THE ORIGIN OF MAN.

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It is reported that when General Pershing stood before the statue of Lafayette in Paris, he unbonneted and announced "Lafayette, we are here". It is also reported on good authority that he did no such thing. But whether or not this remark was made, or was correctly ascribed to the General, America was in France.

To make a crude paraphrase of the episode and the remark, we may visualize the great army of the human race standing before inarticulate nature and its leaders in thought announcing "Cosmos, we are here." We are here, indeed, but the journey here has been long and there are no old patriarchs with us who remember the events of the starting or of the long journey. For some centuries back, we have kept records inscribed on paper, parchment and stone, records that are dubious in veracity, lacking in details. The more critical these historians become, the more dubious appear the records which we have kept. Back of the written records of the latter part of the journey are the kitchen middens, the dolmens, the rock shelters and caves, the flint-chipping shops and the great encampments of Pre-history. Back of these records, what?

Man has come out of the Past, for we are here! But, so far as I am aware, no one knows just whence, or how, or why? There be many of us who think we know, but closer analysis of our thought will show that what we think we know, we only believe! To know is to be above the question of belief or unbelief.

The quality of "Certainty" is difficult to define. It obviously isn't the same for all minds. And in the last bitter analysis, I suppose that we are not certain that if I release my pencil, it will immediately fall to the floor—for we haven't tried this particular experiment yet. But all normal minds expect the pencil to fall, expect the sun to rise tomorrow, expect that the pangs of hunger will be appeased by the ingestion of food, expect that the co-ordinate action of locomotor muscles will move us from one place to another. In our experiences,

these combinations do not fail, and we say that we are certain on such things. Concerning the origin of our species, however, we are uncertain. The printed title of this lecture should be followed by a question mark.

All races of men have thought on this question of our origin. The lore of humankind is full of accounts which purport to explain the riddle. Some of these accounts have died with the cultures which produced them—witness the Egyptian myths of Creation. Nobody believes these myths today, after they have been laboriously deciphered from the hieroglyphs of the tombs and the temples, though they surely have the sanction of antiquity (if that is a sanction). They have been believed by millions of people! Do you know why no one believes them today? I don't know, but I think it is chiefly because no one else believes them. Further, some cultures have outgrown and discarded their own earlier conceptions—witness the Scandinavian legends. But many ideas still survive.

All of these surviving ideas of Man's origin which have been inherited from the Past are based on an ultimate "Authority". They are authoritative statements in that men have received them by document or word of mouth from sources which they credit as truthful. No demonstration of their truth is possible. Unlimited credit must be extended to them; i. e., faith.

Note now the profoundly significant fact that these accounts are diverse and conflicting. They cannot all be true—though they all claim to be. Only one can be true, if indeed that one can be identified. Not that deliberate deceit was practiced in launching these explanations. Most of them are growths, not full-built launchings; like folk tales, like the Homeric poems. But unreliable as statements of fact, nevertheless. What they do tell truthfully is what the people who constructed them thought,—or what the translators thought they thought —or what the copyists thought they ought to have thought,—or what the priests think we ought to think they thought,—or some combination of these factors.

This welter of "authoritative" answers which in the Past have come out of the persistent questioning of

"whence came we, and how, and why?" is in striking contrast with another type of answer that has been advanced during the past century. Instead of "Authority" as the source of information, "Evidence" is appealed to. Whether correctly interpreted or not, Facts have been used in building the explanation. And a different method of thought has been used than any other ever before in the field. I refer to the scientific explanation of Man's origin, some of whose fundamental facts and inferences I shall present this evening.

What is this method which differs so markedly from any other? One essential feature of the method of Science is that the search for Truth must be made calmly and dispassionately, without pre-conceptions or pre-judgments. The only emotions permitted are the joy of discovery and the love of Truth. Another essential feature is the painstaking labor of discovery and collection of all available evidence, and the careful testing of every scrap of that evidence. No guessing is allowable. Another essential feature is the submission of every conclusion, whether major or minor, to the vigorous criticism of every one who is informed as to the facts. No other criticism is worth anything. Only thus will the true meaning and relationships of facts be revealed, and this is the purpose of Science. If Truth is to be found this method will not miss it.

Scepticism is essential in the scientific method. Anyone who has ever proposed a really new idea has discovered this fact. Doubt and challenge constitute one means of intellectual progress. We would still be savages if it had not been for scepticism. Modern medicine began when someone doubted the efficacy of the witch-doctor. Modern science could never take origin until after the myths of primitive man had been challenged. Paganism must needs be questioned ere Judaism or Christianity could have their beginnings.

All generalizations used in the scientific explanation of the Origin of Man are inferences. I have indicated that we do not know. The drama was played long since. None of us saw it played. The theatre is still here and we can prowl around back of the scenes and examine the

discarded properties and other records of the players but at the best we only infer the character of the play. Inferences, however, are just as fundamentally a part of the "Authoritative" interpretations.

