowries as a medium of exchange. But in time true money, in the shape of copper models of hoes, spades, and knives, came into being. This helped, as elsewhere, to undermine the old social system through the possibilities which it offered for the accumulation of wealth other than that in land. Thus the nobles could no longer monopolize riches.

A radical alteration in the method of fighting, which took place shortly after the middle of the first millenium B. C., contributed immensely to the overthrow of the old feudal organization. This change corresponds precisely to that which had already occurred in the West a few centuries earlier.

The ancient Chinese records show us that the war chariot was the mark of a nobleman. Only despised peasants fought on foot. The story has come down to us of a battle of the Chinese against the barbarians to the north—the ancestors of the Tartars—which illustrates this clearly. The barbarians had not yet learned to fight on horseback. In fact their tactics of guerilla warfare seem to have pretty much resembled those of the Indians of eastern America—the Iroquois and others. The Chinese commander saw the impossibility of contending successfully from chariots against such nimble foes, so ordered his nobles to dismount and fight on foot. This they refused to do as beneath the dignity of their class. The commander then had one of them beheaded, whereupon the rest obeyed and gained the victory.

As we have seen, men probably learned to fight on horseback, sometime before 1000 B. C., in the open grasslands of southeastern Russia and western Asia. At first mounted

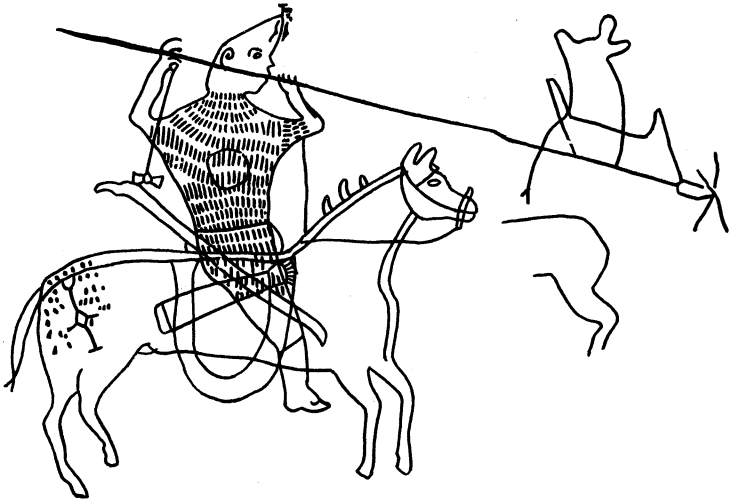


FIG. 103. Ancient rock engraving of a mounted warrior, Siberian Iron Age. From Laufer

warriors appear to have been armed with spear and sword, like the footmen; and in the west this type of fighter developed into the heavy-armored knight of the Middle Ages. But in northern Asia fighting on horseback was taken up by peoples who used the deadly composite bow made of strips of wood, horn, and sinew, glued tightly together and often neatly covered with birch bark (Plate 92). This weapon, while it had to be kept dry, shot far harder and farther than the simple bow made of a stave of elastic wood alone. The difference between the two types of bow has been aptly compared to that between the old smoothbore musket and the modern high-powered rifle.

Companies of swift horsemen thus armed began early in the first millenium B. C. to make their influence felt in western Asia, where they terribly devastated wide regions. Gradually this method of fighting spread eastward across Asia, until sometime about 400 or 500 B. C., it appeared on the northern borders of China, and the Chinese had to adopt it in self-defense.

Their doing so contributed in more ways than one to the overthrow of the whole feudal system. Not merely could bodies of light horse-archers ride rings around an old-fashioned army, composed only of infantry and chariots, and riddle it with arrows as they pleased. The social change involved was far more significant than this. Chariots had always been necessarily a mark of wealth, which under the feudal system meant high birth, but now almost everybody could get hold of a horse to ride and a bow to shoot. Very much in the same way did the introduction of gunpowder help to bring about the overthrow of the feudal nobility in medieval Europe.

About this time, too, iron, already long used in northern China for domestic utensils and implements, began to be fashioned into weapons—especially long, straight swords, often with bronze or jade mountings. These proved far more effective in battle than the old bronze swords. Bronze continued, however, for a time to be used for armor; but here, too, iron eventually replaced it.

Besides these material changes in Chinese civilization, ideas developed which proved scarcely less influential in undermining and eventually destroying the ancient feudal system. The period between 500 and 250 B. C. saw the rise of several great thinkers and teachers who founded different schools of philosophy. Their maxims exerted a powerful influence upon Chinese life in all its aspects. New ideas took possession of the minds of men. The time was ripe for changes of the most far-reaching nature.

Asiatic archer and slingers; to illustrate the composite bow built up of different materials, typically wood, horn, and sinew. After Forestier, *The Roman Soldier*

Chinese bronze helmet. Used after the introduction of the long iron slashing sword. Photograph by courtesy of Mr. Peter J. Bahr

The opportunity brought the man. In the latter half of the third century B.C. there arose in northwestern China a great conqueror. By a series of masterly campaigns he annexed first the Yangtse Valley, then the ancient Chinese states in the basin of the Yellow River, and finally the hitherto independent and barbarian south. He abolished the ancient line of priest-kings and swept away the old feudal aristocracy. In their place he appointed officials, with himself as "First Emperor" supreme over all. Thus was established the Chinese Empire, destined to last for over two thousand years (from 221 B.C. to A.D. 1911). The man who founded it was Ch'in Shih Huang-ti.

CHAPTER XVII

PREHISTORIC MAN IN THE NEW WORLD

THAT North America has been joined to Asia at various times in the geologic past we know. A most striking proof of this is the very close resemblance between certain forms of animals living in the two hemispheres. Thus we find true alligators—not crocodiles—in the rivers both of China and of North America; while that curious animal, the tapir, occurs both in southern Asia and in tropical America, and the American bison, popularly miscalled the "buffalo," is much like his cousin of the Old World. The same is true of the moose, or true elk, which occurs in various closely similar forms from Scandinavia right across Siberia and Canada to Maine. The animal we call "elk" is not really the elk at all, but was mistakenly so named by the early settlers. This list of resemblances might be extended almost indefinitely.

The same is true of humanity itself. The type of man living in the New World when it was discovered by Europeans is of the same species as that found everywhere else. It is especially close of kin to races still found in various parts of central and northeastern Asia. There, just as in the Americas, we find people with brown or copper-colored skin, dark eyes, and coarse, straight, black hair. If dressed alike, in many cases they could not be told apart.

Just when man first entered the Western Hemisphere we can not yet say with any assurance. One thing, however, is certain, that he originated in the Old World and only arrived much later in the New. It is possible, of course, that some of the earlier races of man may have wandered across into North America; but if so, they perished without leaving any traces that have so far been definitely identified. The American Indians, the only race known certainly ever to have lived in the Western Hemisphere before the white man came, seem not to have arrived there until toward, or perhaps even after, the close of the Ice Age.

We must not suppose, however, that they invaded the New World all at once, in a large body. On the contrary, the process must have been a very gradual one, going on through several thousands of years. It was only after northeastern Siberia itself had been occupied by man that little groups began drifting over into North America. Whether the land connection between the latter and Asia was still in existence when this first occurred, or whether it had already sunk beneath the sea, we do not know. But however the first man in America arrived, whether on foot or by canoe, it seems quite certain that he reached his new home as a mere savage—a hunter and food-gatherer. He had learned how to make various forms of stone tools, but we can not say whether he yet had the bow and arrow. The dog also no doubt accompanied him to his new home.

Once settled in the New World, the ancestors of the American Indians gradually multiplied and spread out over more and more territory. In this way the whole of the Western Hemisphere was slowly peopled.

It was not, however, until long afterward that the first beginnings of settled agricultural life began to appear in various favorable localities. Several reasons render it practically certain that the ancestors of the American Indians did not bring with them any cultivated plants from the Old World. Those which we find grown later are of distinctively American species.

Hunting and food-gathering first began to give place to food-growing and a more settled life probably in the high plateau areas of the western portions of both continents. In these regions, elevation and a somewhat dry climate prevented the dense growths of forest and bush which render farming operations so difficult in many places even today. In parts of this plateau region, indeed, irrigation was found necessary in order to induce crops to grow at all. The ingenuity developed in meeting this need led in turn to still further advances in civilization.

This Archaic culture, as it is called, included not merely food-planting but also the making of pottery and the weaving of baskets. The New World remained wholly ignorant of the plow until Europeans brought it in. The hoe, of stone, bone, or shell, and the planting-stick constituted the farming implements, and the women did most of the field work for the reasons given in Chapter XII. Great reliance was placed on magic and religious ceremonies in trying to assure an abundant harvest. Out of this developed in some regions the practice of human sacrifice on a scale rarely if ever equaled.

Doubtless much experimenting, conscious or otherwise, with different wild plants took place before these prehistoric Americans determined the most useful ones. The plant destined to prove of the greatest value was maize, or Indian corn. ("Corn" properly means what we in America call "grain.") This seems most probably to have been developed very early by cultivation from a wild grass on the highlands of Mexico. It spread steadily both north and south, as more and more people came to recognize its value. This happened the more easily because in war, while the men prisoners were usually killed, the women were more apt to be carried off into captivity; and it was precisely they who knew and could teach their captors the processes of primitive agriculture. In time maize thus spread over a great part of the Western Hemisphere, where, like wheat and rice in the Old World, it became the basis of civilization.

Beans and squashes probably ranked next in importance among American food plants. "Irish" potatoes were grown to some extent in Peru, and sweet potatoes seem to

PLATE 94

American Indians hunting the moose with stone-headed spear. Painting by George de Forest Brush, in the National Gallery of Art, Washington

have come from the Amazon Valley, as did manioc, or cassava, from which tapioca is made.

This Archaic culture—we can hardly speak of it as a civilization—eventually spread over a somewhat wide area. At length, probably sometime after 1000 B.C., it began to develop certain well-marked local varieties which gradually assumed higher forms.

The Civilization of the Mayas

It is still too early to say where the first marked local variation took place. We find, for example, rough stone buildings of extremely early date on the Peruvian plateau, and there are other very ancient remains elsewhere; but we may safely say that the civilization developed by the Maya Indians of southern Mexico and Guatemala was among the first. They, like all other native American peoples, lacked several things without which we could hardly imagine a true civilization getting along at all. They had, for example, no work animals, no metal tools, and no wheeled vehicles of any sort. Yet even without these aids, the Mayas made remarkable progress.

Fig. 104. Maya sacred design of the Feathered Serpent. Note the human head in the distended jaws. After Spinden

It would be a mistake to think of them, however, as a wholly civilized people. The masses, who did most of the hard work, lived pretty much as their ancestors had lived, with very few of the luxuries or even comforts of life. Only a small upper class, composed of priests and war leaders, supported in leisure by the toil of the common people, had time to evolve a higher civilization. The Spaniards found it easy to conquer them mainly for this reason. They had only to destroy the civilized ruling class, comparatively few in number, and the old culture was gone forever.