Since Science holds that Man is a product of organic evolution, let me say now that there is no absolute proof of organic evolution! But, for that matter, we have no absolute proof that the Battle of Thermopylae ever occurred, or the Battle of Waterloo; that Alexander the Great ever lived, or Aristotle, or Jesus of Nazareth! We have no absolute proof that Electrons exist! Or atoms! No one has ever seen them. We do have certain documents on which we rely more or less for our history of Man. We do have certain phenomena which find their best explanation in the atomic theory and the electronic. We do have evidence dealing with the prehistory of Man. We rationalize the facts we have, for they mean something; and our best thought in terms of such knowledge as we do have leads us to these theories.

From what sources has Science collected the evidence on which her interpretation of the Origin of Man is built? There are two unrelated sources available. One is the character of Man today. It includes comparison of Man's body with the bodies of other animals (comparative anatomy and blood tests), and the sequential changes of individual development before birth (embryology). The other source is the pre-history record of Man, and its data come from Geology and Paleontology and Archeology. In a very cursory fashion, because we have but an evening together on this subject, I shall sketch the leading facts and inferences contributed by these sciences. It is unnecessary for me to emphasize that there has been nothing sketchy about the building of these sciences. If there is a comparative anatomist present or an embryologist, or a geologist, or paleontologist, or anthropologist, he will be displeased with me because I do not do his subject justice. I plead brevity of time as my defence. We who read tonight are running through a vast region of knowledge at top speed. A lifetime would be necessary to master it all—and we have less than two hours! No one has a right to chal-

lenge any interpretation I present to you on the ground that my facts do not adequately support them. I cannot present all the facts. No one has a right to challenge any interpretation until he is well-informed on the facts which support it. I have it from a well known lifelong student of the evolution of plants that he once encountered the best-known opponent of the scientific interpretation and asked him point-blank how much he knew of theories or evolution (for there are many, Darwin's is only one of them) and was told "I don't know anything about them! I don't want to! It is all wrong". That, of course, is pre-judgment and has no place in the search for Truth.

EVIDENCES FROM BLOOD TESTS.

I shall take up first the evidence from blood tests. The serum of human blood, injected into a rabbit after separation of the red blood corpuscles and fibrin by coagulation, causes the formation of a substance in the rabbit's blood which the biologist calls an anti-body. It is similar to the anti-toxin formed in the blood of a horse after injection with the diphtheria virus. Now the serum of the rabbit's blood, containing the antibody, will form a white precipitate if mixed with more human blood. It will do this, even though the human blood is old and dried. But no precipitate results if the rabbit serum be mixed with non-human blood.

By using stronger solutions and more time than the standard legal blood tests require, quite distant relationships can be brought out. Reactions with the blood of the man-like apes (the Anthropoids) closely resemble those obtained with human blood; the blood of the Old World monkeys comes next; the blood of the Marmosets and New World monkeys gives but a slight reaction and that of the Lemurs (Man's most distant relatives among the Primates) gives no reaction. This harmonizes perfectly with all other evidence as to relationships among the Primates.

Thousands of blood tests of this character have been carried out on all kinds of vertebrates, and even on many invertebrates, with the same indications of relationships

that had been concluded earlier on other evidence. It seems (this is one of our inferences) that certain chemical characteristics in the blood of related groups of animals have persisted throughout the long evolutionary history from the time of divergence from a common ancestral stock. Blood tests have very strongly confirmed the theory of evolution which was built on entirely different evidence in the first place. One of the best tests of any theory is the discovery of new and crucial facts, unknown when the theory was built.

EVIDENCES FROM COMPARATIVE ANATOMY.

Under Comparative Anatomy, I shall consider what are known as "vestigal structures," merely mentioning in passing that the only differences between the skeletons of Anthropoids and Man are those of proportions. Every bone is duplicated. Any one familiar with the anatomy of Man and the Apes must admit that no hypothesis other than that of close kinship is adequate to explain this extraordinary identity of structure. To deny this kinship is to deny the use of comparative anatomy in indicating genetic relationships among any animals. If wolves and dogs, cats and tigers, rats and mice, frogs and toads, are not related by descent, they are related only as different factory models, such as coupes, sedans, roadsters, etc. This is the old argument for design in Nature, and has been in the discard among informed men now these many years.

The word "vestigial" involves an inference. We mean by its use that such structures are but vestiges of formerly functional structures in the ancestral history. Since most of these vestiges are in the soft parts of the body and since our fossil record is limited to the hard parts (bones, etc.), we can't prove that these structures had fuller development in long-past generations. We have simply these "documents" which the vestigial structures constitute. Still, this is no limitation in our conflict with "authoritative" interpretations of Man's origin, for all these depend wholly on documents.

Nictitating Membrane. All vertebrates, from fish to mammals, have in the inner corner of the eye a semi-

transparent eyelid called the nictitating membrane. In amphibians, in birds and in some reptiles, this membrane sweeps rapidly across the eyeball to cleanse it. Watch your Poll Parrot to see it in action. In mammals, including Man, it is present as a functionless rudiment or vestige. Our inference is that organic evolution has carried the mammals beyond the need for it but hereditary inertia still persists in constructing it in each individual. Since Man possesses it also (the plica semilunaris), fair-mindedness demands that we acknowledge our kinship and our descent or ascent from the same stock.