It seems probable that the Mayas first developed in wood the remarkable art and architecture which they later

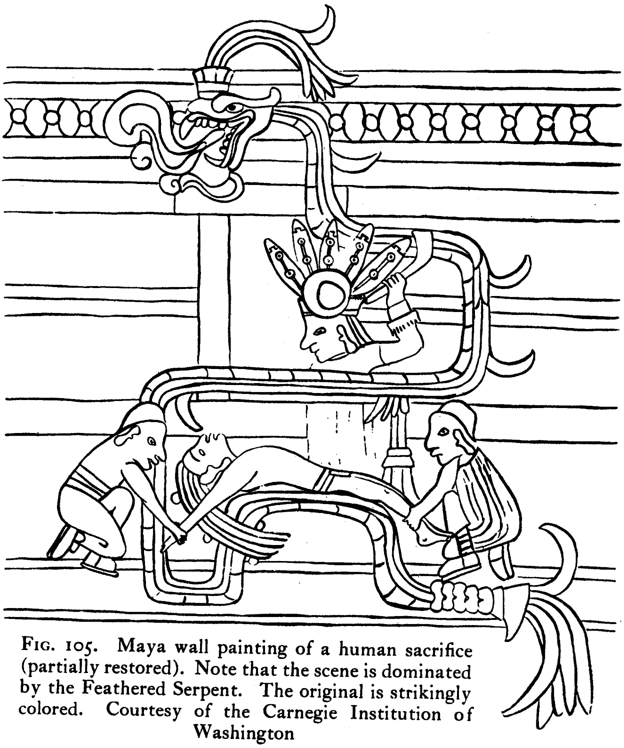
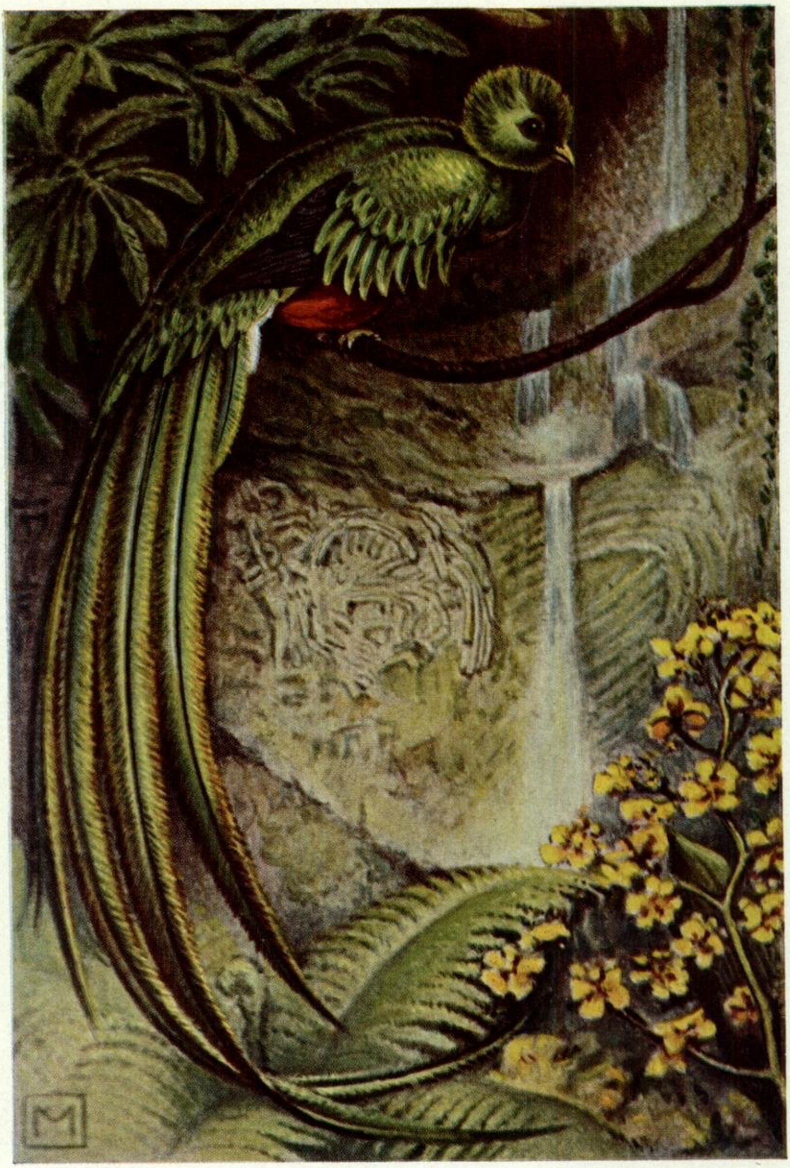


FIG. 105. Maya wall painting of a human sacrifice (partially restored). Note that the scene is dominated by the Feathered Serpent. The original is strikingly colored. Courtesy of the Carnegie Institution of Washington

carried out in stone. Their art was extremely elaborate, symbolic, and, to us, grotesque, and its meaning is often difficult to interpret, though it undoubtedly had a magical · religious significance, as among other primitive peoples. A very frequent design was that of the Feathered Serpent (Fig. 104), depicted in all sorts of forms. The jaguar, the turtle, and the sacred bird known as the quetzal, or re-



The quetzal, or resplendent trogon, prominent in the religious and esthetic life of the Central American peoples of antiquity. After Knowlton

splendent trogon, also occur often. Sometimes there appear monstrous half-human figures with exaggerated noses suggesting the long, flexible snout of the tapir. Priests, chieftains, and warriors are shown decked out in the most elaborate costumes and feathered decorations imaginable. Again we see wretched captives, bound and kneeling, or being sacrificed to some god.

The Mayas developed architecture to a point no less advanced. The dwellings of the common people, probably quite similar to the palm-leaf huts used by their modern descendants, have long since disappeared. The great structures of dressed stone and concrete that stand, ruined and deserted, in the depths of the tropical forests, were mainly religious in character, as their nature clearly shows. Among them we find huge pyramids, formed of solid masses of rubble and earth faced with cut stone or a sort of cement. A kind of limestone which can be split rather easily into rectangular blocks occurs over much of the Maya area, so that the labor involved in quarrying and shaping these with nothing better than stone tools was not so enormous as it seems at first sight. As the pyramids were not tombs like those of Egypt, but foundations for sanctuaries, they rarely contain passages or rooms. Sometimes they are "stepped," or built in successive terraces, and on at least one side there always appears a great ceremonial staircase, often flanked by colossal stone serpents.

On the flat summits of the pyramids stood temples, occasionally rising three stories in height, and topped sometimes with "roof-combs," or lofty ridges, to make them seem more imposing still. There were, too, long galleries in which the officiating priests probably had their habitations.

The builders knew the corbeled or "false" arch, but did not often use it, the vaults being more commonly of solid concrete. Owing to the limitations imposed by the method of construction, rooms rarely measured more than twelve feet in width, and often much less. A sort of stucco, sometimes adorned with paintings of processions and other ceremonials, usually coated the walls; or wide spaces would be covered with dressed stone sculptured in relief

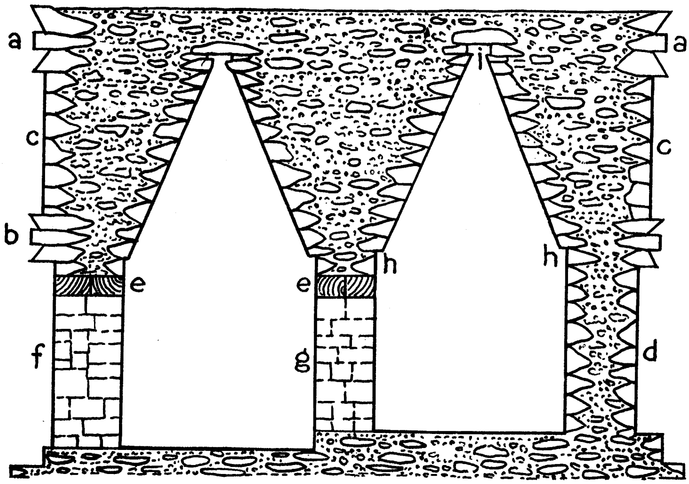
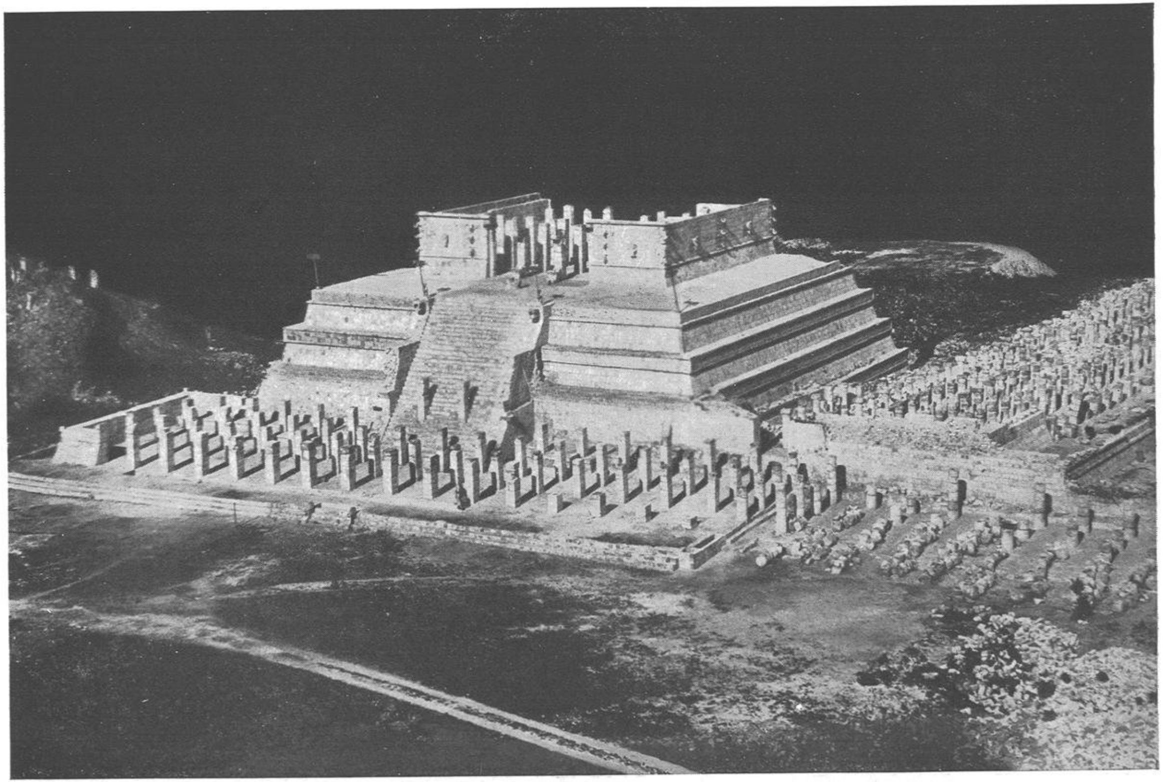


FIG. 106. Diagrammatic cross-section of a Maya building, to show that the stones forming the facing of the vaults are not held in place by their own weight, as in the true corbeled arch, but by the concrete in which they are embedded. After Spinden

with similar scenes. Both reliefs and paintings were tinted in vivid hues, among which green, orange, and red predominated.

Often the Mayas arranged their pyramids and buildings around the sides of a plaza paved with slabs of stone. We find also what have been called "ball courts," where a game somewhat like our basketball was played as a part of the religious ceremonial. Here and there about the sanctuaries stood tall stone slabs, known as *stelae*, covered with elaborate carvings including brief inscriptions.

For, as one of their great achievements, the Mayas developed a system of writing very distinctive in character. This doubtless grew up out of primitive pictographs to



Ruins of a Maya temple, cleared of the tropical forest and bush. In the decoration of their buildings the Mayas made effective use of color. Courtesy of the Carnegie Institution of Washington

Maya pyramid. The pyramids of the ancient Mayas were not tombs, like those of the Egyptians, but foundations for shrines and temples. Courtesy of the Carnegie Institution of Washington

FIG. 107. Maya wall painting. The same type of thatched huts is still in common use among the Indians of Central America. Courtesy of the Carnegie Institution of Washington

which definite meanings came to be attached, and had apparently even reached the point where sounds as well as ideas had begun to be represented. So thoroughly, however, did the early Spanish conquerors do their work of destruction that the key to this writing has been lost. Many efforts have been made to regain it, but so far we can do little more than read the dates which the inscriptions often give.

Among their other inventions, the Mayas included that of a calendar based in part on the changes of the moon. Although complicated and showing signs of gradual development, this was accurate and serviceable to an exceptional degree. It says much for the astronomical and mathematical knowledge of its inventors.

Of their social, political, and religious systems we know far less than we could wish. It is evident, however, that, as with all early cultures, no clear distinction was drawn between things sacred and things secular. Their whole civilization was closely interwoven with the religion which had inspired and shaped it. There were helpful gods and hurtful ones, and the essence of worship was to gain the good will of the former and keep in check the latter. To help achieve these ends, they threw into the *cenotes*, or huge sink-holes in the limestone, which often held a pool of water at the bottom, precious offerings of gold and carved jade and living men and women.

The Mayas were beginning to acquire some knowledge of metals, including both gold and copper, which were, however, rather rare and served almost or quite exclusively for the manufacture of ornaments, probably all invested with a religious symbolism. Apparently they had begun to make no really useful tools or weapons of copper, but only ceremonial forms based on stone originals.

The Mayas had also become expert potters and had developed weaving and basket-making to a high point. They cut jade and other semiprecious stones into grotesque and fantastic but often beautiful forms. Their sculptures and wall paintings show that they made great use, for decorative purposes, of the plumes of various brightly hued tropical birds. The gorgeous headdresses and other ornaments of feathers must have helped give their stately religious ceremonies an aspect of the utmost magnificence.

Thanks to the dates on the Maya monuments, we can reconstruct, if only in meager outline, the history of this most interesting people. According to tradition, they came from the north. Their civilization is now believed to have had its beginnings pretty far back in the first millenium B. C. It first reached its full bloom during the early centuries of the Christian Era, in what is known as the Old Empire, centering mainly in Honduras, Guatemala, and southern Mexico. Among ruins belonging to this early period are those of Copan, in western Honduras; Quirigua, Piedras Negras, and Tikal, in Guatemala; and Palenque, in the Mexican state of Chiapas.

Between A.D. 600 and 960, a shift of the Maya center of civilization took place, for some unknown reason, from the comparatively hilly south to the wide, level, jungle-covered plain of northern Yucatan. Here, between A. D. 960 and 1195 flourished the New Empire. Among the ruins found in this region, along with many others, are those of Uxmal, Chichen-Itza, Labna, and Tuloom.

Then followed a period of decline, hastened if not indeed caused by civil war. The appearance of Toltec or Mexican influence, clearly visible in the architecture and sculpture of the time, characterizes this epoch. As we have pointed out, the civilization of the Mayas was never the possession of the whole people, but only of a very small upper class. Hence adverse conditions of any sort easily affected it, and it was already far gone in decay when the Spaniards arrived. A remnant, however, survived in the remote interior of Guatemala, about Lake Peten, until the beginning of the eighteenth century, when it, too, was destroyed.

It must be emphasized that the surviving Maya ruins are in reality only religious or, to use a modern expression, civic centers. The cities themselves, the homes of the common people, built of highly perishable materials, must have stretched for considerable distances about these groups of pyramids, sanctuaries, and so-called "palaces" of cut stone and concrete and stucco. Traces of these humbler dwellings, in the shape of vast numbers of low mounds, still occur in the depths of the tropical forests, which have long since resumed their primeval sway. There are also remains of boundary walls and even paved roads, suggesting a former numerous population and a lively commercial and social life.

It is noteworthy that with few exceptions, as at Tuloom, on the eastern coast of Yucatan, no evidence exists to suggest that the Mayas ever fortified their cities. Nor do they bear any sign of having been destroyed by violence. They were not primarily commercial or military or even political communities in our sense, but were first and foremost religious centers, and their sacred character doubtless helped protect them from molestation. Furthermore, during the greater part of their history there seem to have been no foreign foes capable of threatening them seriously.

The civilization that produced them was essentially religious, artistic, and intellectual in nature, rather than warlike. Nevertheless, as the Spaniards found to their cost, the Mayas could fight, and fight well, and it may be that in the days of their prime they felt their armies afforded them the protection which some people might seek in fortifications.

Be that as it may, their civilization perished, but its influence spread far and wide over the surrounding regions in somewhat the same way as did that of the Greeks in the Old World. And the Mayan people themselves remain, an industrious, cleanly, hospitable, and often highly talented race, forming a valuable element in the present-day population of Central America.

The Toltec Civilization

The Mexican plateau advanced in civilization more slowly than the Maya region, although in Mexico maize (and through it the possibility of progress) seems to have developed. But in time a somewhat different although related civilization grew up there—that of the Toltecs.

Among other structures, these people erected great pyramids, in some instances even larger than those of the Mayas, but in general of poorer construction and therefore less well preserved. In their architecture the Toltecs made no use of the principle of the vault, so conspicuous in Maya buildings; and they differed in other respects as well. But although not quite so advanced, they seem to have been more aggressive and warlike than the Mayas. While the latter, early in the second millenium A. D., had begun to decline, at the same period the Toltec culture was thriving and expanding. It is accordingly at this time that we find traces of its influence in the Maya civilization.

About the twelfth and thirteenth centuries A. D., the culture of the Toltecs, for reasons not yet fully understood, also began to decay, though it was very far from disappearing entirely. When the Spaniards arrived, under Cortes, in 1519, certain of their cities and centers of worship were still flourishing. Much of southern Mexico, in fact, was then occupied by civilizations differing from one another to some extent in outward aspect, but essentially akin in their fundamentals.

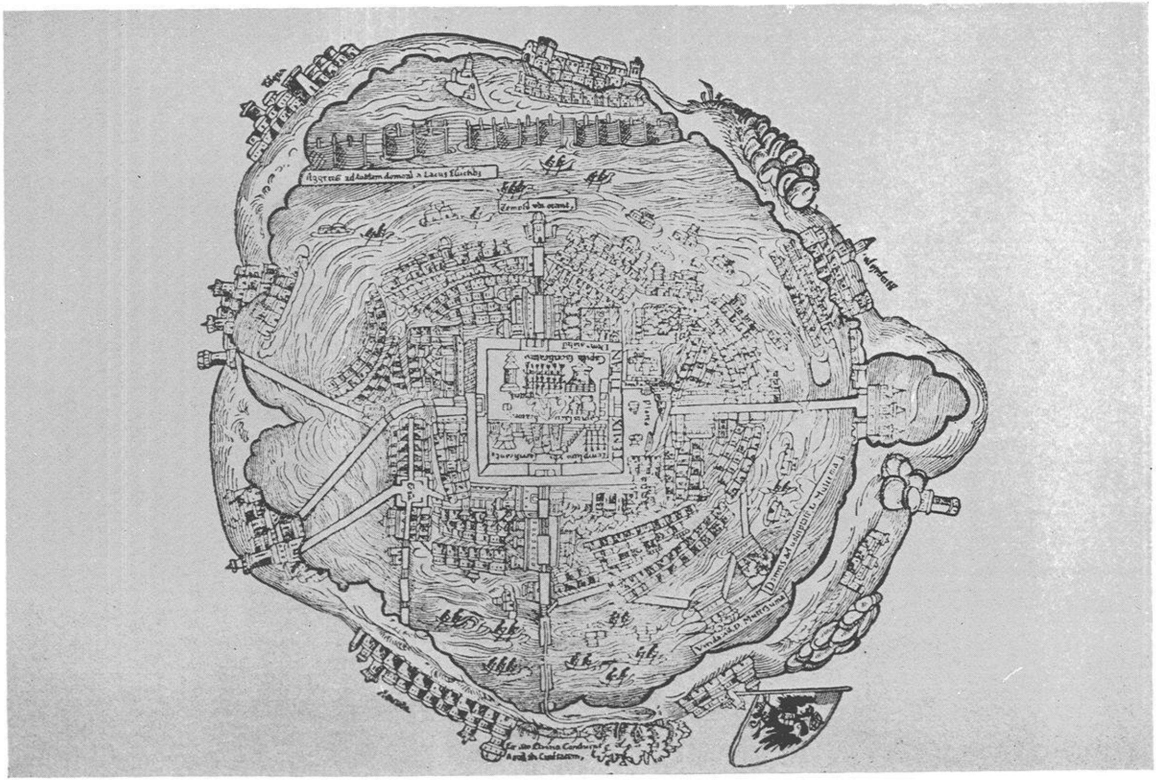
The Aztec Civilization

We have come, however, to associate the history of the Mexican plateau especially with the people called the Aztecs. The latter, according to their own accounts, began as a barbarous and uncivilized tribe in a region to the north of that in which the Spaniards found them. Thence they moved gradually southward. About six hundred years ago, finding themselves at war with their more civilized neighbors, they took refuge in certain swampy islands in the shallow lakes of the valley of Mexico. Here they lived a sort of amphibious life, partly on land and partly on the water, and steadily absorbed more and more of the higher culture of their neighbors.

In their island refuge, approximately in A. D. 1325, they founded their capital city of Tenochtitlan, later called Mexico. In time they filled in and built over more and more ground, erecting palaces, temples, and pyramids, as well as great communal houses. Long causeways connected this island stronghold with the mainland, the sole other means of approach being by water. Here the Aztecs dwelt secure from attack and by degrees extended their power. About A. D. 1430 they formed with the nearby cities of Tezcuco and Tlacopan a league in which the leading place was held by Tenochtitlan. The war-chief of the latter, who also possessed many priestly attributes, was its supreme head. The Spaniards called Montezuma an "emperor." He was in reality a priest-king of a very ancient type, such as the more advanced peoples of the Old World had outgrown thousands of years before.

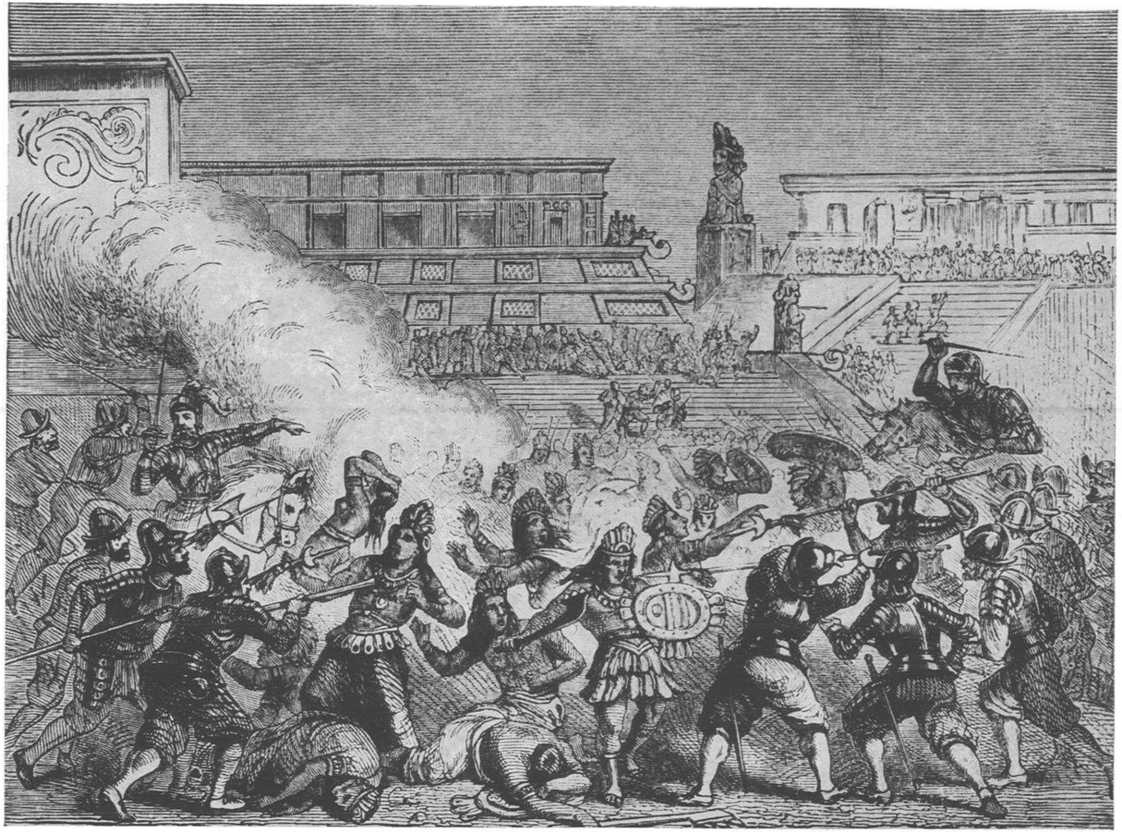
Aztec society, however, was far removed from simple savagery. It had a highly organized priesthood and what was tending to become a real hereditary aristocracy; it had warriors, craftsmen, laborers, peasants, and slaves. The upper classes kept the masses of the people under a severe social discipline, through which they learned habits of obedience and of submissiveness to superiors.