Vermiform Appendix. Man carries a wholly useless, and on occasions a very expensive, blind tube which opens off the caecum or upper end of the large intestine. Everybody knows of it as the "appendix". Now an appendix is usually considered as something added, to increase the value of that to which it is added. Not so here! It has not been added, nor does it increase the value of anything—except the surgeon's bank account. In herbivorous mammals, the appendix vermiformis, or its homologue, is large and has a definite digestive function. In some of the herbivores, it is as long as the entire body. In Man, it develops in the embryo to the same diameter as the large intestine but it does not grow after birth, and as I have said, has no known function except that of keeping surgeons busy. It is a vestigial structure, inherited from our ancestral stock.

Muscles of the External Ear. Dissection of the human scalp reveals the existence of a set of muscles for lifting the external ear, and for twitching it back and forth. There are eight separate muscles involved. But can you use them? Very few people can. The Anthropoid Apes possess the same musculature but are similarly helpless to command it to function. But in the Barbary Ape, the baboon and other tailed apes, and in the monkeys, these muscles are functional. Why do we and the Anthropoids have them, if they are not vestiges of a common ancestral possession, abortive in certain branches of the family tree today?

Of similar import are certain scalp muscles, functionless in most of us and used only by a positive will to do so by others.

Hair Tracts on the Human Body. That there is an irregular distribution of hair on the human body is nothing new to you. Everybody knows it. But, like every other phenomenon under Heaven (and, indeed, in the Heavens) it is a member of a cause-and-effect sequence. Why should our bodies have dense pubic, axillary and cephalic hair, and sparse hair elsewhere? Among us today, there are two explanations current.

(1) Man was made (i. e. created) that way.

(2) Man's hair pattern is inherited from pre-human ancestry and has been modified to the present distribution by the habit of wearing clothing.

Everybody will accept the inheritance hypothesis if you don't push it too far. For example: both of my children possess a so-called "cow-lick" in the hair close to the upper forehead line and a little to the right of the mid-facial line. Now I don't—and I can prove by certain photographs taken years ago that I never did. Nor does anyone among my immediate blood relations. But my wife does! So does her father, her sister and her brother. No one has any difficulty in believing that this feature in my children is inherited from their mother's family.

This is a variation in hair pattern among different members of the same species. Let us now consider a feature which is constant in the species. It is the hair pattern on the back of the forearm. You will find on your own arm that the hair on the upper arm and on the back of the hand grows down as all hair should if it is to serve as a thatch. But on the forearm, it points upward and backward toward the elbow. No other mammals have this peculiarity except the Anthropoid Apes and certain South American monkeys. Some of these creatures have been observed, during rain, to place their hands on their heads. In such a posture, this orientation of the hair serves perfectly as a thatch.

Now, whether or not this hair pattern is due to the habit of making a roof of the arms, its possession by a

group of animals, closely related in the blood tests and in many other ways, indicates clearly that the pattern is a hereditary feature, just as does the "cow-lick" variation in my children.

The males of our species grow hair on chest and abdomen, often a heavy coat of it, but neither males nor females grow it on the back. If the race has lost a complete hair cover by reason of climatic change, it should be sparsest on the more protected side, i. e. the front. But if it has been lost through the use of clothing, it is perfectly normal that primitive men, wearing primitive garments of skins thrown over the shoulders, should lose the back hair first and most completely. Apparently the race hasn't yet worn a complete cover of clothing long enough to equalize the distribution.

Pineal Body. A peculiar process of the mid-brain, particularly of the optic lobes, is the pineal gland or body. It is found in all vertebrates. It grows out from the upper surface of the brain and ends just below the skull, or perforates the skull at the parietal foramen and ends beneath the skin. It was first identified in Man, I believe, and was early thought to be the seat of the Soul. This for two reasons which you are welcome to evaluate as you may. (1) One reason was that no other use for it could be discovered. (2) The other reason was that no other place for the Soul could be found.

Then the New Zealand "Sphenodon" was dissected. Sphenodon is a very archaic type of reptile, amazingly like the ancient fossil reptiles in his skeletal structure, and quite different from lizards, snakes, crocodiles and turtles, the other reptiles of the present. In Sphenodon, the pineal gland was found to have 1—a transparent scale covering the terminus of the gland, 2—a lens, 3—a vitreous humor, 4—a retina, and 5—a nerve stalk connecting with the optic lobes of the brain. Though not functional even in this "living fossil", the pineal gland is clearly a cyclopean eye which was possessed by very early vertebrates. Man has the abortive or vestigial pineal eye, also! Ergo, Man has come from the same very primitive vertebrate stock. Or, if you insist, it is

the seat of the Soul. If so, however, you must grant souls to fish, frogs, flamingos and furseals.

Supernumerary Nipples. Man is a Primate. The Primates include those mammals whose brain-box is relatively large, forebrain highly developed, fore limbs adapted for grasping and terminating in hands with flat nails, teeth adapted for a mixed diet, and two mammary glands on the breast. All other mammals have more than two mammary glands, generally distributed in two rows along the ventral side of the body. In our domestic cattle, they are grouped on the groin.