The Aztecs had made great advances in farming, or more properly gardening. Most of the land belonged not to individuals but to the local village communities. They constructed floating islands, called *chinampas*, made of rafts covered with earth, where they grew not only vegetables but also flowers, for which they showed much fondness. They possessed no domestic animals other than the dog, as no wild species suited for domestication then



Old Spanish map of Tenochtitlan, the ancient Aztec capital, now the city of Mexico. After Cronau, *Amerika*

PLATE 99



Cortes, believing that he detected signs of treachery among the inhabitants, inflicted condign punishment on the town of Cholula. After Ridpath, *History of the World* existed in that part of the New World. They did, however, domesticate the turkey, later introduced by the Spaniards into Europe.

Pottery was, of course, early known on the Mexican plateau. In time it came to be of high quality. Much interesting work was also done in the carving of jade and other hard stones, in the manufacture of mosaics, in weaving, and in the making of baskets.

The Aztecs worked gold, silver, and copper to some extent, but the principal material for tools remained stone. For those requiring a cutting edge, such as the knives used by the priests in killing their victims, they employed obsidian, or volcanic glass. They armed heavy hardwood clubs with a double row of obsidian blades, making weapons capable of striking a frightful blow, and they used spears and bows and arrows. The warriors, brilliant with war paint, carried round shields adorned with feathers, while officers further protected themselves with helmets in the form of birds and beasts of prey, with tunics of quilted cotton which could stop a stone-tipped arrow, and with wooden greaves for the legs. Montezuma himself, on account of his sacred character, was carried into battle on a litter.

There were many divinities, the chief being the war god, Huitzilopochtli. Worship consisted of pageants, dances, processions, and various ceremonies, in which flowers were lavishly used, incense was burned, and music was made on flutes and drums.

In the Aztec religion human sacrifice played an almost incredibly great part. The worshipers and often the victims were decked out in brilliant costumes, feather ornaments, and headdresses. In some instances they regarded the victim as the earthly personification of the god to whom he was destined to be sacrificed, and treated him accordingly with every honor up to the very day of his doom. When, about a generation before the coming of the Spaniards, the Aztecs completed the great central group of temple-pyramids at Tenochtitlán, they accompanied its dedication with a perfect orgy of human sacrifice. According to the old chroniclers, tens of thousands of victims of both sexes had their hearts torn out and offered to the bloodthirsty gods. One of the principal aims in Aztec warfare, in fact, was the capture of victims for the insatiable altars.

FIG. 108. Design from Aztec sacrificial stone; the war god, Huitzilopochtli, on left, in the costume of an Aztec warrior of high rank, seizes a captive, symbolizing the capture of the town of Tuxpan, "The Place of Rabbits," as indicated by the sign in the upper right-hand corner. After Spinden

Like the Mayas, the Aztecs had a sort of writing, and they had also invented a kind of paper, whereon they recorded events, made official reports, and even attained to the beginnings of true literature. The predominant tone of their writings, especially of their poetry, was one of sadness and the inevitable approach of death.

Fierce fighters as they were, the Aztecs offered the Spaniards a brave and determined resistance. It is doubtful if Cortes, with all his ability and energy, could have reduced their stronghold in the lake if smallpox had not broken out among them. Even so, he had to storm their great communal houses one by one before their resistance was finally crushed. History has rarely recorded a more savage struggle. When the Spaniards at last conquered, little remained of the once proud aboriginal city of Tenochtitlan but a smoking heap of ruins.

THE CIVILIZATION OF THE INCAS

Civilization, so far as we now know, began almost if not quite as early in South America as it did on the Mexican plateau. Just as everywhere else in the more advanced regions of the New World, it gradually developed out of an earlier "Archaic" culture and depended primarily on the growing of maize. High up in the Andes, a kind of buckwheat known as *quinoa* came to be raised; and it was in Peru, as we have seen, that the "Irish" potato was domesticated. Other plants cultivated included beans, manioc, gourds, and the maguey. The Peruvians terraced the sides of the mountains to form fields, and built aqueducts and reservoirs for irrigation.

Western South America has another claim to fame, also, in that it alone of all the regions of the New World accomplished the domestication of animals other than the dog in aboriginal times. It possessed, fortunately, a wild animal, the guanaco, or huanaco, a distant relative of the camels of the Old World, which could be utilized in this way. From it in time two domestic forms developed—the llama, used mainly for carrying loads, and the alpaca, valued for its fleece. Another wild species, the vicuña, yielded an exceptionally fine wool, reserved in later times for the use of the Inca ruler alone. Such progress toward civilization implies many centuries of settled life, and undoubtedly had already been achieved long before the Incas appeared on the scene.

For the Incas came into prominence comparatively late and founded their empire only a few hundred years before the discovery of America. They claimed to be "Children of the Sun" and formed a ruling nobility held in superstitious reverence by their subjects. The Inca ruler was a divine king-god, a good deal like the earlier Egyptian Pharaohs. In order to keep the sacred blood of the royal line absolutely pure, he was required by custom to make his full sister his chief wife.

The Inca Empire, when the Spaniards arrived, had come to include not only what is now Peru but also Ecuador, Bolivia, northern Chile, and northwestern Argentina. It was organized in great detail on a basis of state socialism. The common people had almost every act of life from birth to death closely regulated. Practically no such thing as private property existed for them. The state was everything, the individual nothing. On the other hand the state guarded the people against foreign invasion, protected them from injustice, and looked after them in sickness and in health. It relieved them of all personal responsibility and freed them from worry about their care in old age. Under such conditions obedience became a habit and the common people little more than animated machines, constantly directed and supervised by the officers of the state. Often whole groups of people were shifted about and settled wherever needed, even in regions far distant from their original homes. In this way, the Incas spread their civilization and rendered it more homogeneous throughout the empire.

They established this in the first place, of course, by force. They raised armies, organizing and handling them with the same attention to detail which marked the conduct of affairs in peace. The warriors carried the bow, the javelin, the sling, the ax, and the club—practically all of them made of stone, copper weapons being mainly ceremonial and not for use in actual warfare.

They had developed mining and metal-working to a certain extent and knew gold, silver, and copper. Some of their recovered implements made of the last-named metal contain tin, and hence are in reality of bronze. It seems almost certain, however, that they did not add this alloy intentionally, but that it resulted from the accidental presence of tin in the copper ore. At all events, Peruvian civilization fell far short of developing a true Bronze Age. At most it was only Chalcolithic—that is, using both stone and copper implements.

The Peruvians had developed pottery to an extraordinary degree, even though they knew nothing of that useful contrivance, the potter's wheel. It consisted of plain, engraved, painted, and varnished ware (Fig. 109). Weaving was another art carried by the Peruvians to a very high pitch of excellence. They utilized both cotton and the wool of the alpaca and vicuña, designs being either woven into the fabric, embroidered, painted on, or dyed. Featherwork was also highly developed, as were wood-carving, inlaying, and the manufacture of jewelry studded

FIG. 109. Section from design of a painted vase; ancient Peru. Interpreted as portraying a victorious war chief saluting his sovereign. After Squier

with emeralds. The people regularly wore clothing, sometimes of an elaborate character, along with caps, sandals, and necklaces.

In architecture the Peruvians carried building in stone to a point in some respects scarcely ever equaled in any land. The Incas understood thoroughly how to handle and transport vast building blocks, with which they constructed not only temples but mighty fortresses, like that of Sacsahuaman protecting the ancient capital of Cuzco on the north. In building these, they cut enormous stones of irregular shape to fit one another so closely that the joints can scarcely be penetrated by a knife blade. Sometimes they dispensed with mortar and occasionally fastened blocks together with T-shaped clamps of copper. Yet in all this only stone tools seem to have been employed, for the Incas had no suitable metal ones.

They knew the corbeled or "false" arch, but more often they covered buildings with extremely thick and elaborate roofs of thatch. Like the Mayas, they sometimes coated the walls with stucco; but those of the more important buildings, such as palaces and temples, they lined with plates of gold studded with jewels.

The engineering feats of the Incas have aroused the admiration of later times. Some of them—the construction of aqueducts, the terracing of fields, and the moving of blocks of stone weighing many tons—have already been mentioned. They also built bridges, sometimes of great stone slabs on masonry abutments, or suspended on cables of twisted osier. In certain cases mountain streams were crossed by means of a traveling basket slung from a single cable. The Incas also constructed a remarkable system of roads, even at the dizziest heights. These were not, indeed, meant for wheeled vehicles, of which none existed; but they were perfectly well adapted to the passage of swift-marching companies of footmen or strings of laden llamas. Without them the Incas could hardly have kept their vast empire together.

In transportation by water, on the other hand, they had remained in the canoe and raft stage. The principal type of craft was the balsa, made of bundles of reeds lashed together, and propelled by means of paddles or poles. The early Spanish narratives speak of a sort of rudimentary sail as occasionally used, but these statements all refer to a portion of the coast only a few hundred miles south of Panama, where the Spaniards had been for a generation before they seriously undertook the conquest of Peru. Hence it seems just possible that the Peruvians got the idea of a sail from the Spaniards. Thirty years would seem time enough for it to have spread along a few hundred miles of coast. They may, however, have developed it quite independently.

Yet with all this high state of civilization, the Incas lagged behind the Mayas and the Aztecs in one important respect. They lacked a system of writing. There is a single assertion by an early Spanish chronicler that in ancient times they had had one which was later forgotten; but this statement lacks the support of evidence of any kind, and may almost certainly be disregarded.

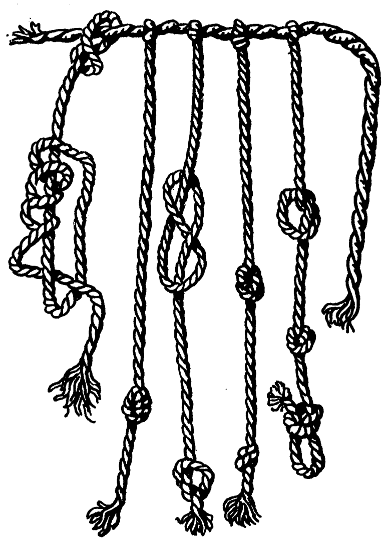


FIG. 110. Portion of a Peruvian *quipu* of knotted strings, by means of which records were kept, as writing was unknown. After Radin

The place of writing was taken by the use of knotted cords with which records of all sorts were kept. These, however, had the disadvantage, like the wampum belts of the North American Indians, of being legible to specially trained men only. In other words the knotted strings, or *quipus*, were only exceptionally elaborate aids to memory. We sometimes use a knotted handkerchief for the same purpose (Fig. 110).