Not infrequently in Man occur supernumerary nipples, arranged in two rows as in our domesticated carnivores, the dog and the cat. In every human embryo the two rows begin to develop but commonly all but two disappear before birth, and no more than two ever function. This phenomenon of supernumerary nipples means something. The inference of the comparative anatomists is that it is reversionary to primitive mammalian stock, from which modern carnivores, herbivores, primates, etc., have descended.

Opponens Hallucis. In the hand of Man, the thumb or first digit is opposable to the rest of the digits, and this arrangement makes of the hand a remarkably effective grasping appendage. In Man's foot, however, the great toe is closely appressed against the others in the same plane and cannot be opposed, which in the Gorilla and Orang-Outang, opposability is well developed.

Yet there is sometimes found in the feet of some men a non-functional muscle, identical with the one used by the anthropoids in opposing the great toe. This, the opponens hallucis, is inferred to be a survival from the primitive ancestral stock from which Man and the Anthropoids have both descended. Can you suggest a better explanation?

Grasping Power of Very Young Infants. A newborn human infant is about the most helpless creature in the world. He can make only one adjustment of the many which are essential to his life. He can ingest liquid food by the act of sucking. Everything else has

to be done for him. Similarly, new-born apes and monkeys are very helpless but they do one other thing well —they cling to the mother with a tenacious grasp.

Now here is a chance to test our hypothesis of the origin of Man. If he has descended (or ascended) from ancestral stock which also gave rise to the apes and monkeys, and if the habits of that stock were arboreal before the differentiation, we might expect young humans to possess some trace of the trick of holding tightly onto the mother as she climbs about the trees. The original investigation of this question was conducted with about 60 babes, from a hour to three weeks old. It has been checked by thousands of experiments subsequently. Here are the results of the original investigation.

Thirty infants an hour old grasped a stick and held their entire weight suspended for ten seconds or more. 12 held on for half a minute, 4 held on for a minute.

When four days old, 50 of the 60 held on for half a minute or more.

When three weeks old, this ability was at a maximum, several holding their entire weight suspended for a minute and a half, two for two minutes, and one for two minutes and a half.

In no case did the babes utter a cry or give any other signs of distress until they let go. In all cases, the infants' legs hung in the typical simian baby position, for the young monkey or gorilla clasps with legs as well as grips with hands.

This ability to sustain its own weight is remarkable in a new-born child, whose muscles are so weak that it cannot even sit up. It is a feat that many a healthy adult cannot perform. It is of no use to the human infant. Why does he have it? Only one logical answer has ever been proposed!

I shall now close the list of vestigial structures, once called "useless scaffolding left in the body". But not because it has all been recited to you. I am told that 150 distinct features of this character have been found. Enough has been presented to show you the nature and significance of the evidence from this source. If you examined one of the older buildings in your city,

and discovered bricked-up, soot-stained flues in the walls, though the building may now be heated by radiators and steam pipes, you would conclude that formerly it had been heated by stoves or fireplaces. If you found that rectangular holes, a foot or so in dimensions, had been cut in the flooring and subsequently closed by new flooring, one to every room, and that plates and sills had been cut beneath them, you would conclude that, subsequent to the stoves and fireplaces, and preceding the present steam-heating plant, this building had had a warm-air heating plant. The argument from the vestigial structures in the human body is closely analogous. It isn't homologous, and of course is but an illustration, not a proof.

EVIDENCES FROM EMBRYOLOGY.

Let us now consider some of the striking contributions of the science of Embryology to this question of the origin of Man. Each human individual starts with the fusion of a sperm cell and an ovum cell. These are the gametes. The fertilized egg, the zygote, is about 1-5 of a millimeter in diameter, barely visible to the unaided eye. Except for its potentialities it is like any one-celled living animal. It encysts itself in the uterine lining and multiplies by very rapid division until it is a solid spherical mass of cells. The marvelous cell structure and the intricate mitotic changes in this multiplication are barred from this discussion. We haven't time to outline them. But there is in this subject alone almost a microcosm. It differs from the world that we see about us more than the imagination can conceive. Only months spent with the microscope can convey to you an appreciation of its nature.

Shortly, this spherical mass of cells develops two cavities and thus two surfaces, an outer and an inner. A little later, continued multiplication of cells and increasing size of the embryo develops a third or middle layer of cells. These three are called the primary germ layers, and all animals above the sponges have essentially the same stages to this point in development. Further changes follow quickly and the mammalian type of embryo soon appears. From the outer layer of cells de-

velop the skin, the hair, enamel of the teeth, and the entire nervous system. From the middle layer develop the skeleton, the skeletal muscles, the circulatory system and the sex cells and organs. From the inner layer develop the alimentary canal, pancreas, liver, and the lungs which are structurally a part of the alimentary tract.

There are several features of this development of the mammalian embryo on which I wish to touch. The first is the remarkable similarity in early stages as illustrated in the development of the embryos of the pig, rabbit, monkey and man. The different embryos in early stages are difficult to distinguish from each other. In the first stage each has 1—an enlarged head region, 2—a longitudinal structure composed of primitive muscle segments, 3—a large heart, and4—a group of gill slits and arches. In the second stage the rudimentary eyes are shown and the rudimentary limbs appear. Please note that the human embryo has a tail, actually longer than its legs. It also has the muscles for wagging it! This tail and its musculature are commonly absorbed before birth, but instances are known of individuals in which the tail persists throughout post-natal life. The tail always grows in the right place! It is either an inheritance or it is the result of design. And if designed for this individual, it seems to me a crude sort of practical joke for the gods to play.

Let us consider embryos of three vertebrates very unlike in maturity—fish, fowl and Man. All three possess gill slits and gill arches, though none of them have any use for them in the embryonic conditions and only the fish needs them in maturity. That fact that all amphibian, reptilian, avian, and mammalian embryos possess them means something. And only one thing! It means that all vertebrates, Man included, have come from a very ancient water-breathing stock. One pair of these slits in the human embryo finally becomes the eustachian tubes or canals between the throat and the ear drum. The others commonly close, though in some individuals scars persist, and rarely, complete openings through the neck.

At the time when the human embryo's gill slits are open, its heart is two-chambered, like that of a fish, and

its entire circulatory system is like that of a fish—arteries and veins for gills existing and none of the pulmonary arteries and veins being developed. Later this condition is modified, a three-chambered heart appearing as in the Amphibia and finally a four-chambered heart. The gill circulation system disappears, the lung system develops, though up to the time of birth, the blood of the embryo is aerated in the maternal placenta.

Another startling thing about the human embryo in its later development, after it assumes mammalian characters, is the presence of a heavy and complete coat of fine, dark hair—the lanugo. This disappears before birth. If it had any utility, if it were designed for any purpose other than to puzzle embryologists, it would be needed after birth, not before. When considered in connection with the hair tracts of adult Man, this complete furry coat of the unborn human embryo makes out a strong case for something more than a fig-leaf girdle for our progenitors. We may not like these facts and their obvious implications, but we cannot ignore them.

Embryos of other vertebrates bear similar witness to ancestral characters. The unborn balleen whale has hair, teeth, and rear limbs, though the adult has only a few bristles and no vestige of either teeth or rear limbs.

Such conclusions as we have reviewed may be repellant to us. But if they are justified, we must adjust ourselves to them—we cannot change the evidence. You know that men generally believe what they want to believe—that is, they think with their emotions rather than their reason. And they generally want to believe what they were taught early in life. Thus Conservatism flourishes, and instead of rushing into new mistakes of radicalism, we continue to make the same old mistakes. It is for us to decide whether or not the human reason is a safe guide, and whether our minds are open or closed.

EVIDENCES FROM GEOLOGY AND HUMAN PALEONTOLOGY.

We pass now to the second main division of the subject—Evidences of the origin of Man from Geology and Human Paleontology. What is the character of the geologist's record? How does he read it? Let me illustrate with this region for an example.

Here at Harrisburg are certain geological formations exposed in the hills south of the valley, and mines entering other formations beneath the valley floor. Strata of coal, shale, sandstone, and, farther south, limestone, are involved. The total thickness is very great but is only a small fraction of all known stratified rocks of the Mississippi Valley. The limestones along the Ohio dip under the sandstones of the hills, and these sandstones dip under the coal in turn. The lowest formations are the oldest, for they were deposited first. That these rocks are the cumulative deposits of sands, clays, limey debris and peat is obvious for the contained fossils record marine waters or swamps. There can be no reasonable doubt as to these conclusions.

Above these sedimentary rocks at Harrisburg and to the north is a curious deposit, or series of deposits, which was laid down under quite different conditions. It is the glacial drift, and its modified forms made by the water which resulted when the ice sheet melted. Again, I must carry you along rapidly without stopping to prove to you that this material is of glacial origin. No one conversant with the facts doubts it today though when the idea was new, there were many conservative minds which refused to accept the explanation. The central plains of the Mississippi Valley record at least four, perhaps five, such stages of glaciation after the marine and swamp deposits were made. Intervening epochs of deglaciation are recorded also, with certain evidences of the altitude and character of the land surface, of the climate, and of the plants and animals which moved into the region when the ice sheet waned, only to be driven out again with the next refrigeration of the climate. Its an exceedingly interesting subject but not the subject on which I am announced to speak.

This is the kind of evidence on which the geologist relies for reading the Book of Earth History. In many ways it is far more reliable and in some ways more complete than the data from which we construct our history of nations. There is no personal equation, no choice, no pre-conceptions, in the selection of what is to be recorded. If error creep into our interpretations, it is our

own fault, not the fault of the writer. While in reading human history from documents, there are two places for serious error; 1—in the writing, the translating, the copying of the record, and 2—in the reading of it. I am reminded here of the comment of a certain parson on the subject of Earth History as read from the rocks and the fossils. He said that the fossils were not the record of an immensely long period of time with very slow evolutionary changes, nor were they (as some have suggested) forms spoiled in the haste of Creation in the time limits of six days. The fossils in the rocks, said he, have been placed there, telling an apparently consistent story at variance with a literal Genesis, to test your faith in Holy Writ.

The History of Man goes back but a very short time as the history of the Earth is measured. Man appeared only yesterday, geologically, though for eons of time conditions were shaping for his appearance. Our record of fossil man is very meagre, for Man is a dry-land animal, and most of the evolution of life is recorded in water-laid sediments where conditions for burial and the checking of decay were most favorable. Man, who is not aquatic or amphibious, did not live in such places.

Furthermore, most of the sedimentary rocks of the globe were deposited long, long before Man appeared. Fossil Man probably does not antedate the Pleistocene or Glacial Period.

Pithecanthropus. The earliest trace of the human family in the geological record is the famous "Pithecanthropus erectus" or Ape-Man of Java. It is also known as the missing link. It was found in river terrace gravels along the Bengawan River, near Trinil, Java, in 1891. Its discoverer was Dr. Dubois, a Dutch army surgeon. Only the skull cap, three teeth and the left femur were found. These were associated with the remains of numerous extinct animals. The age on the basis of these associated fossils is early Pleistocene or later Tertiary. Though Java had no glaciation during the Pleistocene, it went through the glacial period just the same.

These fragments were at once recognized as human or closely related to human, and they have since been

carefully scrutinized and measured by many of the world's greatest students of Anthropology. From these few relics, they compute the size of the brain, they determine the essentially human character of the dentition, they assert that the creature walked erect and they indicate its height. How do they do this? Let me answer by analogy. You may go into the details of the literature if you are still unsatisfied.

Each one of us has some speciality, either a hobby or a profession, in which we are better informed than the average man. The subject matter may be postage stamps, or radio, or the gasoline engine, or birds, or dogs. Let us say it is stamp collecting. You have an opportunity to examine a lot of old United States stamps. Though no dates be on the stamps, you can date the issue, for you know the secret marks which distinguish the 1873 issue from the 1870, or you find the grill, or the watermark, or you count the perforations, and quickly distinguish one issue from another. I, the uninformed, am hopelessly in the dark. Or it is radio. To you, grid leaks and rectifiers and impedance and variometers and microfarads and audio frequency mean something definite—to me they are jargon.

In the same way the trained anthropologist can tell from dozens of little features of a skull (features which you and I would never even see, though we held a skull in our hands) that its owner was Mongoloid, Negroid or Caucasoid. He can distinguish the sexes. He can differentiate fossil skulls as of different races without knowing the locality of the find, or the stratigraphic horizon. I shall have to ask you to be content with my parallels, for our time is too brief to allow us to dip into the subject of skulls and skeletons, except in the most superficial way. But if you have any lingering doubts or awakened interests concerning these discriminations, I shall be glad to tell you where you can dip as deeply as you like, and where you will come up wholly convinced, assuming that you have an open mind.

Regarding Pithecanthropus, the conclusion reached by all but one prominent anthropologist is that he was a primitive type of human, not ape. All agree that his

age is between 500,000 and 1,000,000 years. The restorations commonly seen have a good deal of the artist in them.

Homo Heidelbergensis. Probably next in age to Pithecanthropus is the Heidelberg Man," "Homo heidelbergensis". All that we have of this stage in Man's evolution is a lower jaw—but it is complete. It was found in river sands and gravels at Mauer, near Heidelberg, Germany, in 1907, 80 feet beneath the surface. These sands and gravels are of Pleistocene age, as must be, therefore, the entombed jaw. The jaw is very primitive, heavy and massive. It lacks the chin prominence, so characteristic of modern man, and in this respect is more like that of a gorilla. The ramus, or portion to which the masticating muscles were attached, is also simian in character. But the teeth are distinctly human. There is the horshoe curve, instead of the two parallel rows which the apes have and there is no greater development of canines than in modern man. Opinion of anthropologists unanimously places this jaw so much closer to Man that it bears the name of the human genus —Homo.

No cultural relics have been found associated with either Pithecanthropus or Homo heidelbergensis. But chipped flints of equally great antiquity are known from other localities. These are the much discussed Eoliths. Are they the first rude beginnings of Man's use of tools, or have they resulted from fracturing and chipping by frost and waves and streams? Opinions differ on this very widely, and I have nothing definite to offer you. It is one of our unsolved problems.

Eoanthropus Dawsoni. I have indicated differences of opinion about Pithecanthropus, though they now are much less than formerly, and unanimity concerning Homo heidelbergensis. The next oldest human relic is known as the Piltdown Man, from Sussex, England. It was discovered in 1911. About it, controversy raged hotly for a time for its implications are singularly diverse. The find was simply a group of fragments of the skull, a canine tooth and a fragment of the ramus of the lower jaw with a few molars in place. The fragmenta-

tion was due to a blow from a workman's pick during excavation. The discovery was made after the gravel in which it was embedded had been shovelled over and mixed. Though the skull fragments were pieced together satisfactorily by the anthropologists to show a primitive human brain case, the jaw was distinctly simian—without a chin, and with simian accentuation of the canine. One group of students concluded that the jaw and skull did not belong together that the skull was human but that the jaw was once the property of a primitive chimpanzee. Nothing in the facts of the case could settle the dispute.

But if scientists believe in a Providence which guides men toward the Truth, they must admit its working when another discovery was made in the same deposit a few years later, of the same type of skull and associated with it in place the same type of jaw and teeth. The dispute has nearly died away now, save for a few irreconcilables, and the Piltdown Man, Eoanthropus dawsoni, takes his place as an early type of human. His ape-like jaw, however, bars him from our genus, Homo. He apparently represents a branch of the human family which died out. The probably older Heidelberg Man is more nearly related to our line of descent. Between the time of Heidelberg Man and of Piltdown Man occurred the third of the four recorded Pleistocene glaciations in Europe. Both lived in interglacial times but Homo heidelbergensis was probably something like 200,000 years older.

Homo Neanderthalensis. If you begin to feel disappointed because of the fragmentary character of our fossil men, be cheered by the fact that post-Piltdown remains are far more numerous and consist of fairly complete skeletons, associated with relics of Man's culture. This is because post-Piltdown Man lived in caves and rock shelters and buried his dead in these protected places.

In 1856, workmen uncovered what appears to have been a complete skeleton in a small cave in the gorge known as the Neanderthal, near Düsseldorf, Germany. Much of it was scattered and lost before its significance

was recognized. Its announcement as a relic of primitive man made a great sensation at that time for the first battle between Science and Theology was then raging. That war apparently isn't over yet! The usual opposition developed, the rival contention being that it represented a dwarfed and diseased individual of modern Man. But more skeletons of this well-marked race have come to light in Europe since 1856, occupying the same stratigraphic horizon, and all scientific men are now agreed that we have in this Neanderthal skeleton the type of an extinct race of men, Home neanderthalensis.

Neanderthal Men were not more than five feet, three inches tall, the women even less. They did not stand erect, as the curved femur, the lack of reverse curves in the spinal column and the position of the foramen magnum shows. The skull was set forward on the spinal column and gave the face a forward thrust somewhat like that of the gorilla.

The skull has a low and receding forehead, prominent and enormously heavy and continuous supraorbital ridges, a large nasal opening, prominent muzzle and no chin. The dentition is distinctly human.

Anthropologists and geologists are agreed as to when Neanderthal Man lived. Not in an interglacial epoch, but a glacial! The ice sheet reached from the Scandinavian highlands across the Baltic into northern Germany when this race lived in Europe. A very cold and very wet climate then obtained as far south as northern Spain and northern Italy. We know this from the skeletons of Arctic animals associated with Neanderthal skeletons in the cave debris. The list includes the woolly rhinoceros, the woolly mammoth, Scandinavian reindeer, muskoxen, arctic foxes, hares, ptarmigan and lemmings. The Arctic mammoth got as far south as Rome.

And Neanderthal Man had a culture. He had fire, he had hunting weapons, and cutting tools of flint (the lower Paleolithic), he buried his dead. He must have had some kind of a language. Perhaps burial of the dead means that he had notions of a future life.

That culture was exceedingly primitive, however. To illustrate, one of my youngsters was recently looking through that great book which appeals to all manner of men—the Sears-Roebuck catalog. He raised the question "Daddy, what would the Cave Man have thought of all these things?" I asked him to select the articles from that wonderful display of our modern material needs which he thought Homo neanderthalensis could have understood and used. And all that he and I could find was a hatchet, a knife, a maul and a blanket.

Cro-Magnon. But Neanderthal Man did not hold his place. His race became extinct with the waning of the last ice sheet. Europe became peopled with a new race of Men, invaders who clearly did not descend from Neanderthal Men. They had developed elsewhere, probably in Asia, when Neanderthal men held Europe. The new race, of post glacial age in Europe, is known as Cro-Magnon Man. Here we have the first record of our own species, Homo sapiens.

Cro-Magnon Man is, in almost all respects, the most perfect physical type of human that we know. The first specimens came to light in 1852, though it was some time before they were recognized as stone-age men. Now we have hundreds of finds. The men were six-footers. The skeleton indicates a fully erect posture, not the slouching attitude of the Neanderthalers. The skull show a brain capacity equal to that of modern Man, and a profile very similar. There are no great supraorbital ridges, no enormously wide noses, no muzzle, and there is a typically modern human chin. Restoration shows a countenance almost as well proportioned as in the finest races of men today. Yet the Cro-Magnons have been extinct for 25,000 years.

The Cro-Magnon race had a remarkable culture. Their flint and bone tools were beautifully worked and remarkably varied, they carved in ivory and bone, they drew and even painted in polychrome on the walls of their caves. The evolutionary stages of their culture are well worked out, the Aurignacian, Solutrean and Magdalenian being the best-known stages. Yet Cro-Magnon Man did not hold Europe till the dawn of his-

tory. He was replaced by new invaders, the Nordic race of northern Europe (the blonds), the Alpine race of central Europe and the Mediterranean race of the southern part of the continent. These three races came from the southeast and east before the pre-Greek culture of the Cretans developed about the Egean Sea.

Was Europe the home of Man? Our record seems almost wholly confined to that continent but it probably is because only that continent (save North America) has been studied at all intensively for its history of the Past. North America seems to have no record of ancient Man. Asia seems more probably to have been the homeland of our genus and species, and the European races of pre-history and history seems to have migrated into Europe from the larger land mass. Africa is now yielding remains of primitive races and their culture, but whether it originated them or received them as immigrants is not yet known.

It is not my purpose to go into the culture of primitive man. I shall simply note that the Neandethal race is the oldest race with whose remains the flint weapons have actually been found associated. It isn't difficult, it is, for people in any part of the United States to believe that pieces of flint shaped like knives and arrow heads are the implements of a primitive race? Our fathers found the American Indian using them (sometimes they tried to use them on grandfather) and we unquestioningly interpret the arrowhead we find in the field as a relic of their culture. The American Indian was still in the Stone Age when his dispossession of the continent began.

But for almost all of the 3,000 years of recorded history in Europe, these cultural relics of early Man were thought to be thunderbolts, or petrified iron implements, or of Roman origin, or the work of supernatural agencies. And so they must still be considered if we follow literally any "authoritative" account of the origin of Man. Only by the scientific explanation of Man's immensely long ancestry and immensely slow development can we accept them as actual tools. The whole difficulty in accepting the scientific explanation lies in the conser-

vatism and the egotism of our race. We have been taught that the Universe is anthropocentric, and we like the idea. If we could get a completely detached view of our race, as we conceivably would view intelligent Martians, or as they would view us, and if we knew nothing of the lore which we have heard since childhood, our difficulty would not exist.

I wish now, in closing, to generalize the high lights of the picture of Man's evolution. In what respects does Man differ from the other animals? One great distinction is his possession of articulate speech. That seems to date back as far as Heidelberg Man. Indeed, the temporal lobes of the brain, which have to do with speech, are well developed even in the skull indentations of Pithecanthropus. Speech, however, never would develop without a need for it, and the need lay in Man's power of thinking in relationships and abstractions. This is a matter of the brain. Not of the size of the whole so much as the size of the parts known as the "Association centers". These significant areas are well mapped out by physiologists, and casts of primitive skulls yield certain evidence of the great growth of these areas from stage to stage of fossil Man. The association centers of the brain enable Man to meet predicaments and to extricate himself from them. He has not been forced to develop horns or tusks or fangs or claws or hoofs or a body armor. His wits have enabled him to survive without such physical specialization, and that same lack of physical specialization enables him, with the use of his brain, to adapt himself to an amazing variety of situations, compared with other animals.

I wish also to present our family tree. The roots of the tree strike back many, many millions of years; the base of the trunk dates some 50 million years back. The branching off of the first primitive monkeys is far, far back and since then have had no share in our line of descent, the first primitive apes similarly have been separated from our line subsequent to their divergence, and the first appearance of the human family, ancestral to the fossil and living races is later. No one with any knowledge of the subject thinks that Homo sapiens came

from any genus of monkeys or apes. Nor was this idea ever held by Science. To charge Science with such an absurd statement is to placard oneself as grossly ignorant. In the terminal part of the tree Professor Elliott Smith, its author, places Eoanthropus earlier than Heidelbergensis. He is almost alone in this, though he may be right. Note the blind endings of Pithecanthropus, Eoanthropus and Heidelbergensis branches. They became extinct. Cro-Magnon is not shown for Professor Smith evidently thinks that this race gave rise to the Nordic, Alpine and Mediterranean races.

A question of vital moment has arisen in the minds of many of you tonight. What is the meaning, the significance, of this scientific interpretation of the origin of our kind? Although it is probably true, would we not be better off if we had never known of these things? The evening is far spent and I cannot give much time to an answer, if, indeed, I am capable of answering.

You and I both respect and honor modern England and modern Scandinavia, which have climbed to their present status of culture from barbarism in the time of Julius Caesar, more than we do modern Greece and modern Italy whose former greatness far outshines their present. And to me, the conception of an upward climb of the entire race from lowly ancestral beginnings to our present status is more ennobling and more inspiring to all individual and social high endeavor than the older view of Man as "fallen" and as doing penance.

Clearly to recognize the lowly origin of Man is clearly to understand the nature of his innate disharmonies. We see the primitive traits of hunger, sex, acquisitiveness and pugnacity as perfectly normal inheritances which are too frequently disharmonic today in our elaborate social structures. These primitive urges must be socialized in the group and sublimated in the individual to the spiritual ideals of our best thinkers. Helpfulness must replace hatred, among races and nations and sects as well as among individuals. Tolerance must replace Antipathy. Fundamentalists, Modernists, Catholics, Jews, Negroes, Kluxers, Nordics, non-Nordics, Frenchmen, Germans,—all must live on the same planet and

share in its bounty. This is the great lesson of Science as applied to the art of living.

The most terrible menace the race has ever faced, we face today—modern warfare. It is founded on exceedingly primitive emotions and instincts, it blights or destroys everything of value in human life which it touches, it embraces a whole nation—no one can escape. Even the victor loses! And for an intelligent race, it is utterly unnecessary. We must destroy War, or War will destroy our civilization.

Despite all that I have said tonight which militates against the conceptions of the orthodox theologians, I say in closing that Man has for his future development, no guidance that does or can excel the principles of life taught by Jesus of Nazareth.