That a people without writing should have a liter
may seem strange. Yet the Incas had made grea
vances in this direction. They composed elaborat

tories, dramas, poems, and other works, though these could only be memorized and were not written down until after the Spanish conquest.

As might be expected among a people so devoted to the worship of the heavenly bodies, the Incas had made considerable progress in astronomy. A fairly accurate calendar had been worked out, based originally on the phases of the moon, but later corrected and modified by observations of the sun. For the Incas, like other early agricultural peoples the world over, attached great importance to periodical ceremonies performed to insure an abundant harvest. And these must be held at the right time every year if they were to do the most good. The accurate dating of historical events, which seems so important to us, was only an afterthought with the peoples who originated calendars.

Thus the civilization of the ancient Peruvians was bound up with acts of worship to an extent hard for us to realize. They drew no line between things secular and things religious. Everything centered about the adoration of the sun and of his earthly representative, the Inca sovereign. Temples existed in various places, the principal one, naturally, at Cuzco, the Inca capital, in its valley in the Andes over 11,000 feet above the sea. Here solid gold and jewels covered the walls, and at one end shone a huge circular plate of the same metal, representing the sun. This disappeared at the time of the Spanish conquest and has never since been found.

The Incas also worshiped the moon, the planets, the rainbow, the earth, and, along the coast, the sea, in addition to many minor divinities. They held gorgeous festivals and occasionally offered human sacrifices, although to nothing like the extent that prevailed among the Aztecs.

Attached to the temples were convents in which dwelt "virgins of the sun"—girls chosen for their beauty from all over the empire, some destined for the Inca ruler's harem, and others devoted permanently to a religious life, in which they spent much of their time weaving fine cloth, especially of vicuña wool, for the Inca's use. For noble youths, there were schools and a sort of order of knight-

FIG. 111 Peruvian mythological design showing a combat between the "Man of the Earth," wearing a helmet of animal form with plumes, and the "Man of the Sea," symbolized as a crab. After Squier

hood, the latter to be won only by passing successfully through severe ordeals.

In theory, if not actually in practice, all gold and silver belonged to the great Inca. His wealth was almost fabulous. His palace utensils were made of precious metals, and some of his gardens contained full-sized models of plants and animals in gold, silver, and jewels. He himself was thought too holy to set foot to the ground, and hence was carried about on a litter covered with gold and precious stones (Plate 100).

At the death of each Inca ruler, his whole palace, with all its contents, was left intact, an entire new equipment being provided for his successor. Thus there accumulated a stock of treasure of well-nigh inestimable value. The last of the Incas, Atahualpa, in his effort to ransom himself from his Spanish captors, collected in a few davs a

FIG. 112. Peruvian concept of the God of the Air. After Squier

mass of gold objects amounting to between fifteen and twenty million dollars. The total loot gained from the conquest of Peru must have been vastly more than this. The Spanish monarch is said to have received, as his "royal fifth," fifty million dollars. If these figures are correct the sum total of the plunder gained by Pizarro and his handful of Spaniards must have equaled a *quarter of a billion dollars* in actual bullion. Whatever the amount, it was enormous, and its dumping all at once on Europe, until then rather poor in the precious metals, was undoubtedly in part responsible for the disturbances of all kinds which occurred there for a long time afterwards.

Atahualpa, called the last of the Incas, though he was a usurper. Below he is seen carried on his sacred litter, while at the top and sides are shown Peruvians engaged in mining operations. From an old print

PREHISTORIC MAN IN THE NEW WORLD

Conclusion

In marked contrast to the Old World, nowhere in the Americas at the time of their discovery had civilization developed to any extent in the great river valleys. That it would eventually have done so is hardly to be doubted, although the absence of domestic animals would have been a great handicap. The interesting and highly organized tribe known as the Natchez, for example, found on the lower Mississippi, might in time have developed a civilization in some ways comparable to those of prehistoric Babylonia and Egypt. So, too, might the mound-building Indians of the Ohio and elsewhere. And many other tribes had advanced far beyond primitive savagery. All these experiments, however, were doomed to failure; none of the tribes had reached the point where they could offer effective resistance to the white man.

Before closing this sketch of the higher aboriginal cultures of America, we must consider the question of possible borrowings from the Old World. Certain students, mainly Europeans, have thought that they could detect traces thereof. Most American specialists, on the other hand, are convinced that what civilization we find is the result of entirely independent progress under somewhat similar natural conditions.

Aside from all other considerations, it must be said that the supporters of the theory of Old World origins for the great American civilizations almost entirely ignore the historical problems involved. Of the latter, one of the most important is the development of sailing craft. The distance from southeastern Asia to the western coast of Central and South America is nearly half that around the whole world. A globe shows this even more strikingly than a map. For canoes driven by paddles alone, voyages of such enormous length, even allowing for stops at islands along the route, would be simply out of the question. Only by sailing craft, before the days of steam, could they have been performed. But no evidence whatever exists to indicate the presence of vessels using sails in the regions of southeastern Asia until about the beginning of the Christian Era. The evidence against it, on the other hand, is plentiful and, it would seem, decisive.

The great Polynesian migration, from the East Indian Archipelago to the islands of the Pacific, is now thought to have begun sometime about A. D. 100. It did not reach the eastern Pacific until some six centuries later. This movement depended wholly upon the use of sailing-canoes, and probably commenced not long after the latter had become known.

Again, the Chinese began rather early to keep copious records of all sorts, yet these say nothing whatever of sailing craft until as late as the third century A. D.

The Japanese, who have also been mentioned as possible importers of the Old World culture to America, learned the use of the sail from the Chinese, but employed it very little until about the year A. D. 1000.

The great American civilizations were founded ages before this. The Mayas and Peruvians had already reached a high degree of development long before the commencement of the Christian Era.

It is true that Asiatic junks have been blown across the relatively narrow North Pacific more than once *during the past two or three hundred years*. Yet there is no sign that their crews ever succeeded in the slightest degree in spreading their civilization among the American Indians. There have been preserved a few traditions of invasions by sea along the northwestern coast of South America, just where, as we have seen, the early Spaniards found the sail in use. It is quite needless, however, to suppose that these were anything more than raids by canoe from other regions farther up or down the same coast.

Statements in Polynesian legends, again, have been interpreted as referring to visits to the American continent. Also certain food-plants in the Pacific islands have been thought to be of American origin. But if the Polynesian canoe-men, expert and daring as we know they were, ever really reached America, it must have been long after civilization there had attained a high stage of development. The civilized portions of America, moreover, were not on the coast, where such voyagers would have had to land. On the contrary, their centers were far inland, in regions separated from the Pacific by long stretches of deserts and mountains and tropical forests. The civilization of the Incas, the Mayas, and the Aztecs was wholly of native American origin, and it is both needless and useless to look for its inspiration anywhere in the Old World.

Most aboriginal American cultures are dead. Yet they still live in many elements of our own civilization of the present day. They have contributed to it many extremely valuable cultivated plants, among them such staples as Indian corn and the potato. To them we owe the domestication of certain creatures like the llama, still used for transport over the lofty Andean passes; the guinea pig, invaluable for purposes of experiment in biological laboratories; and the turkey, in a far more intimate sense than the white-headed eagle the national bird of the United States. Without the gifts we have received from the ancient American peoples, our own civilization would lack much of value.

CHAPTER XVIII

NEW DISCOVERIES CONCERNING ANCIENT MAN

THE last few years have witnessed a truly remarkable growth in our knowledge of ancient man and his story. The remains that he has left behind him, both of himself and of his handiwork—in the ground, in caves, in river-deposits, and (for the later periods) in tombs and on the site of many a buried village or city—have been revealing themselves in ever increasing quantity. Accounts of fresh discoveries have been coming in almost daily, from Africa, western Asia, the East Indies, Australia, China, and the Americas—to say nothing of Europe itself, the source of so much of our earlier knowledge of the subject. The more striking and significant of these new finds we shall enumerate in the following pages.

Let us begin with Africa. That continent, we now know, has during ages been the home not only of many types of man, living and extinct (one of the latter, Rhodesian man, we have already discussed, on pages 154–162); but also of creatures that were not quite men but were nevertheless more manlike in some ways than are any of our existing close cousins, the great apes. One of these "missing links" is the newly discovered genus, *Australopithecus*. Of this we now have two skulls, one that of an immature specimen, the other that of an adult (on the special importance of skulls as evidences of type, see page 45).

Of these two, the first was found embedded in travertine rock from a quarry near Taungs, in South Africa, by Prof. Raymond Dart, of the Witwatersrand University at

Johannesburg. He named the new creature *Australopithecus africanus*. So remarkable were its characteristics that for some time doubt was felt whether it was a manlike ape or an apelike man. After much study, it has turned out definitely to be a hitherto unknown extinct anthropoid ape, akin to the gorilla and the chimpanzee but displaying certain features far more like than theirs to the corresponding ones in man himself. Though obviously that of a very young individual (Fig. 113, upper)—apparently a female five or six years of age—yet its skull had housed a brain which even at that age already equalled or surpassed that of a fully grown male gorilla. Its teeth too were much more human than apelike in form, their number and arrangement corresponding to those of a modern child of similar age.

On account of its very youthfulness, however, the "Taungs ape" could tell us little, save inferentially, about the form which it would have assumed had it lived to maturity. To know this, it was necessary to await the discovery of an adult skull. Such a one was found (Fig. 113, lower), no longer ago than 1936, in a limestone cavern at Sterkfontein, by Dr. Robert Broom, of the Transvaal Museum at Pretoria. Fortunately almost complete, its form could be restored without much difficulty. To his new discovery Dr. Broom has given the name of *Australopithecus transvaalensis;* for though evidently closely related to the earlier specimen, it seemed to be of a slightly different species, which lived during a somewhat later geological period. This new skull has in every way confirmed the surprisingly manlike character of the first find. That the creature was really an ape and not a very primitive man now became clearer than ever; but it was an ape far more like man than any yet known, whether living or extinct. Its teeth, for instance, are even more like our own than are those of the undoubtedly human "Peking man" (which we shall discuss later in this chapter). Dr. Broom closes his announcement of his discovery (in the *Illustrated London*

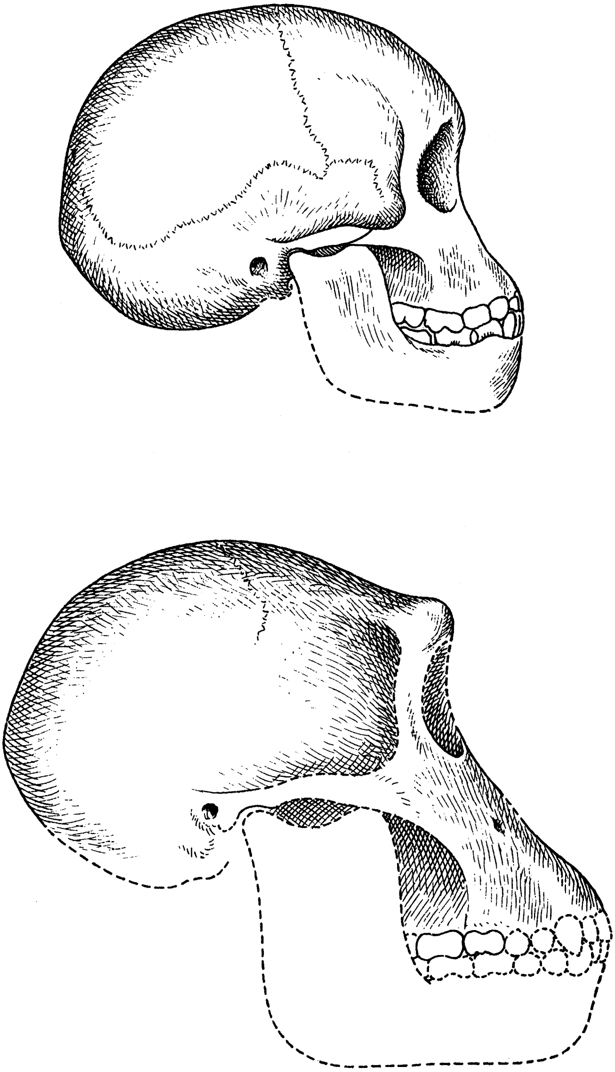


FIG. 113. Side views of the infant and adult skulls of the Taungs ape (*Australopithecus*), mentioned in the text. The first after Dart, the second after Broom.

News for Sept. 19, 1936) with the following words: "It now seems moderately certain that during the greater part of the Pleistocene, and possibly during the Pliocene, large, non-forest-living anthropoids flourished in South Africa, and not improbably it was from one of the members of this group that the first man was evolved."

Much other work of first-rate importance has also been done of late in the way of exploring South Africa's remote past as it concerns man; but this we can do no more than barely mention here.

Turning now to East Africa, new finds of great interest have been made there too, many of them by Mr. L. S. B. Leakey, a young Cambridge graduate familiar with Kenya Colony from his boyhood. These discoveries have attracted wide attention, and have done much to increase our knowledge of man's existence in that part of the world during the distant past. Among other things they have shown us that there conditions were in certain respects quite different from those which obtained in Europe during the same periods. In the latter region, as we have seen (Chapter V), there occurred a succession of Glacial Periods, when the country was covered by vast sheets of ice, like Greenland today. In Africa we find instead a series of Pluvial Periods, marked by great increases in the amounts of rainfall and probably connected in some way with the recurring Ice Ages in Europe. On the other hand, East Africa's Old Stone Age has been found to have passed through much the same phases as did that of Europe (already described in some detail). With these European sequences, the very impressive series of Paleolithic cultures worked out for East Africa by Mr. Leakey himself and by Mr. E. J. Wayland are in part parallel. Thus in the southern continent too, there occur pre-Chellean *coups-de-poing* or "fist-axes", as well as stone implements characteristic of various other European cultural periods. There are, however, some differences, as we might expect. For instance, in Europe, as we have noted (page 199), the Mousterian type of culture invariably comes before the one known as the Aurignacian. In Africa, on the other hand, this order has sometimes been found reversed; layers of Mousterian culture occur above instead of below Aurignacian ones. It has thus been made clear that in certain parts of that continent these two cultures existed at the same time; sometimes, indeed, they even fused to form still a third.

Mr. Leakey has also discovered remains not merely of man's handiwork but also of man himself. Among these have been those of a tall, big-brained race which lived at a time roughly contemporary with Europe's later Old Stone Age, perhaps 15,000 or 20,000 years ago. These people, according to Sir Arthur Keith, may have been the remote ancestors of those Hamites—tall, muscular, frizzly-haired blacks (not Negroes)—who inhabit so much of northeastern Africa today.

In the same continent, too, a great deal of work has been done of late years in regard to the sequence of cultures and of human racial types in the Nile basin. Especially in Egypt, man has been traced from far back in Paleolithic times all through the ages, right down to the historical period.

Important discoveries have also been reported from the great island-continent of Australia during recent years. New light has been shed, for example, on the ancestry of that most primitive of all living peoples, the aboriginal "blackfellows." These, instead of being (geologically) recent immigrants from southern Asia, as we formerly supposed, are now revealed as having reached Australia many thousands of years earlier—perhaps, indeed, as long ago as the close of the Pleistocene period (on the latter, see page 19).

For instance, near the little township of Cohuna, in southeastern Australia, there have been found the bones of five individuals of a race clearly ancestral to the living aborigines, but displaying the latters' primitive characteristics in a still more marked degree. Cohuna man's frontal torus, or brow-ridge of bone, was even more massive than those of his modern descendants; his jaws projected forward—an apelike trait, as we have pointed out (page 46)—farther than did those of Rhodesian man, and his canine teeth and bony palate were larger than those of any other human skull known, vying in these respects with those of the male anthropoid apes. The only very early human skulls thus far known of a type more primitive than that of Cohuna man are those of *Pithecanthropus* in Java (pages 145 *sq.*), of *Eoanthropus* in England (pages 134 *sq.*), and of *Sinanthropus* in northern China.

The lovely tropical island of Java has also contributed not a little highly interesting information to our recently acquired fund of knowledge regarding very early man. It was there, it will be remembered, that *Pithecanthropus erectus*, just mentioned, was found by Dr. Eugene Dubois as long ago as 1891. Though much search had been made in the interval, it was not until over 45 years later, in 1937, that a second skull of the same creature was discovered, by Dr. G. R. H. von Koenigswald. Still another skull—this time that of an extremely youthful individual, thought to have been perhaps an infant *Pithecanthropus* around four years of age—has lately been found. The Early Pleistocene date of Java man is now quite generally accepted, and probably the majority of students at present regard it as more definitely human—less of an ape—than was at first believed. It is only fair to say, however, that the original discoverer, Dr. Dubois, has recently announced it as his latest conclusion that *Pithecanthropus* was not a man at all—that in reality he belonged to a large species of anthropoid ape closely allied to the gibbons (but on this point see Dr. Hrdlička's remarks, quoted on pages 152 *sq.*).

Very recently, near Ngandong, in Java again, Dr. W. F. F. Oppenoorth has discovered nearly a dozen more or less damaged skulls of a primitive type to which he has assigned the name of *Homo soloensis*—otherwise, Ngandong man. This creature had apparently reached an evolutionary stage comparable in many ways to that attained by the Neanderthal race (see Chapters VII and VIII); though certain features of his skull have been thought to indicate a relationship with Rhodesian man. *Homo soloensis*, it has also been suggested, was possibly the ancestor of the Australian aborigines.

Ngandong man seems to have made little or no use of stone, but to have employed in its place bone and deer-antler as the materials out of which he fashioned his few simple tools and implements. The way in which some of the above-mentioned skulls have been broken open, apparently for the sake of extracting the brains, suggests that like so many other peoples, both ancient and modern, Ngandong man was a cannibal.

Let us turn now to the continent of Asia. There, during the past few years, have been made some of the most momentous discoveries yet recorded in regard to very ancient forms of man. About bygone ages in China especially, we now know far more than before. The most important find, beyond comparison, has been that of the famous "Peking man."

Practically all that we know about this very primitive human type has come from one site—a deep fissure-cave near the village of Chou Kou Tien, 37 miles southwest of Peking and just at the edge of the picturesque Western Hills. For some years previous to the discovery, this cave had been the scene of explorations for the fossil remains of extinct animals, of which it had been found to contain great quantities. The study of these had shown them to be of Early Pleistocene age. Here and there in these deposits the eminent Swedish geologist, Dr. J. G. Andersson, had noted the presence of sharp-edged fragments of quartz, a kind of stone not naturally occurring in the locality. This fact had led him, as long ago as 1921, to suggest they had been brought into the cave by some form of early man.

As the years went by, there turned up from time to time among the fossil remains of animals a few bits of jaws and skulls, as well as teeth, which were clearly those of some species of man. To one of these teeth, a lower molar, the late Dr. Davidson Black, of the Cenozoic Laboratory at Peking (an institution supported by the Rockefeller Foundation), devoted close study. As a result he took the bold step of erecting a new genus of very primitive man, to which he gave the name of *Sinanthropus pekinensis*.

Dr. Black's action, though regarded by many at the time as hardly justifiable on such slender grounds as the study of a single tooth, was destined to receive speedy and ample justification. For a year or two later, in December 1929, Mr. W. C. Pei, the young Chinese paleontologist then in charge of the excavation, discovered a nearly complete brain-case of "Peking man" (Fig. 114).

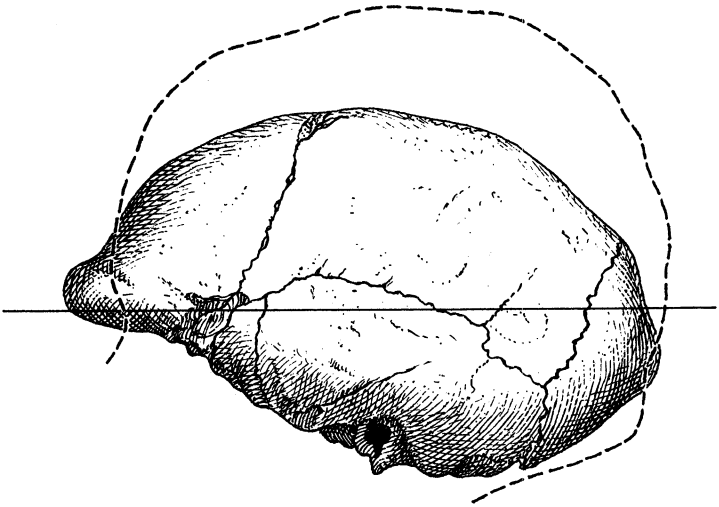


FIG. 114. Side view of the brain-case of Peking man. On it is indicated (by broken line) a modern Chinese skull, to show the development in size of brain.

The specimen was completely embedded in the very hard travertine rock that had slowly formed around it.

When this had been removed—an operation so delicate and laborious that it took months of painstaking toil on Dr. Black's part—the new discovery proved to be the upper part of the skull of a young adult of the newly established genus of early man; whether male or female could not be definitely determined, though the latter seemed on the whole more likely. The basal and facial portions of the skull were gone; but fortunately the interior of the brain-case, showing the shape and arrangement of the brain, had been preserved in almost perfect condition.

Work in the cave has gone on, though often in the face of great difficulty and even danger (especially from bandits). As a consequence, several more skulls, most of them fragmentary but one at least nearly complete, have been brought to light. According to the latest reports, about 24 individuals of various ages are represented, though some only by a few teeth. Curiously enough, almost no other parts of the skeleton of Peking man have been found. There are reasons for suspecting that he too was a cannibal, killing and dismembering his victims in the open, but bringing their heads into the cave in order to eat their brains. At all events, for the present at any rate our knowledge of *Sinanthropus pekinensis* is derived almost entirely from his skull, lower jaw, and teeth. Fortunately it is just these parts of a skeleton that can tell us most about its original owner.

Hence we are able to say that while very primitive and lowly in type, Peking man was close to the main line of evolution of modern man. His skull had a low vault, his brain capacity being only around 1,000 cubic centimeters—far less than that, for example, of the Neanderthal race, which averaged about 1,450 cubic centimeters. Like so many other ancient human skulls (to say nothing of those of the great apes like the gorilla and the chimpanzee), so too that of Peking man had a very prominent and "beetling" frontal torus or brow-ridge. He was, according to most authorities, quite closely related to *Pithecanthropus* or Java man; but his skull also displays features resembling and perhaps foreshadowing similar ones found in both Neanderthal and modern man. Its discovery has further established a bond of union between Java man and Piltdown man; for in it occur in combination certain characteristics which appear separately in those two very ancient and primitive forms of humanity. Peking man's skull is thus of a very generalized type.

The lower jaw of *Sinanthropus* shows a curious mixture of human and apelike traits. For one thing, it displays a very early, even rudimentary, stage in the development of that characteristically human feature, the chin (on its evolution and significance in man, see pages 47 *sq.*). His teeth, though larger than those in modern human jaws, are in most respects quite like our own. The shape of some of them has led to the suggestion that Peking man may have been the ancestor more especially of the Mongoloid race—that stock of mankind to which belong the Chinese, the Mongols, and many other peoples, including the American Indians. On this point, however, no general agreement has yet been reached.

Peking man already knew the use of fire; for some of his hearths have been found in the cave. He also made a few exceedingly simple and crude tools of stone and deer-antler—though these have not been linked in type with any of the early European implements. Lastly, he lived beyond doubt at or very near the beginning of the Pleistocene geological period, variously estimated at from 250,000 to 1,000,000 years ago.

The discovery of Peking man, though by far the most important, is by no means the only one that has been made during recent years concerning ancient man in China. In the extreme northwestern part of that country, not far from the borders of Mongolia, the French Jesuit Fathers Emile Licent and Teilhard de Chardin have found human remains and artifacts. These occurred at or not far above the base of those deep deposits of loess earth which cover so much of northern China; associated with them were bones of extinct animals such as the woolly rhinoceros and great wild bull. These and other indications show that they belong to the latter part of the Old Stone Age, perhaps 25,000 or 30,000 years ago, when the climate was decidedly colder than it is now. These finds are consequently vastly more recent than that of *Sinanthropus*, from whose times they are separated by a period certainly to be reckoned in hundreds of thousands of years. Thus there is this enormous gap in our knowledge of ancient man in China which nothing has so far been found to help bridge.

Much has, however, been learned in regard to more recent times in that part of the world, during the Chinese Neolithic or "New Stone" and Bronze Ages. Deposits belonging to these epochs have been excavated by the Academia Sinica, a Chinese governmental organization, and by the Freer Gallery of Art, of the Smithsonian Institution. The finds thus made tell a great deal that is new in regard to the ancient Chinese civilization of late prehistoric and early historic times, during roughly the third and second millennia before our Era.

We learn, for example, that during their New Stone Age the ancestors of the present Chinese people were already living in China itself. This has been shown by the skeletons that have been found, and which are of the type still found in the northern Chinese people. We have found too that the Neolithic Chinese had a culture only a little more advanced in some ways, perhaps even less so in others, than that of the Eastern Woodland Indians of North America at the time of Columbus. In winter they lived in circular pit-dwellings (Plate 101) constructed partly or wholly underground and entered through an opening at the top; in summer they probably occupied huts built in trees or on piles. They made pottery, some of it quite fine and painted with simple geometric designs; they used tools and weapons of stone, bone, shell, and wood; they

Example of the dome-shaped pit-dwellings used as winter habitations by the Neolithic Chinese.
Excavated by the Freer Gallery of Art, of the Smithsonian Institution

had pigs, dogs, and possibly chickens; and they grew millet and perhaps rice.

We have also considerably extended our knowledge of the Chinese Bronze Age, which seems to have lasted approximately from a time not very long after 2000 B.C. down nearly to the Christian Era. As we have already seen (pages 320 *sq.*), the Chinese Bronze Age was a fairly high one. Nothing further has, however, come to light to tell us how it first arose in China—to what extent it was a local development, and how much of it was an importation from older civilized lands to the west of China.

In Manchuria too, since 1931 Dr. A. S. Loukashkin and others have been finding, in Pleistocene formations, rich collections of fossil bones, mainly those of mammals, living and extinct. These same deposits have also added somewhat to our knowledge of ancient man, of whose presence in extreme eastern Asia during Paleolithic times we had had hitherto no definite proof. The explorers have, it is true, found few if any remains of ancient man himself; but traces of his handiwork, in the shape of crudely formed stone implements and pieces of worked bone, have not been entirely lacking.

Of the fossil animal bones themselves, moreover, many had been split as if for the sake of extracting the marrow; while almost none of them remained in anything like normal articulation, even the lower jaws generally being found detached from the skulls to which they belonged. These facts suggested to Dr. Loukashkin and his colleagues that the bone deposits represented refuse that had gathered about the camps of Paleolithic hunters. We are reminded of the great collection of bones found about the ancient camp at Solutré, in France (see pages 53 *sq.*).

Elsewhere on the continent of Asia, important additions to our knowledge of man's ancient past have lately been made. Thus we have learned that Mesopotamia, so far as it had yet been formed by the silting up of the head of the Persian Gulf, was inhabited continuously by man through every successive phase of the Old Stone Age. It has also become increasingly probable that in the Near East—somewhere between the Black Sea and the Indian Ocean—we must look for the initial steps in the process of man's emergence from the earlier hunting and food-gathering stage to that of growing his own food, both animal and vegetable. It now seems probable that, as we have already suggested (see page 242), this momentous change began during the Mesolithic period or "Middle Stone Age", perhaps 10,000 or 12,000 years ago. Further light has also been shed on that remarkable early civilization which flourished in northwestern India (see Chapter XVI).

We have not yet, it is true, discovered all the intermediate stages of the long and arduous trail that finally led man from life in caves and in the open air to one in houses, villages, and towns; but the gaps in our knowledge grow steadily narrower and fewer as time and archeological research go on.

It was already known (see pages 126–129) that a variety of Neanderthal man once lived in Palestine. That country, along with Arabia, was fertile and well-watered and therefore admirably suited for occupancy by ancient man during those periods when more northern lands were passing through their long succession of Ice Ages. Though the systematic investigation of prehistoric sites in Palestine did not begin until as late as 1925, it has already yielded important results. In particular, much has been learned through the careful and methodical excavation of certain caves in a lofty cliff on the southern face of Mount Carmel, that great rocky promontory jutting out into the Mediterranean and made forever famous through its associations with the prophet Elijah.

In one such cave, the Tabūn ("Oven"), were found remains of a local variety of the Neanderthal race, associated as usual with a culture of Mousterian type. These people seem to have lived at a time rather earlier than those western European Neanderthalers about whom we have had so much to say in preceding pages.

In another cave again—this time hardly more than a rock-shelter—the Mugharet es-Skhūl ("Cave of the Kids"), in 1931 and 1932 were found several skeletons of a race preponderantly of the modern type, though retaining many primitive features. A tall people—though the women were considerably shorter than the men—they may have lived during the latter half of the Riss-Würm interglacial period (see pages 66 *sq.*) and been the long-sought ancestors of that Cro-Magnon race whose advent in Europe marked the beginning of the Upper Old Stone Age (see page 76).

In deposits later in date than the above, but still of a very respectable antiquity, the excavators unearthed the remains of a culture which they named the Natufian. This was clearly related to the Tardenoisian (see page 232), and represents the Mesolithic or "Middle Stone Age" of Palestine. Among its implements were sickles made of small sharp flints, suggesting that perhaps even then man in that part of the world had begun the cultivation of some variety of cereal plant (on the importance of this step in human progress, see pages 242 *sq.*). It is perhaps significant in this connection that precisely in Palestine—on the slopes of Mount Hermon—has been found growing what seems to be true wild wheat (not merely one of the domestic varieties that had somehow escaped from cultivation).

While all this work has been going on in other parts of the world, much progress has been made in Europe also. Until recently it was not known with certainty—though it had long been suspected—that man had reached either Scotland or Ireland during the Old Stone Age. It has now, however, been learned that he then lived in both countries. Recently a skeleton of the modern or Neanthropic type of man has been discovered in a cave in Sutherlandshire, in the extreme northwest of Scotland. The surrounding deposits indicate that its owner probably lived at a time contemporary with the Magdalenian period in France, and was therefore of the latter part of the Upper Paleolithic age. Man's presence in Ireland during the same epoch has also now been demonstrated, although of his physical type we know nothing as yet.

It has, moreover, now been made clear that in Britain the sequence of Late Paleolithic cultures was not quite the same as that in France. In the latter country, we recall, the order was Aurignacian, Solutrean, and Magdalenian, the latter phase being followed by the Azilian, on the borderline between the Old and the Middle Stone Ages (in regard to the Azilian, see pages 43 and 52). In Britain, on the other hand, the Aurignacian type of culture persisted, little affected by later influences, until it finally faded into an Azilian-Tardenoisian culture characterized by the use of "pygmy" flints.

We may here say a word parenthetically in regard to the last-named type of stone artifacts. Pygmy flints have sometimes been regarded as tokens of degeneracy and weakening in the cultures of the Old Stone Age. In reality they are remarkable indications of progress in human ingenuity and inventiveness. For unlike the stone "fist-axes" and "points" and "scrapers" of an earlier day, pygmy flints, or microliths as they are sometimes called, were used not singly but in combination, both with one another and with other materials, to form real tools (not simply implements) of some complexity. Thus a flat piece of wood or bone might have excavated along one or both of its edges a groove in which was then cemented a row of sharp-edged pygmy flints, to form a dagger, sickle, or harpoon. Microlithic industries are now known from end to end of the Old World, and mark a real and important stage in the progress of mankind.

New finds have also been made recently in the Scandinavian peninsula. Here too, just as in Scotland and Ireland, man was not known to have lived until the Old Stone Age had passed away. Now, however, his traces, in the form of open camps (not cave-dwellings or rock-shelters) have been found in considerable numbers, even as far north as the county of Finmarken, in extreme northern Norway—far within the Arctic Circle. This newly discovered culture, known as the Finmarkian, belongs to the very end of the Old Stone Age or to the beginning of the Mesolithic period that followed.

Its camp-sites are invariably found situated on or very near the seashore, and as their relics show, their ancient occupants depended mainly for their livelihood on the pursuit of the reindeer and the seal. Thus their mode of existence must have been very similar to that of the Eskimo while still in their Stone Age, before they had begun to be affected by European influences, two or three hundred years ago.

Full Neolithic or "New Stone" types of culture, we may note here, seem not to have reached such far northern regions—and then only as the possession of peoples still in the hunting and fishing stage—until around 2500 B.C. at the earliest. By that time, as we know, agriculture and cattle-breeding had been practiced in the Near East and certain other portions of the globe for thousands of years.

In central Europe also, many interesting and important finds have been made of late. In Moravia especially, much new light has been cast on the life of the men and women of the later Old Stone Age. In that country there are now known a hundred or more sites of ancient camps in the open—not inhabited caves or rock-shelters. Of these, one of the most important is that at Vĭstonice (Wisternitz), 25 miles south of the capital, Brno (Brünn); while another is situated near Předmost, 60 miles to the northeast, toward the borders of Silesia and Poland. Among those who have carried on excavations at these sites is Dr. E. K. Absolon, curator of the government museum at Brno. His discoveries have been of the most interesting character.

Buried at the present day beneath several feet of loess soil, these camps were originally situated on plains, out in the open. Their occupants were a race of hunters apparently contemporaneous with the Cro-Magnons of western Europe (see page 76). Not so tall as the latter, they were, however, as comparison of their skeletons shows, much like them in other respects. In fact, Sir Arthur Keith regards the two peoples as closely related, and as being among the ancestors of the modern Europeans.

In some respects these ancient Moravian camps recall the one found at Solutré (see page 53). Instead, however, of the wild horse being the chief object of the chase, as there, in prehistoric Moravia it was the mammoth or hairy elephant that was especially sought. In one small area alone, for example, Dr. Absolon came upon the bones of no less than sixty of these animals. There also occur in the camp refuse the bones of many other species—among them the European bison, aurochs or wild bull, stag, reindeer, lion, bear, and wolf.

The camp at Vǐstonice occupies at least 1,000 acres of plain, but has been excavated only in small part. Even so, it has already yielded enormous quantities of finds. In addition to the bones that we have mentioned, the explorers have unearthed literally thousands of objects of stone, bone, and ivory—among them weapons, tools, ornaments, toilet articles, needle-cases, and spoons. They also found figurines (apparently idols) made of clay. There was however no pottery, which seems to have remained unknown, at least in that part of the world, until later. These ancient Moravians, like their relatives the Cro-Magnons, were evidently artists and craftsmen as well as doughty hunters of big game animals.

Generally similar were the finds at the Předmost site, only a little smaller in area. But there, at a depth of almost 10 feet below the present surface of the plain, the excavators unearthed in addition a remarkable collective grave. This was roughly oval in plan, 13 feet by 7½ feet wide. On one side it was bounded by a sort of fence made of shoulder-blades of mammoths; on the other, by lower jaws of the same animal, set upright. Within the enclosure thus made were the bones of 20 persons—12 adults and 8 children of various ages. The burials had occurred at different times, and the grave had evidently been in use for a considerable period. The bodies had been laid away in the "contracted" position, on their sides, with knees drawn up. Over all had been placed a layer of stones 16 inches thick, either to prevent the ghosts of the dead from leaving the grave, or to prevent hyenas and other animals from disturbing the remains.

Our knowledge of the ancient cultures of the Old World has now advanced far enough to justify us in attempting certain tentative conclusions in regard to their diffusion. It was quite plainly not the result of simple coincidence that, in the Eastern Hemisphere, certain types of artifacts occur throughout wide and continuous regions, sometimes several thousand miles across; while other types, quite different in form and technique, have spread over similarly large and continuous areas elsewhere.

Let us take a concrete illustration from the earlier portion of the Old Stone Age—the *coup-de-poing* or "fist-ax" (see Index, under "Fist-ax"). This implement was made by chipping away a large pebble until what was left assumed the desired almond shape. This method of making stone tools diffused itself, no doubt very gradually, from Portugal on the west to India on the east, from the British Isles on the north to South Africa on the south. Its center of origin we do not yet know accurately; but it was almost certainly somewhere in the vast area from northern Africa to southern Asia.

In the central and eastern portions of the latter continent, on the other hand, and thence on eastward to the Pacific, the manufacture of stone implements appears to have been based primarily on the utilization of "flakes", struck off from the sides of pebbles (see Index under "Flake industry"). The region from which this method of making stone tools diffused itself may have been somewhere in Central Asia, or perhaps as far east as China.

In addition to the above two fundamental ways of making implements from stone, there was, according to some (among them Dr. Oswald Menghin, one of our leading authorities on this and kindred subjects), still a third technique in which bone largely took the place of stone. This view, though hardly more than a working-hypothesis as yet, is quite plausible, and seems to fit in well with the known facts. According to its advocates it was especially characteristic of the northern portions of the Old World.

There was, of course, from the very first a large and steadily growing amount of overlapping and intermixture of cultures; for one adopted from another whatever suited its own particular needs. Evidences of this process, known as "culture-borrowing", become more and more apparent as we proceed downward on the stream of time. Just as in much later and even modern days, so in the Old Stone Age too, though far more slowly, ideas and inventions and techniques had a way of spreading themselves over vast areas, often by means and along routes that we are not able to trace.

Our above brief account of the more striking of recent advances in the study of ancient man in the Old World would be incomplete without a short survey of what we have learned lately in regard to his presence in the Western Hemisphere also.

Some authorities, among them Sir Arthur Keith, have expressed the belief that America will yet disclose proofs of man's existence here during remote Pleistocene times. That it has not done so thus far seems certain; but the tendency of late has been to push back the probable date of his first appearance here farther than would have appeared warranted only a few years ago. It is now quite generally accepted that American man (*i.e.*, the Indian—

the only race of whose presence here in early times we have definite proof) came here originally from Asia. The difficulty about fixing the date of his arrival here is that so far no very early traces of human occupancy have been found in northeastern Asia itself—the region from or through which the ancestors of the American Indians must have traveled in order to reach the New World. All we can yet say is that the oldest examples of human handiwork (no actual remains of man himself have occurred in connection therewith) have been found in deposits which, according to the geologists, belong to the very end of the last Ice Age here—the "Wisconsin" it is called. Even this, however, need not imply a time more remote than 12,000 or 15,000 years ago—a relatively recent period, geologically speaking.

Several human skeletons, mostly incomplete, for which a considerable antiquity has been claimed, have been found in both North and South America; but all seem to be those of American Indians, and for none of them can be established an age of more than a very few thousand years at most.

The earliest trace of man's handiwork (as opposed to his actual skeletal remains) yet found in the New World seems to be the now famous "Folsom industry." This was so named from a village in New Mexico near which it was first recognized, a few years ago; but it has since been found to occur over a wide area of North America, extending almost from coast to coast. Its type form of artifact is the "Folsom point", a variety of stone implement quite different from anything made by the later Indians and very beautifully and skilfully executed. Associated with it have been found bones of various extinct animals, especially those of a bison differing from the existing species.

As just stated, no human bones have been found that could plausibly be attributed to Folsom man; hence as to his physical aspect we can say nothing as yet, although he is generally supposed to have been a very early American

Indian. (Some of the Folsom finds are discussed in the first volume of the present series; see pages #345-348).

In 1935, excavations in the Confins cave, in Brazil, under 6 feet of alluvial soil covered by a layer of stalagmitic origin, disclosed an incomplete human skeleton, almost surely that of an early Indian. Its discoverers do not claim for it an antiquity of more than a few thousand years. No artifacts were found with it; but in the same stratum, and apparently of similar age, occurred bones of a mastodon and various other creatures no longer living.

Traces of fairly ancient man have also been found during the past few years near the Straits of Magellan, at the southern extremity of South America, by Dr. Junius Bird, of the American Museum of Natural History in New York. With these too were bones of extinct forms, among them the giant ground sloth.

The animals mentioned in connection with the last three recent discoveries were all members of a fauna formerly believed to have died out before man reached the Western Hemisphere. The finding of their bones in association with early human remains is not, however, proof in itself of the extreme antiquity of the latter. For some species appear to have survived much later than we formerly thought—perhaps indeed down to a few thousands years ago.

The new discoveries enumerated in this chapter have enabled us to extend our knowledge of man's past to a point which would hardly have seemed possible even a comparatively short time ago. Many problems still remain to be solved, of course; but here, just as in other fields, our knowledge is steadily growing as time goes on.

NOTE: There has just occurred an excellent illustration of the rapidity with which our knowledge of ancient man is growing. Since this chapter was written, word has come in of the discovery in California of two distinct and hitherto unknown stone industries which appear to be even older than the Folsom one just discussed. In one—the more ancient—the stone implements have been thought to show kinship in form with some of the South American artifacts found recently near the Straits of Magellan (see third paragraph above).

If authenticated, these newest finds would strengthen the probability, now amounting to a practical certainty, that for the antiquity of man in America we must allow a period of 15,000 years at the very least.

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APPENDIX

Neanderthal Remains in Chronological Order of Discovery

NAME OF FIND	YEAR OF DISCOVERY	BY WHOM DISCOVERED	FIND CONSISTS OF—	ESSENTIAL DATA OF DISCOVERY	ORIGINALLY REPORTED BY—
Gibraltar	1848	Laborers	Skull of adult female, damaged (without lower jaw)	Found accidentally in a crevice during blasting for emplacement of a battery	G. Busk, 1868; P. Broca, 1869
Neanderthal (Rhine Province, Germany)	1856	Laborers	Skullcap and 13 bones of skeleton of adult male	Found accidentally in a cave	C. Fuhlrott, 1857; D. Schaaffhausen, 1858
La Naulette (near Dinant, Belgium)	1866	E. Dupont	Imperfect lower jaw of young adult female	Excavated from undisturbed deposits in Troue de la Naulette, under layers of stalagmite alternating with 6 layers of earth, the two 12 feet in thickness	E. Dupont, 1866

NAME OF FIND	YEAR OF DISCOVERY	BY WHOM DISCOVERED	FIND CONSISTS OF—	ESSENTIAL DATA OF DISCOVERY	ORIGINALLY REPORTED BY—
Sipka (near Stramberk, Moravia, Czecho-Slovakia)	1880	Karel J. Maška	Fragment of front part of lower jaw of child of about eight years	Excavated from the "Badger hole," a low lateral extension of the Sipka cave. Lay 1.4 meters deep in undisturbed ash bed	Wankel, 1880; Schaaffhausen, 1881 and 1883; R. Virchow, 1882; Maška, 1886
Spy No. 1 and No. 2 (Namur, Belgium)	1886	Marcel de Puydt and Maximin Lohest	2 skeletons of adult males	Excavated from terrace in front of a cave, 6 and 8 meters distant from entrance, 4 meters deep	J. Fraipont and M. Lohest, 1887
Bañolas (Gerona, Spain)	1887	Lorenzo Roura	Lower jaw	In hard travertine, about 15 feet from surface	Cazurro, 1909; Harlé, Pacheco, and Obermaier, 1912
Malarnaud (Ariège, France)	1889	F. Regnault	Lower jaw of adult female	In ancient clay, with bones of extinct animals, capped by a layer of stalagmite	H. Filhol, 1889

NAME OF FIND	YEAR OF DISCOVERY	BY WHOM DISCOVERED	FIND CONSISTS OF—	ESSENTIAL DATA OF DISCOVERY	ORIGINALLY REPORTED BY—
Krapina, (Croatia, Yugo-Slavia)	1895 1899 1905	K. Gorjanović-Kramberger	Parts of over 20 skeletons (adult and sub-adult, both sexes)	Excavated from the fillings of an old rock-shelter, with remains of fire, bones of extinct animals, and stone implements	Gorjanović-Kramberger (various dates)
Le Moustier (Dordogne, France)	1908	O. Hauser	Skeleton of adolescent male	Excavated from an accumulation of cultural débris of Mousterian age, in lower rock-shelter, at Le Moustier	O. Hauser and H. Klaatsch, 1909
La Chapelle (Corrèze, France)	1908	Abbés A. Bouyssonie, J. Bouyssonie, and L. Bardon	Skeleton of middle-aged male	Burial (formal) in a depression dug in the marly soil of the floor of a cave	A. and J. Bouyssonie and L. Bardon, 1908; M. Boule, 1908
Jersey (English Channel)	1910	Nicolle and Sinel	13 teeth (from both jaws) of one skeleton	Cave accumulations, near an ancient hearth	R. Marett, 1911; A. Keith, 1911

NAME OF FIND	YEAR OF DISCOVERY	BY WHOM DISCOVERED	FIND CONSISTS OF—	ESSENTIAL DATA OF DISCOVERY	ORIGINALLY REPORTED BY—
La Quina (Charente, France)	1908–21	Henri Martin	Skeleton of adult female (?), 1911; lower jaw, 1912; skull of child, 1921; fragments of several skeletons (different dates)	Partly in ancient mud bed of the nearby stream (adult skeleton, etc.); partly in kitchen refuse and débris (child's skull, etc.)	H. Martin, 1911-1927
La Ferrassie, (Dordogne, France)	1909 1910 1912	Peyrony	6 skeletons (2 adults —male and female —and 4 children)	At base of accumulations in a shallow rock-shelter	Capitan and Peyrony, 1909, 1912
Ehringsdorf (Weimar, Germany)	1914 1916 and later	Quarrymen	2 lower jaws; remains of skeleton of child; portion of a thigh bone	Deep in hard travertine and intercalated layer	G. Schwalbe, 1914; H. Virchow, 1920
Galilee (Palestine)	1925	F. Turville-Petre	Fragments of skull of young adult, including frontal bone	Cave, at the base of undisturbed Paleolithic layer, 6½ feet below the present floor level	F. Turville-Petre and Arthur Keith, 1927

NAME OF FIND	YEAR OF DISCOVERY	BY WHOM DISCOVERED	FIND CONSISTS OF—	ESSENTIAL DATA OF DISCOVERY	ORIGINALLY REPORTED BY—
Ehringsdorf (Weimar, Germany)	1925	Quarrymen	Broken vault of skull of adult	Deep in hard travertine in Fischer's Quarry	F. Weidenreich, 1927
Gibraltar	1926	Miss D. A. E. Garrod	Skull of child of about ten years	Rock-shelter, with Mousterian culture	Abbé Breuil (shelter); Miss D. A. E. Garrod (preliminary notes, 1926)

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX