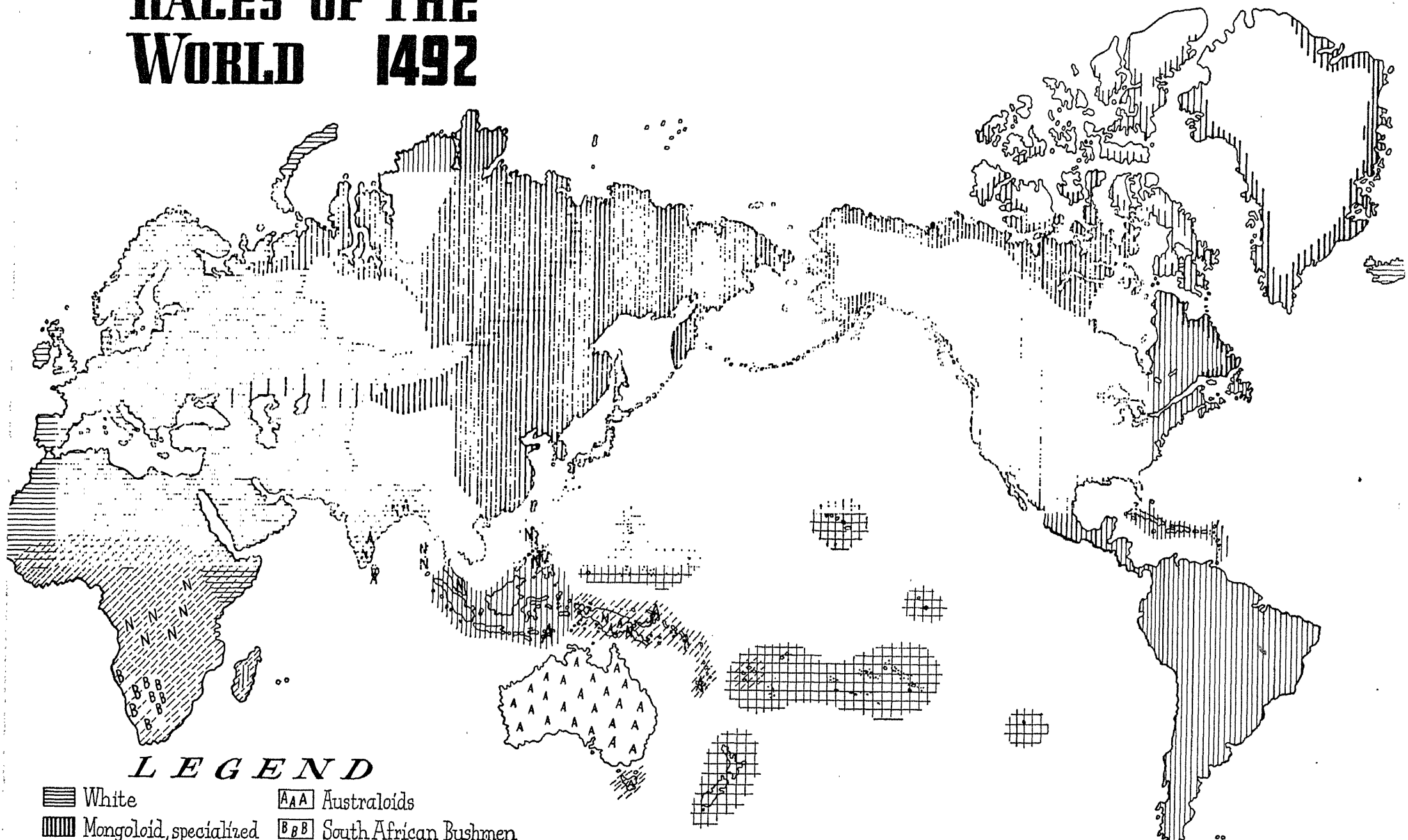
RACES OF THE WORLD 1492



LEGEND

- White
- Mongoloid, specialized
- Mongoloid, unspecialized
- Negroes
- AAA Australoids
- BBB South African Bushmen
- NNN Negritoes

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MANKIND SO FAR

This is a

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AN AUSTRALIAN ABORIGINE
MOST "ANCIENT" OR PRIMITIVE OF LIVING MEN

Mankind So Far

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To

E. A. HOOTON

Hominis sapientis,
viro sapienti

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PART I

Animals and the Coming of Man

CHAPTER I

Evolution

OF ALL ANIMALS, we men are the only ones who wonder where we came from and where we will go. The future is the more awesome prospect; it is dim, and the prophets are dismayed. But we can take a calmer view of our past, because it is water over the dam. We are totally bewildered, of course, about the beginnings of life and the reasons for our existence, and these are questions which have been grist to the mills of philosophers and myth-makers alike. But we know, roughly, what happened along the way, and that is the story of human evolution.

Man himself is the newest animal. He blossomed suddenly in a few million years (sudden, in perhaps a billion years of life on earth) upon a stem of anthropoid apes, an older lineage, which is founded in turn on far more ancient and primitive roots common to all the higher animals. In other words, that part of man's history which he can properly call his own is short indeed, and the further back we follow him, the more widely does he share his ancestors with other living species. In some ways man is a startling phenomenon: he is certainly a remarkable being, and one who himself has radically affected the course of wild life on the planet. Furthermore, you might say that, for the lord of creation, he came from a rather unexpected quarter. But viewed as a matter of history his arrival seems almost logical, given the circumstances, and he looks in this light more like a foregone conclusion than a providential afterthought. In body and brain he is simply a made-over ape, with no fundamental distinctions at all; his organization and all his parts go back, lock, stock, and barrel, to the anthropoids, and beyond them to those earlier ancestors in whom those parts first appeared. The change from ape to man, in fact, is infinitesimal compared with that from a reptile to a mammal. Man may represent the high-water mark of evolution at the present day, but otherwise he fits readily enough into the great framework of natural history, and that is how he should be judged.

The animal kingdom, as it evolves, is something like a growing spruce tree. Such a tree is covered, outside, with the young living twigs. You will find several of them sprouting in a group from the end of one twig which grew last year, and next year each of them will bud forth with two or three newer twigs apiece. The whole tree is an expanding cone, growing upward and outward. Somewhat in this way new animals have appeared, with each species tending to give rise to several other species, related but differing, as time goes on. Some evolve upward, some only sideways; but the twigs are always spreading, growing, and multiplying. Furthermore, extinct, fossil animals are like the older twigs and limbs within the outer shell of the tree. You have to look for them, but they tell you where the living species came from.

Suppose man to be at the top of the tree. Here the shoots of this spring would be the races we see today, all of them growing out of a common twig which represents the species *Homo sapiens*. This parent twig, of last year's growth, proves to belong to a cluster, these being other ancient species of man, of which Homo sapiens is the only living one. All of these, however, sprout from a still older twig, of the year before, which is the original human stem. This turns out to be one of several of that vintage, which represent all together a large and varying group of anthropoid apes. Therefore, creatures who might be called men fall naturally into groups and stages portrayed by the last three years' growth of the top of the spruce tree. Several parallel lines of anthropoids became the modern and extinct apes except for one, which turned into the human stem (the family Hominidae). From the latter there have sprung out in the last few million years a number of distinct types of man whom we know only as ancient fossils. Among these but one has survived, and in a shorter period this one has again begun the process of splitting apart, getting as far as the stage of races. That is the history of man since he first put in an appearance.

If you had such a Christmas tree as I have described, you might, by looking at it closely enough, perceive a good deal about man's relationships and his history. But there are other things which it could not very well explain. It would not tell you the subtle shifts and changes by which man became what he is, nor show how all his parts are hand-me-downs from earlier and simpler forms of life; in other words, why he has his particular nose, hands, or feet. Such are the special secrets of man's own evolution. Nor would the

spruce tree tell you anything about the process of evolution in general. So I must begin at the beginning.

I shall spare the reader the intricacies of genes, chromosomes, mutations, and so forth—all the mechanics of evolution—because they are not actually necessary here. The main thing is the pattern by which different kinds of animals have branched out from one another, or diverged; how some of them progress in a mysterious way toward higher things, while others fall behind; and how some become adapted to a particular way of life, turning into the most extraordinary specialists, while others remain general in their nature. And there is also the mystery of how and why evolution takes place at all.

Evolution and Its Probable Causes

The "theory of evolution" is an overworked term, in its popular usage, and unfortunate besides, because it implies that, after all, there may be something dubious about it. Evolution is a fact, like digestion. I have never seen my own digestive processes, but I would not be so fatuous as to cast doubt on their existence by talking about the "theory of digestion." The phrase is doubtless the expression of a die-hard prejudice. Apes insult us by caricaturing us, and when it is proposed to put them under the microscope, most people would prefer the wrong end of a telescope.

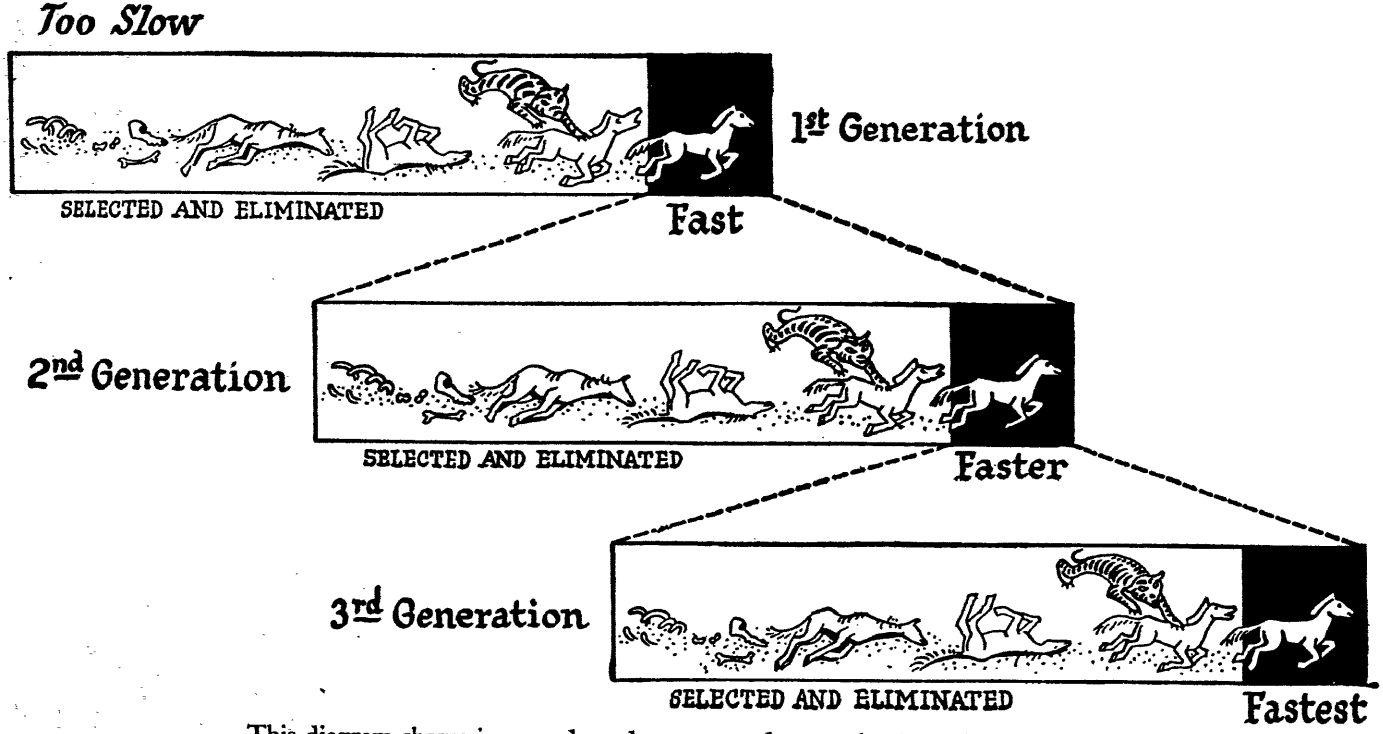
Evolution, as a word, has the sense both of development and of unfolding, and has been defined most simply as "descent with modification." In itself, it is no more than the inescapable presumption that existing kinds of life, with all their advanced or special organs, have been derived by some natural process of change out of preceding forms.[1] This idea had been voiced before Darwin, and since his time further ideas and hypotheses have developed, with regard to heredity (descent) and the causes of variation (modification). There is much uncertainty along these frontiers of knowledge, of course, but there is no confusion about evolution itself, because it is limited quite simply to the statement I have made. It does not pretend to explain how life began. That is another thing entirely. The human line, in fact, can be traced back only to the fishes. Nor is it known just why evolution occurs, or exactly what guides its steps, but Darwin produced the first really cogent answer, and in that way he made evolution respectable.

[1]See the historical sketch in Darwin's *Origin of Species*.

Darwin is supposed, by those who have not read him, to be the man who thought of evolution and who said that men were descended from monkeys. Neither notion is even half true. Evolution had already been perceived by many, and scientific men had been teetering on the verge of some sort of an acceptable hypothesis as to how it worked, when Darwin gave them a magnificently logical one. What Darwin did was to publish in 1859, after half a life of travel and of the most patient observation and study, the first consistent explanation of evolution in his theory of natural selection. This, and not evolution itself, is his monument. His reasoning and the examples he was able to cite at first hand were devastating, and the impact on the world was great indeed.

Selection is not a difficult idea, as Darwin expressed it. More animals of every kind are born than can survive, because any given species has, in its habitat, a natural, balanced density of population, controlled largely by the food supply but also by various other things, such as the actuarial prospect of getting eaten itself. But reproduction rates run high and create a surplus in the species. Therefore, only a fraction of each generation comes to maturity, and this fraction will be composed of the individuals who are best endowed, best fitted in every way to the part of the world they live in, in all its aspects, climatic or animal. This is the famous "survival of the fittest," in the "struggle for existence," which is not so much a struggle between fox and rabbit as between rabbit and rabbit. This surviving fraction, obviously, becomes the parents of the next generation, so that selection is the tendency for each succeeding generation to be ever more "adapted," or developed, in the ways most useful to the species; and so the complexion of the species gradually changes, and Eohippus, for example, becomes a horse. Now here is the point on which Darwin's theory differed from others. The change comes about not because of anything that happens to the fraction which survives—let us say one tenth—but because of what happens to the other nine tenths. They are selected for oblivion, and eliminated. Selection, then, simply alters, very slightly, the heritage of a stock, by pruning and pruning again.

It can be said right away that this view of Darwin's is out of date. Evolution is not so simple as that, and natural selection, which once bore all before it, is no longer accepted by naturalists generally as



This diagram shows in a crude and exaggerated way what Darwin meant by natural selection, as it might have affected the speed of horses. Enemies kill off all but the fastest so that, *on the average*, the next generation is as fast as the fastest of the last. In this way, the average shifts imperceptibly in the direction of greater speed (and not by leaps and bounds, as in the diagram).

the only key, or even the main one.[2] The naturalists are, in fact, still pretty much in the dark. A subdued chain is clanked now and again by the ghost of Lamarck who, preceding Darwin, thought that effects produced by environment or by use and disuse on living animals could be bred, as the generations progressed, into their offspring, giving rise to evolution in this way.

Not long ago it was felt that Darwin had silenced Lamarck for good, but there is now less certainty. Moreover, some of the evidence of Darwin and his followers has been found faulty, and the reality of certain things which he assumed, such as the severity of the struggle for existence, is in doubt. It is also true that much has been discovered since his time, particularly in heredity, and that Darwin was somewhat mistaken as to the source of the raw materials from which selection picks and chooses (not recognizing the importance of mutations), just as earlier ideas of evolution had been unaware even of a guiding principle like selection.

You might, therefore, propose to say that Darwin was wrong. This would be the utmost folly, for it was Darwin's perception of the general scheme which brought the whole theory of evolution into bloom. Later discoveries, like Mendel's laws and the theory of the gene, are only auxiliary, being a demonstration of truths which Darwin had been forced to take for granted. And the fact that his followers made out too perfect a case for natural selection does not detract from the historic effect it produced. It put teeth into evolution. A lot of diverging and piecemeal beliefs all flew together, and in a short time the doctrine was completely established in biology, and was affecting the whole world of learning and theology as well. As an explanation of creation, natural selection is purely mechanical in its workings, and it showed God moving in a more mysterious way than had ever previously been allowed for. Darwin was a great scientist, and for better or for worse he was responsible for much of the philosophy of our times.

Evolutionary Radiation and the Appearance of Species

Whatever the causes of evolution, its primary and most obvious effect is radiation. This is the branching out of types, according to the spruce-tree simile. It is expressed, in fact, in the system by

[2]Darwin was himself acutely aware of many difficulties and did not consider it as the only agent of evolution. He was perhaps out-Darwined by some of his followers.

which animals are classified scientifically, called taxonomy. Any recognized kind of animal is a species, of which there may be varieties, like the breeds of dogs or the races of man. Closely allied species, like dogs and wolves, or the members of the cat tribe, go into a genus, so that the pussycat, lion, and tiger are all Felis something-or-other, Felis being the generic name. Clearly related genera in turn form families: the four apes make an example. Above this, families are grouped into orders, which again are the great subdivisions of a class, classes covering animals with certain fundamental common characters, like the mammals; therefore dogs, seals, and bears all belong to the order Carnivora of the class Mammalia. (Man himself belongs to the order Primates.) But in this science of taxonomy there can be no fixed rules for making divisions, and classifications are sometimes changed, for the fundamental reason that the whole system is merely one for charting evolutionary radiation, and this very radiation is a continuous affair, and not a mere matter of pigeonholes.

All mammals, for example, have clearly sprung from what must have been substantially a single form; meat eaters branched off from fruit or grass eaters, and, later on, among the last-named, a small and early species gradually fanned out to become horses, camels, and rhinos. Plainly, two kinds of animal can be at any distance from the fork where they originally diverged, and it is impossible to say, except arbitrarily, when this distance will put them in separate genera, families, or orders. Furthermore, if you can trace the direct lineage of any animal, you will find it to have changed so much that its own ancestors by this system must be named a different species. For example, not only did the little Eohippus father several species of living horses and donkeys which are distinct among themselves, but it also has to be classed itself as very different from all of them, barely coming into the same family. The question of how to define a species, therefore, is the pons asinorum of biology. While these facts give the zoologists an insoluble confusion to wrestle with, the reason behind them, this unbroken flow of change and divergence, is nevertheless the keynote of evolution, and is of great importance in the history of man.

In other words, an evolutionary restlessness and instability mark all living things.[3] Darwin painted too forthright a picture of species being urged along strict paths of adaptation by the lash of natural

[3]Genetically speaking, the constant appearance of mutations of all kinds.

selection. Adaptation is important. But it is clear that there is also a great deal of free evolutionary meandering, simply because it is unnatural for animal forms not to vary and change, and those which have been stable for a long time are probably partly chained to an equally stable and demanding environment. Life has no real inertia, and it would probably not have taken such manifold forms if evolution were not to some degree at random, or did not at least respond to other principles besides natural selection. At any rate, the whole vista shows us examples of both rapid and slow evolution, often in the same species at different times; and we may even find animals which look like living fossils surviving to the present along with their more evolved descendants. It also indicates that radiation makes several species out of one when all the biological factors work on an animal which is so widespread that there is not free interbreeding throughout its territory. Such a species simply falls apart.

Simplified, it is something like this: If all members of a type of animal breed together, they will share their physical features pretty thoroughly, and as evolution takes place the whole group gradually changes as one. But if such a group or species becomes in any way divided into two or more colonies, then these colonies can evolve independently, and there is no reason why they should follow exactly the same path. Their new features, from the element of chance, will not correspond. Gradually minute differences become fixed, other factors drive the wedge, and the gap widens. This is the "origin of species."

Radiation is evolution in the concrete; its historical expression and its keynote. Alone, however, it does not explain how higher forms of life came into being. By itself it does not imply that evolution means becoming better, but only becoming different. But evolution has, of course, tended toward higher organization: greater strength, speed, defense, nervous control, and so on. Animals which have these qualities actually or potentially are "progressive." Two other contrasting terms of importance are "specialized" and "generalized."

Specialization: Its Advantages and Disadvantages

A specialized animal, first, is one which is strongly developed in one or more ways, or organized along a particular line. A giraffe

is quite simply specialized in height, by modifications of both his neck and his legs. An electric eel or a torpedo ray has the particular specialization of being able to produce and deliver a whacking bolt of electricity. Specialization, furthermore, tends to increase, more or less in a straight line, since almost all such features are useful or necessary adaptations of some sort, until extreme forms may be attained. The steady development of size and tusks in the elephants, for example, is one of the clearest pages in the annals of paleontology.

The advantages of specialization are clear enough, but there are also very great disadvantages, which arise from the "irreversibility of evolution," or the principle that a species never backtracks and reduces a specialized character. This is particularly so when specialization takes place, as it often does, through loss, as in the case of the horse, who has narrowed the number of his digits down to one on each foot. "The Moving Finger writes; and, having writ, moves on." The whole of paleontology indicates, for example, that if nature ever switches on the giraffe so that he becomes in fact as overextended as he looks, he will be on evil days. He has stuck his neck out for good and all, and he will never be able to get it in again, and the difficulty will be solved only by his becoming extinct. There is no obvious reason why this should be so, but it seems to have the force of a law. Specialization, therefore, is apt to mean a sort of surrender to environment for the sake of a close and comfortable adjustment to a single way of life. It is a disguised strait jacket. There is no turning back, and, most important of all, there is practically no chance of evolution to a higher plane. The consolation, nevertheless, remains considerable, because the animal type is able to exploit its surroundings and its chosen life more fully.

Man as a Generalized Animal

A generalized animal, on the other hand, is one which departs little from the general, standard form of its forebears, as if it had the determination to progress conservatively and without distortion or not at all. In the history of such animals the evolutionary changes themselves will be seen to have been generalized, even though fundamental. Such changes have been the lungs of land-dwelling vertebrates and the warm blood of mammals. These are not specializations. They are not so much adaptations to the environment

as conquests of it; blows for freedom rather than slavery. It is the doctrine of the liberal education as against that of vocational training. It is the philosophy of avoiding ruts, even though he who follows a rut may find the going easy and profitable. There is, of course, no moral virtue in remaining generalized. It is a matter of chance.

Nor is either kind of animal necessarily inferior. There is a constant tendency, obviously, from generalized to specialized forms, since this is a one-way street; in fact, most of the higher animals are specialized. This is particularly true among the mammals; specialization generally leads to greater success, which is apt to lead in turn to large size, and the majority of our most familiar animals are relatively large. Another thing: since greater adaptation makes for success, specialized forms eliminate their own more generalized, outworn parents by the survival of the fittest. This perhaps more than anything is the reason why most fossil forms are fossil; Eohippus, for instance, could not compete with his own descendants, honest-to-goodness horses, let alone fight off the growing, specializing offspring of his little carnivore contemporaries. But generalized types are not of necessity backward and humble. They may be primitive, but they may be very progressive. This can be illustrated somewhat by the case of the eye of man and his higher primate relatives, which is perhaps evolution's brightest gem of all. It is intricate and highly developed. Not only is vision in the optical sense excellent and flexible, but it is the only eye which sees fully in three dimensions and in color. Of course any eye is specialized for sight, being useless for anything else. But the human eye, for all its intricacy, is not specialized beyond this for a particular purpose, nor does it give the impression that it might not continue evolving to undreamed-of capacities. Its improvements to date have been basic patents, so to speak, which would hardly seem to have confined its evolutionary possibilities.

It is not at all easy to find examples of highly developed animals who are more or less generalized throughout. Such a one is man himself, however, and there is probably no better illustration. This is a very significant fact indeed; it is the key to man's having appeared upon the scene at all, if anything is. Its importance cannot be overdone.

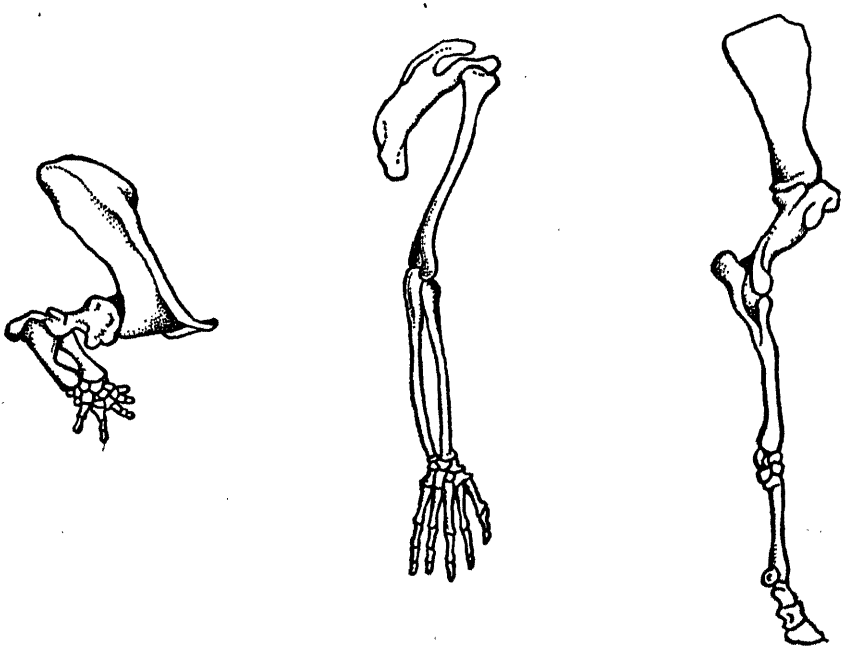
I have mentioned the human eye as a generalized, progressive feature. But you will think at once of the brain as our true crown-

ing glory. There is also nothing specialized about this; it is simply the most advanced and best of mammal brains. It is enormously developed as to size and refinement, but it is only the biggest brain in a big-brained family. Consider its connections with man's unspecialized anatomy, however. Man has long met his needs by doing things internally, in his head, rather than externally, through adaptations of his body parts. It would be going too far to say that he was driven back upon his intellect, and so developed it, because of his outer lack of special weapons or other accessories; that is assuming more about evolution than we know. But it is not going too far to say that, whatever the course by which he reached his high mental powers, he thereupon found himself unburdened by physical specializations, and was able, because of his generalized nature, to turn his hand to the most complicated of pursuits.

Only the foot of man is a really specialized organ: from the simple, almost elemental primate foot it has been made over into an arched platform. It is able also to apply a powerful force at the ball, and is thus the only foot which can take a human step. Clearly it will never go back to being the hand-like affair which is the proper primate appendage (weird as it looks to us), and in all truth our foot is our most definite characteristic. Hands are, on the contrary, extremely generalized and relatively primitive. They have the fundamental vertebrate plan, having lost relatively few elements, and this is equally true of the wrists and arms. Instead of decreasing the possibilities inherent in the primitive pattern, they have enormously increased them, gently modifying and refining the whole limb for flexibility of movement and delicacy of grasp, through such features as the rotation of the two bones of the lower arm and the opposability of the thumb against the other fingers; until altogether they have become the unfettered genii of the brain. They are the best possible illustration of the blessings of keeping undefiled a generalized form, and educating and refining it, rather than distorting it to obtain a special reward. This is a feature of primate development, and the primate hand is the order's proudest boast; yet man's hand is among the most generalized of any.

To see the force of this point of specialization or its lack, and its effects, compare man with the horse. The latter is extremely specialized, and an excellent example of the way in which specialization proceeds. He has greatly lengthened and strengthened his middle toes, while losing all the others, so that his wrists and ankles

have been moved well up his legs and have been solidified and compacted. Such is the form of the joints of his limbs that they work only in a fore-and-aft direction and are very strong and stable. Most of the herbivores are also specialized somewhat in this direction, but few so much as the horse, who for continued



AMPHIBIAN
GENERALIZED, PRIMITIVE

MAN
GENERALIZED, PROGRESSIVE

HORSE
SPECIALIZED

The skeleton of the forelimb has the same parts, from shoulder blade to "fingers." In the lowly amphibian they are simple and crude. In man, they are simple but refined, while in the horse they have become much altered in their relations, so that it is easier to see the likeness between man and amphibian than between man and horse.

existence in the wild relies almost entirely on running. A bull, for example, can fight, as can many of the horned ruminants. A rhinoceros prefers to. An elephant doesn't have to. All of them have, or once had, the horse's developments for running to a lesser degree, but they also have other protective features, and are thus less specialized in one particular way.

This specialization of the horse has made him one of nature's most admirable open-country runners, but in spite of being a bright animal as well, he has no other capacities; moreover, he will never

turn into anything but a horse. And when a race meeting is held, who is it that runs, and who takes the profit? Almost any thoroughbred horse can run a mile in a minute and three quarters. No man can do it in twice the time. But while the horses run, it is only a race meeting by virtue of a horde of generalized men, who feed, rub, train, ride, judge, rake, ush, play in the band, and sell tote tickets and pop, none of which can be done by the best horse who ever lived.

Finally, let us see how the tendency to specialize and the tendency to progress in a generalized fashion operate as opposing forces in the typical story in evolution. The pattern of this is a family line of animal life which, primarily, is slowly progressing; improving and organizing the bodily material with which it is endowed. From such a stock tangents shoot off, becoming specialized. As we have seen, such special developments may proceed a long way, and these species or types will normally become successful in a certain sphere; however, it is the still simplified main stem which goes on in the general direction of Utopia. The implication of man's being markedly generalized is that he has always been so, that he has kept to such a main stem. I am not trying to make a joke when I say that in climbing his family tree our hero has never got out on a limb, because nothing could express the idea better.

It is certain that man in all his forms has been an obscure animal, keeping out of the way throughout most of his history. During recent eons, as a little ape hanging in the trees, he looked down and saw the herbivores becoming alert and speedy runners, and the carnivores developing fangs and claws and a furious killing power. He had no such gaudy accomplishments, but he could use his hands for whatever it amused his brain to do, and he practiced at that.[4] He seems at the same time to have been accustoming himself to living in families or small groups with strong ties, for he never was a solitary animal. There was little about him to attract attention or command respect, but this lusterless past paid off at tremendous odds in the end.

[4]This implication that practice makes perfect in evolution, or that usefulness can call a bodily feature into being, is purely figurative speech, a device which I shall have to use again for the sake of simplicity. There is actually no evidence or explanation for the phenomenon of adaptation; even natural selection could explain only the modification of organs or features that already exist.

CHAPTER II

The Vertebrates

MEN, FISH, and everything between are vertebrates, or backboned creatures, the highest group, or "phylum," among the twelve irreducible divisions of the animal kingdom.[1] Vertebrates dominate land life, and we more or less depend on them for food. Point out any of these familiar creatures, fish, flesh, or fowl, and you will find that it has certain main features which it shares with all the rest, and with ourselves. Perhaps the most important single possession is an internal skeleton,[2] composed of bone or cartilage; its outstanding feature is a backbone (giving the group its name), which is associated with a spinal cord and which is, significantly, segmented. Aside from this, their muscular systems are well developed and their nervous co-ordination is high, so that they are quick and skillful in movement; for mobility they are excelled only by some insects, and their muscular control is unequalled. They have a three-part brain and acute, well-developed senses, served by complex structures like eyes. Finally, they have an enclosed and unified web of vessels through which the blood circulates to nourish the body tissues, and the blood is refreshed with oxygen by special organs—gills or lungs—and is pumped by a special muscle, the heart.

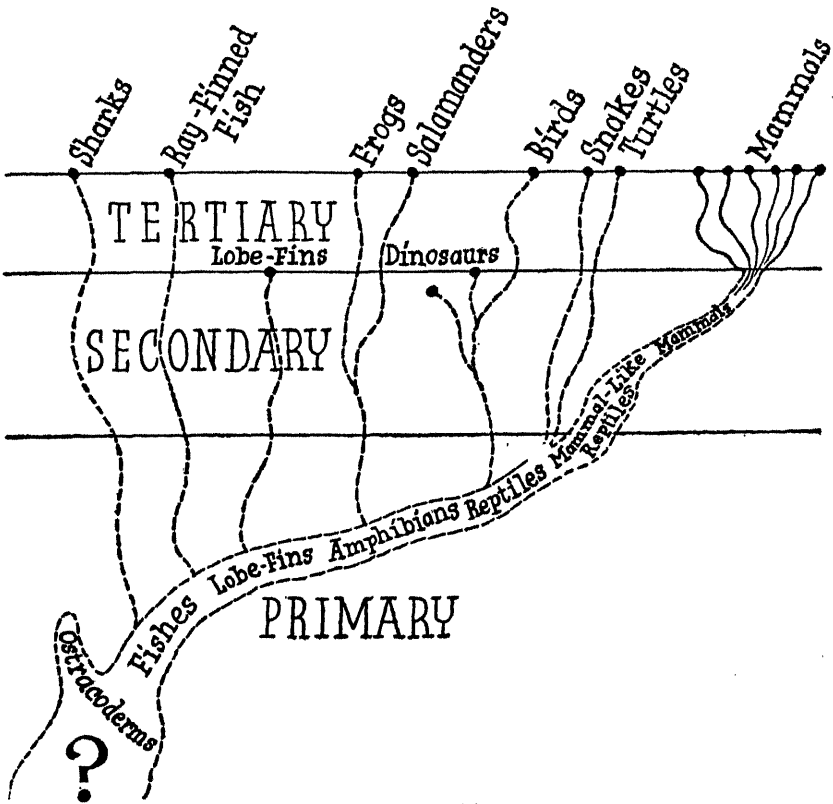
Vertebrates fall, fairly simply, into five classes which form an evolutionary ladder.[3] Of these, the fishes are the lowest, and the essential vertebrates. The Amphibians got halfway out of the

[1]Readers may remember from courses in biology that the proper name is "Chordata"; and that the phylum includes a few exceptional animals who have a spinal cord but lack a true backbone or other vertebrate features. See footnote, p. 20.

[2]Only the vertebrates have this. An external skeleton, on the other hand, is possessed by several phyla, such as the insects and the crustaceans, a lobster providing perhaps the best example.

[3]For a full account of vertebrate evolution, which is covered briefly in this chapter and the next, see *Man and the Vertebrates*, by A. S. Romer, an especially readable book by a foremost authority; also *Our Face from Fish to Man*, by W. K. Gregory, 1929.

water, and the Reptiles completed this change. From the latter arose the two remaining classes, the Birds and the Mammals, who improved greatly on the reptiles, and to some extent in similar ways, both having warm blood and superior nervous organization, and taking care of their young. But these developments were inde-



RELATIONS OF THE VERTEBRATES

pendent of one another, and the birds, alone of the classes named, have, therefore, no place in the human succession. The higher classes thus came up, step by step, from those below, with man's ancestors, of course, in the midst. In following out this ancestry it is as if we imagine a kind of changeling; not a real animal but a creature who became successively all the animals man has ever been. It went through three changes of the most emphatic importance of all: from a fish to an amphibian, then to a reptile, and then to a mammal, after which it wound its way upward to man through far more modest alterations.

Now the present-day classes of vertebrates are distinct from one another, forming large groups which differ fairly sharply in their features, and it is clear to see at what stages man (or his ancestors) acquired his various typical characteristics, like limbs or hair. The evolution of the higher vertebrates did not actually proceed by great jumps, however; it went ahead rather by a perfectly continuous series of transitional forms, which have, almost without exception, become extinct, so that the living classes are something like spots which remain out of a once-connected line. But paleontology has found the fossils which fill many of the gaps, and has been able to discover both the time and the manner of the changes which took place. The living animals only imply the descent of man; the fossils prove it.

Fishes and the Origin of the Vertebrates

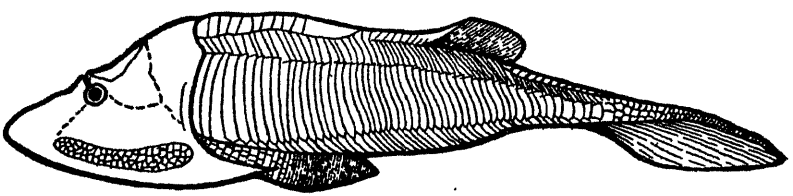
Man, therefore, is a modified fish. Those two animals have in common all the particular features of vertebrates which I have named, and others as well. Even so, they may not seem to be very much alike until you consider also that the whole general anatomical plan is the same in both of them: that the relation of the breathing apparatus and the circulatory system to each other is the same, that the layout of the digestive tract and its accouterments is similar, that the senses and the central nervous system are concentrated in the head, where the mouth is also, and that there are two pairs of fins, or limbs, and, believe it or not, a tail. Other phyla of nonvertebrates have similar parts, but not in the same combination. Insects, for example, have heads of a like type, but they have six legs, and their respiration and circulation, while aiming at the same things, are totally dissimilar.

To the fundamental fish, therefore, we owe a limitless debt. The higher animals have revealed the potentialities of its type of body, which would be hard to appreciate from a fish alone. In the latter, for example, the virtues of an internal skeleton are not fully apparent, but it has allowed land animals of large size to develop—something that has taken place only rarely and with little success in other phyla. Large and movable invertebrates exist in the sea, like the octopus and the giant squid, but anything so spineless and blubbery is not feasible out of the water which supports it. Even hard-shelled forms like crabs have not grown big ashore; the armor

of body and limbs would have to become very heavy in order to stay rigid and avoid collapse.

One last particular property of the most primitive fish was the gill arch, or stiffening rod, between the gill slits. In typical fishes the foremost of these arches became fixed to the base of the skull to form the upper jaw (which is still movable in sharks) and the second became the lower jaw.

The human body can be traced back step by step to this fish version of it. The latter has to be looked on as fundamental because the record goes no further. It is obvious that we have come from a still lower form of life, some one-celled amoeba-like affair, but this is an assumption. It is like saying that you are descended from Charlemagne; it can't be proved, but there is, nevertheless, little doubt of it, considering his family life. The fact is that the



AN OSTRACODERM

This type looked like a true fish, but was less like one than he seems. The head was encased in a single shell, and the body in jointed slats of bone, and there was no lower jaw.

evidence which might connect the vertebrates with a major group of the invertebrates is missing, and their origin is unknown. It is true that several candidates for the role of progenitor have been put forward, for various reasons: the echinoderms (sea urchins and others), because their larvae are something like those of vertebrates; the roundworms, because they are segmented; and the arachnids (spiders and scorpions). But the fact that such differing kinds of vermin have been nominated seems to show that zoology is still floundering in the matter.

There is, however, one half step downward which can be taken, leading to the ostracoderms, a group of extinct armored fishes. They were not segmented, in the proper sense; they had no visible skeleton at all, let alone a backbone; and gills, limbs, jaws, and other vertebrate features were lacking. A typical species had a single shell in the head region and overlapping slat armor for the rest of the body. Nevertheless, this armor was akin to vertebrate bone

in structure, and there is reason to think that some of the outer bony plates gave rise to the uppermost skull bones in vertebrates. Furthermore, it is quite possible that the ostracoderms had perishable skeletons of cartilage, which have vanished. Finally, some particularly well-preserved specimens clearly show the same three-part brain and associated nerves which are a feature of the vertebrates. The ostracoderms are, for these reasons, taken to be the most primitive known vertebrates. But they are not a solution of origins, because they still bring us to a dead end; while they are far from being typical vertebrates they certainly do not belong to any other recognized phylum.[4]

The Amphibians: First Land Vertebrates

The Amphibians are in themselves hardly an inspiring group, but they are, notwithstanding, the original land vertebrates, and they are not to be scorned if they accomplished the difficult transition from the water with only partial success. The present-day Amphibia fall almost entirely into two groups: the very specialized frogs and toads, who hop, and the more generalized, less-successful salamanders who, as Romer says,[5] are hardly more than fishes on land, whose puny legs allow them only a miserable scramble.

The class has a heritage from the fish that is full of liabilities as well as assets. They have come out on land, in the adult stage, where they can enjoy flowers and sunsets and what must originally have been a wonderful freedom from enemies. But their eggs are like those of the fishes, with no protection from drying up and very little yolk to feed on, so that they must be laid in water (a few use makeshifts like wet moss), where the minute larva hatches quickly, to fend for itself and live as a water animal, using gills, while it develops. The adults have lungs for breathing air, con-

[4]There are a few living animals which lack jaws or limbs and even skeletons, but which in some cases are segmented and possess a stiff rod in place of a spine, together with gills, a spinal cord, and other vertebrate features. They are lumped with the vertebrates proper under the Chordata, which is the actual phylum name, since "vertebrate" applies to a segmented bony backbone. These creatures are pretty obviously degenerative, being less like true vertebrates when adult than when young. On the other hand, some zoologists believe that the much-studied lancelet, Amphioxus, a skull-less, jawless, brainless, spineless, and limbless inch-long dab of an animal that looks like the merest ghost of a vertebrate, may be an actual primitive form. It is unlike the ostracoderms in almost every way, so that both of them can hardly be ancestral.

[5]Romer, Alfred Sherwood, *Man and the Vertebrates*, 1941, p. 50.

verted from an air sac which is a sort of ballast chamber for the fishes. But these are wretchedly inferior; the amphibian has to depend to some extent on oxygen absorbed through the skin, and air for his lungs has to be gulped and swallowed in the fashion by which a fish sends water through its gills. He is innocent of chest expansion. Certain types of salamanders have commented on the inefficiency of this system by giving it up as a bad job, retaining the gills of their childhood and remaining in the water all their lives.

In spite of these and other imperfections, however, the amphibians have passed a heritage on to man in turn, in the form of additions to and changes in the fish pattern, for which he should be duly grateful. They provided him with lungs; we have just looked this gift horse in the mouth, but lungs subsequently improved. The great vessels which carry the blood from the heart are an amphibian modification of two of the arches in the fishes which led the blood through the gills, the rest having been dispensed with. The amphibians also started a process of transferring small bones from the lower jaw into the ear (hyomandibular into stapes) which in its continuation created the watch-like bony mechanism of the mammal. Finally, to the torso and backbone furnished by the fish they added true limbs, with their skeletons, and established the generalized form of these for all higher vertebrates.

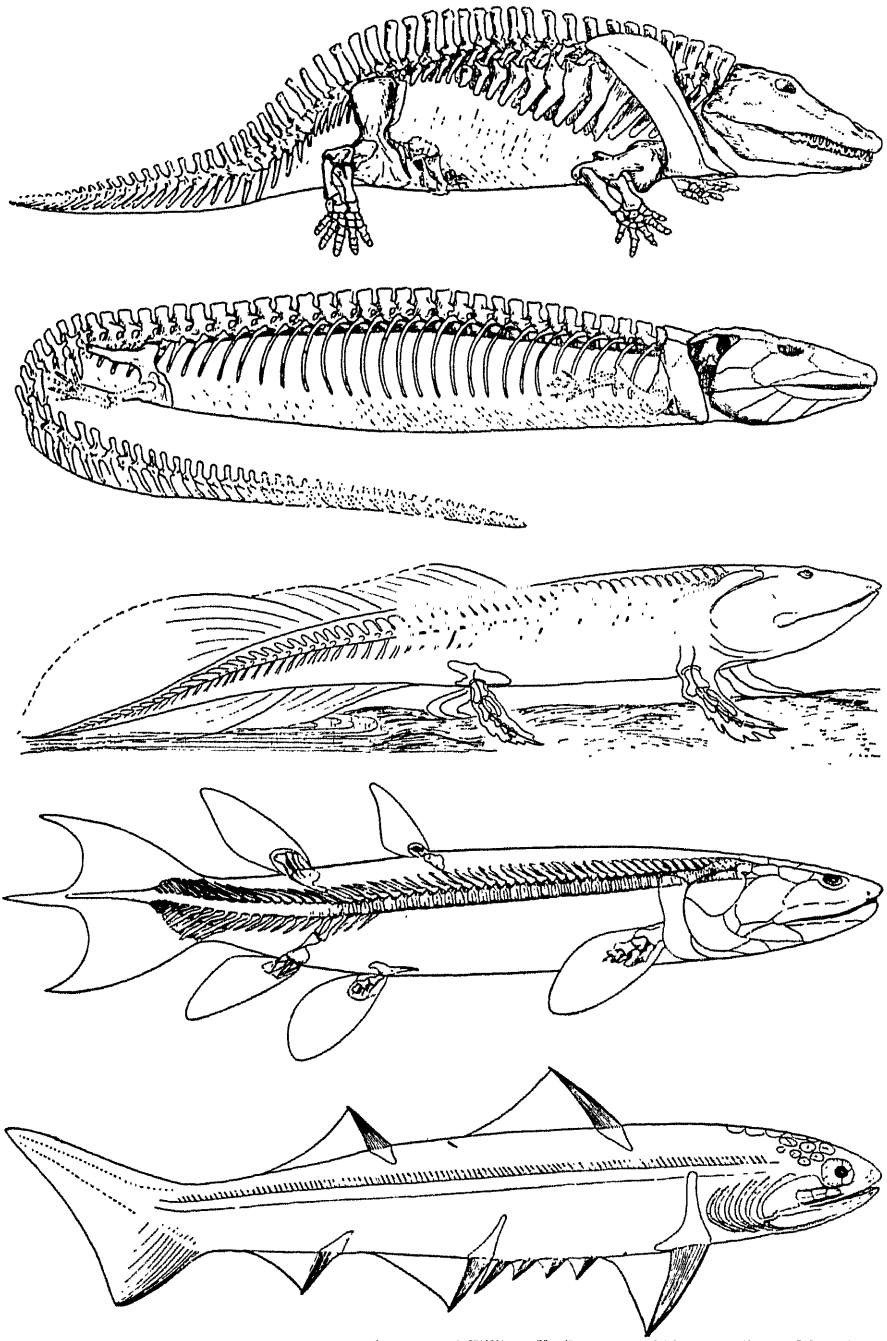
It may seem like a far cry from a fish to a frog, and indeed it is. Let us now look at the history of the amphibians. We have been considering them from an anatomical point of view, which leads one to think too much in terms of frogs and salamanders. It is not proper to judge the Amphibia from these; the class in a sense is practically extinct, the living ones being only the remittance men of a once-great family. There was a time when the amphibians flourished, attaining a good size and many forms, but mainly looking like big lizards or crocodiles. These were the typical generalized ones who have disappeared, even though they were then more highly developed and progressive than those of the present. The Amphibia, therefore, make a prime example of the shortcomings of the study of living animals without the paleontological record, and an illustration of evolution, radiation, and specialization, with the destruction of generalized parents. For the frogs and salamanders were only one branch of their offspring; the other was the Reptiles. More of them anon.

The fossils give the missing parts of the chain between living fish and amphibians; the vital links which constitute the main line leading to man. Amphibians arose from an extinct subclass of fishes reeling under the name of Crossopterygians.[6] They are known more simply as the "lobe-fins." Where modern fishes, the sharks excepted, have light, fan-like fins, perfected for swimming, the lobe-fins had fringe-like fins on stumpy lobes of flesh, which were very rudimentary limbs. These stumps contained muscles and bones, the latter presenting, in a barely distinguishable form, the arrangement which is found in all true tetrapods, or land vertebrates. The crossopterygians also had a simple lung or air sac which enabled them to breathe. Now lungs, and probably primitive limbs, are old in the fish, and there are certain modern species which have the ability to walk or breathe a little, like the mud-springers and the several lungfish. But these are actually side lines, and do not represent the ancestral lobe-fins, who were a major, generalized group possessing both of these qualities which the typical, more specialized modern fish has lost.

This covers half the distance from fishes to frogs. There is general agreement that what brought actual legs into existence was not an uplifting desire to explore terra firma, but the fact that at one period some of the lobe-fins were seasonally caught in the drying and stagnant remnants of disappearing inland seas, and had to trek overland in search of the largest remaining pools, breathing air as they went.[7] If ever natural selection was turning the screws, this was the time. But no species half fish and half quadruped can endure permanently, and the crossopterygians gave way at last to full-fledged amphibian descendants on land and to their

[6]These were thought to have become finally extinct before Tertiary time, or more than sixty million years ago, until a living example, five feet long and weighing 127 pounds, was taken by fishermen in a net off the coast of South Africa at Christmas time in 1938. It was sent to a museum in the small near-by town of East London. The curator, unfortunately, was off on his holiday, and before he got back the fish fell into evil hands, those of the local taxidermist, who stuffed it. Random pieces of its interior construction were recovered, however, and are pronounced to be hardly distinguishable from the fossil types, and early ones at that. So well known is the group to paleontologists that they were confronted by no problem in classifying this specimen, but were able to greet it with a certain *sang-froid*, or the equivalent of "Dr. Livingstone, I presume." This is not to say that they were not just as startled as you might expect. It was a really staggering occurrence, and they will probably deny the existence of sea serpents with less gusto for a spell.

[7]See Romer, *Man and the Vertebrates*, p. 47.



Courtesy of William K. Gregory and Natural History Magazine

CHANGES IN THE SKELETON FROM THE MOST PRIMITIVE FISH TO LAND FORMS

modern fish cousins, better adapted to swimming and lacking respirational aspirations, in the sea.

As to these new amphibians, notice that the evolutionary pressure had been on land-going and breathing, and not on their methods of reproduction, by which they remained always attached to the water. They even continued to spend much time in the water, in their heyday, probably causing additional and direct damage to the lobe-fins by eating them when they met. These generalized amphibians had all of the characteristics of the class which I have already described, and certain others which show their crossopterygian ancestry very definitely.

Their limbs are of first importance. In them the somewhat indefinite bones seen in the crossopterygian lobes became set in a pattern having one long bone in the upper limb, two in the lower part, and, attached by a cluster of bones for a wrist or ankle joint, a foot which had developed five digits. In other words, these creatures, by name the Labyrinthodonts, had molded into a basic pattern, specialized to this degree, what the lobe-fins had presented them with. The limbs stuck out at right angles and were feeble, but in accommodation to them the rest of the skeleton was modified somewhat away from the fish form. It was more thoroughly ossified, and so more solid, while the fish frame has remained always more cartilaginous. The hind limb was loosely attached to the spine by a rudimentary pelvis, and the same attachment for the forelimbs was freed of the skull, to which it was originally hitched in the fishes.

Other details were significant only from their close correspondence with those of fish. Scales were retained on the underside as skids for the belly. A peculiar arrangement of supplementary large teeth and pits, behind the regular row, interlocking in the roof and floor of the mouth, was common to the lobe-fins and the labyrinthodonts, and the pattern of bones in the roof of the skull was also alike in both.

We have thus arrived at an animal which is transparently a lobe-finned fish changed in two simple but profound ways: legs and lungs which were present as mere accessories in the parent have become all important. These pioneer amphibians close the remaining gap to land life and modern forms. They seem to have been an immediate success, and radiation and proliferation set in. One

especially progressive lot gave rise to the reptiles fairly early in the story, while at the other extreme a black-sheep branch of the family gradually became the modern types: the salamanders who have tended to slip back in the direction of fishes, and the frogs and toads who are strongly specialized for hopping. All the last-named are plainly retrogressive, having lost a digit from the fore-foot and possessing incompletely roofed skulls together with skeletons which do not ossify very fully. However, these delinquents and the reptiles are all that remain, the standard-bearers of the line being gone. The latter found themselves, like the lobe-fins, caught between the upper and nether millstones. Good as they were, they were not so good as the reptiles, and except for those who accepted the meanest of land existences, they vanished.

The Reptiles: Their Rise and Fall

The Reptiles succeeded to power. Between them and the modern amphibians there is considerable distinction, if not as much as that between the latter and the fishes. This is partly because of their own upward development, but also in some degree because they simply retained features from the early amphibians, like a fifth finger, which the existing amphibians have lost.

The early amphibian skeleton has, in the reptiles, been improved on in many ways. It is more fully ossified, and the spine is better knit, being stronger but more flexible. (All of this applies to the basic reptile form, best represented today by crocodiles or lizards.) Limbs are vastly improved. Where in the simpler amphibians they all stuck out at right angles from the body, they have in the reptiles been twisted under it, so that elbows point back and knees forward, and the legs are brought into the proper plane for efficient operation. This is for support as well as speed, though the body still lies on the ground at rest. In the bones of the feet and ankle joints some reduction and differentiation have taken place, making simultaneously for greater strength and stability. All of these changes in the legs are, of course, in a mammal and human direction. The internal anchorages of the limbs are also modified. Two ribs, rather than one, form the attachment of the pelvic girdle to the spine. The pectoral or shoulder girdle is more refined and free of movement, and forward of this the vertebrae of the spine lack ribs, giving the reptiles the honor of the first real neck.

The roof of the skull is composed of fewer bones and is higher, and the teeth, which form a single row and replace themselves without limit, differ somewhat in shape, for different purposes.

But all of these things, important as they are, demonstrate only a gradual and even evolution in anatomy. Definite breaks between the two classes are hard to see, and the changes are more like a difference of ten years in automobiles. The radical innovation of the reptiles was not anatomical but something else: it is found in the egg, their mode of reproduction having caught up with physical structure in the business of being adjusted to life on the land. The reptile egg is large and covered with a shell, although the embryo, or larva, is as small as ever to begin with. This embryo is protected from injury and from drying up, not by a pond of water, as in the case of the amphibians, but by its shell and by being centered in a fluid mass. It breathes oxygen, not from water but from air, through a membrane (allantois) lining the shell, to which it is connected by a stalk. It "eats" and grows, furthermore, for a long time before hatching, vegetating on a large amount of stored-up food in the form of a yolk, which is fed through another stalk directly to the gut. It thus may reach a large size, where, on the other hand, the amphibian, without such a legacy of food, is hatched into a watery world as a tiny creature which must fend for itself and which has an excellent chance of being eaten by the first living thing which happens along.

The details of this reptile egg are to us of the first importance, for a system derived from this one is employed by the mammals, who simply retain the whole mechanism within the body of the mother. But that is no concern of the reptiles. To them the achievement was this: the term which the amphibians must serve in the water was by the reptiles wrapped up in an eggshell, and the newly hatched young emerged as full-blown land animals. They were free of the water at last. Now the water stage, of course, is still present in the egg; it would have been asking too much of evolution to eliminate it at a stroke. However, the reptiles can take it with them, which the amphibians cannot. The reptiles have even penetrated the deserts, where the amphibians cannot exist, and have made them a favored habitat. This alone is a symptom of how they had found the key to the open spaces of dry land.

The history of the reptiles has few secrets. They sprang from the amphibians when the latter were still new, and chance has

favored paleontology with an intermediate form known as Seymouria. These animals are something of a borderline case, having small limbs and other amphibian features, including a few of those teeth in the roof of the mouth which go back as a characteristic all the way to the lobe-fins; but otherwise they have various marks of a reptile. Heaven knows what kind of eggs they laid. They are, following the familiar pattern, extinct. They were succeeded by the "stem reptiles," generalized animals with a basic reptilian anatomy, and these in turn gave rise to two main lines of descendants.

One of these was a group of monsters who would have struck an impartial observer as being the final rulers of the animal kingdom, from whose thrall the world was never to escape: the dinosaurs. Size was the order of their day. Many species grew to an appalling bigness and most of them were large. The carnivorous ones were, at the same time, very active by modern reptile standards, some of them rising on their hind legs for greater speed, and becoming adapted to this posture. A superb example of radiation, the dinosaurs evolved in all directions, and their various forms, with their devices for defense, fighting, or locomotion, are the marvel of museum-goers. The land was theirs to dispute only among themselves; many invaded the sea and conquered it, while the pterodactyls invaded the air and conquered that. Perhaps their gargantuan proportions were the result of a selective competition among all species. The swamp-living herbivorous types, the biggest of all, are amazing because of their fantastic ponderousness alone, but their meat-eating congeners were the most fearful of destroyers besides. Almost every section of the earth shook to their tread, and it would have seemed as though Nature had given these animals everything she had.

Certainly their first adaptability appears to have been very great. But their most impressive characteristic was also their Achilles' heel, for their size was a specialization which brought them vulnerability, as specialization is so apt to do. They were closely adjusted to the warm, moist, lush climate in which they had grown up, and which had endured for a very long time. Giant herbivores needed giant swamps, and giant carnivores needed giant herbivores, and these towers of arrogance tumbled readily enough at the modest touch of shifting weather. It appears that temperatures dropped somewhat, and that this fact and possible earth changes

made the swamps disappear and the dinosaurs with them. They went, in a departure that was almost cataclysmic, leaving as their only relics the crocodiles and, of all things, the birds.[8]

While the dinosaurs held sway, only an acute observer would have detected any other animals in the landscape. They were there, however, apparently living mostly in hiding, and probably with all their senses cocked for the approach of a dinosaur. They came down from the other side of the reptile family, the stem reptiles proper, and were already divided into two obscure and unpromising groups: the recent reptiles, even at that time appearing in such odd forms as turtles and snakes, and the mammals.

[8]This is something of a simplification, although temperature was probably the main factor in a combination of factors. Some of the reasons suggested, however, like the belief that one kind of dinosaur specialized in eating eggs, and so nipped all the other species in the nest, seem a little inadequate, to say the least.

CHAPTER III

Mammals

THE BIRTH of the mammals was the last great change through which man's ancestral line has passed, and the story of the vertebrates has no further chapters. Evolution has made no such drastic effort since, nor are there indications that it is bracing itself for one; later mammalian history—and this includes the rise of man himself—is a matter of vastly varied modification of, and improvement on, the fundamental form, which only demonstrates how useful a form it has been. In spite of all this variegation as well as some intense specialization, the mammals are basically much alike, something which can be easily seen by anyone who takes the trouble to look at a group of mammal skeletons in a museum. The same elements are there, from elephants to bats, though they may be contorted to different uses, and every single mammal, for example, has seven vertebrae in its neck.[1] The only important kind of variation is where specialization has resulted in loss, particularly of some of the original five digits, but also in more radical cases like the hind legs of the whales, of which hardly a sign remains.

SKELETON, SKULL, AND TEETH

A typical mammal is four-footed and small, like a mole, a fox, or a woodchuck. The plan of the skeleton displays certain general and significant alterations in that of its reptilian parent. These changes are really worthy of close attention, because in them are established many features of human anatomy. The framework as a whole has achieved still more solidity, combined with flexibility, by means of better-developed articulations of the joints and in the spinal column, and through the fact that ossification is very complete, with little cartilage serving in the adult.[2] The mammals

[1]Excepting the manatee and two types of sloth.

[2]The one important function of cartilage in mammal skeletons is to line all joint surfaces, so that no two moving bones actually bear directly on each other, but have tough, slightly resilient veneers of gristle between them.

are very active, and this firmness of construction allows a strong as well as a refined development of their muscular systems. Even during growth this purpose is served. In lower vertebrates the working bones of the limbs and the spine take their shape (ossify, as bone) within a cartilaginous "form" which takes shape first, so that the center of the shaft or body is bone, expanding outward toward the ends, which remain cartilage. But the growing mammal has centers of ossification at the ends of the bone as well as for the shaft, with cartilage between, so that the caps or joint surfaces (epiphyses) are of bone like the shaft, giving the active animal the advantage of a more completely formed skeleton during his development while still allowing the bone to go on growing in cartilage in the space between; the parts unite and become a single piece *only* at maturity. Whether there are other implications in this device is hard to say, but it is a striking characteristic of mammals, and a surprising novelty in evolution, and it is a fair supposition that it would not exist if it were not important.

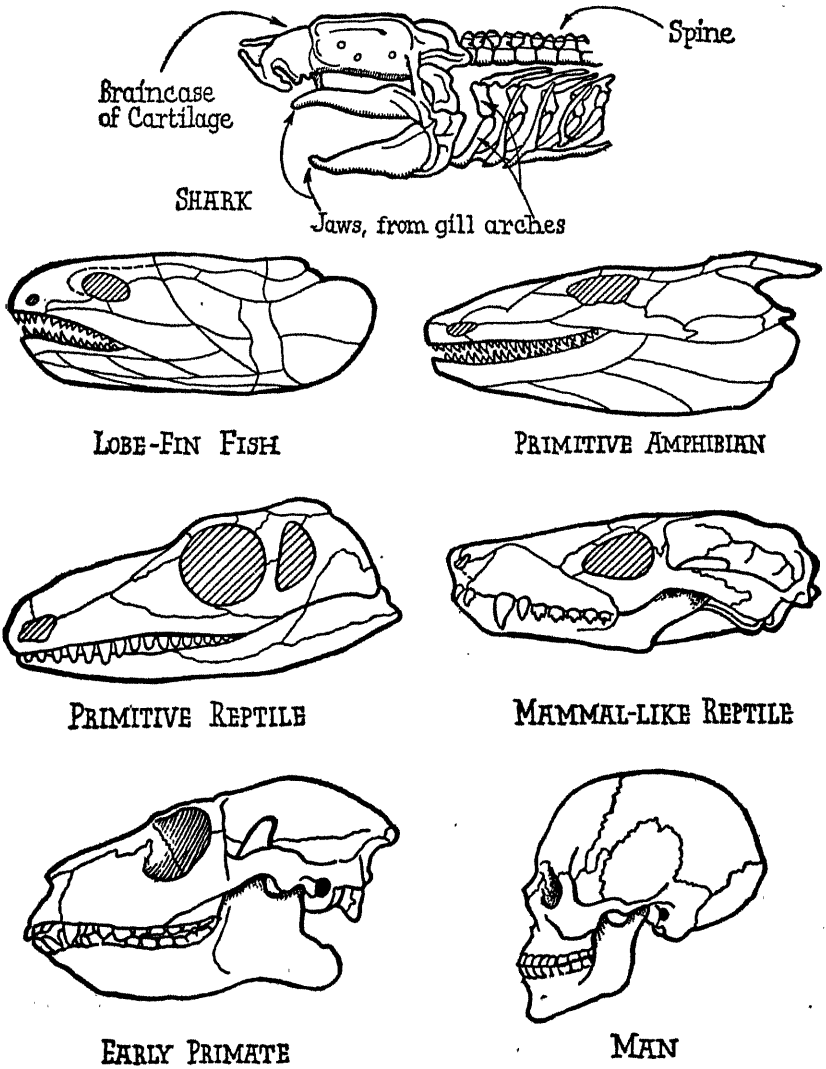
The spine, in lower animals mainly a long string of generally similar segments, is not only better linked together but is also more differentiated in its several sections: the neck is free, the thorax is arched for support in quadrupeds or columnar in man and other primates, while the sacrum, that part articulating with the pelvis, is a solid block formed of several vertebrae fused together. The pelvic girdle, therefore, is a ring, which is firmly joined to the spine instead of being loosely hitched. The pectoral girdle, however, consisting now of shoulder blade and collarbone, is not similarly fixed and solid, but remains movable in its elements, though anchored by all the large muscles of the shoulder region; these bones have been variously adapted in the orders of mammals. This differentiation of the flexible shoulder girdle from the fixed and heavy pelvis is of first importance to man, in whom there is so marked a contrast in the uses of the arms and legs. At any rate, both pairs of limbs are strengthened in mammals, in this and other ways, for powerful action and ability to stand punishment and stress.

One of the most important things about the limbs themselves is that in typical mammals they have been brought completely under the body, propping it up off the ground even when the animal stands still, with so little effort that applied energy goes mainly into actual walking. Reptiles, on the other hand, face something

of a strain in heaving themselves up in the first place, while the amphibians, excepting those who beg the question entirely by hopping, try to walk without getting off the ground at all—a plain mistake. The chronicle of legs, therefore, has three stages: in amphibians the side fins of crossopterygians have been bent at a right angle to meet the ground; in reptiles they have been twisted, the front ones back and the rear ones forward, so that no longer do they jut directly out, but instead provide a better leverage for muscles and work in a fore-and-aft line; while in mammals they have been stabilized in this position. Men, of course, have their own peculiar modification of this last stance, which is one of their very few real claims to distinctiveness, and the foremost of them. A final mammal specialty lies in the bones of the feet; these are rather formless in the lower classes, seeming only to be internal stiffeners and hitching spots for muscles, but in the Mammalia they have characteristic and highly developed shapes of their own, employed for stability, mobility, length, leverage, or other desired ends, as the case may be in different species.

In the skull can be found a long list of changes, not all of importance, of which only a few rate notice here. The number of bones which make it up has been sharply reduced (a trend, as we have seen), and this number is much more constant from group to group than in the reptiles. The lower jaw in particular comprises only one bone, the remaining elements having gone to form the tiny working bones of the ear, or other features of the ear region.

It is the teeth of mammals, however, rather than anything in the skull, which might awaken the envy of humbler beasts. The dental array in reptiles is typically a large number of simple points which can be regrown as often as they are shed or lost. This last might seem an advantage, if you find nothing unpleasant in losing teeth. But mammal teeth are more specialized. A mammal has two definite sets and two only: one which is smaller in size and number, to grow on, and the other a second, adult set which replaces the first as the jaws become large enough to accommodate it; the teeth of this final set are hard and firmly rooted (compared with those of reptiles) and seem to have been meant to last, with luck, as long as the mammal. We, as men, have some reason to feel bitter about this; either something is wrong with our teeth or we live too long—probably both.



SKULLS OF VERTEBRATES

The skull originated as a case for the brain and two separate jaws which were formed from gill arches, and in subsequent development the bones became fewer, the brain larger, and the teeth more refined. (*After W. K. Gregory*)

More striking than the limited replacement of the teeth is their differentiation into four series: knifelike incisors at the front where jaws open widest, for nipping and cutting; dagger-like canines at the front corners where they are most available for gashing and wounding; and premolars and molars, the cheek teeth, which are progressively heavier grinders placed closest to the joint of the jaw where, as in a nutcracker, the crushing power is greatest. Of all of them the cheek teeth are the most noteworthy. The front teeth are merely modified in shape, but the cheek teeth are distinguished by something quite new: cusps. These are, in simple form, accessory points, added to the original one, and in their different shapes and combinations they allow a complex and varied modeling of tooth forms for different foods. In carnivores, for example, they tend to be disposed in a fore-and-aft line, changing the original reptile point into a jagged blade for slicing flesh and cracking up bones. Herbivores have, instead, developed broad and symmetrical ridged surfaces for milling hay and other vegetable matter, which reach great size in elephants. Mammals having a wider diet manage to combine both the above qualities.

A last type of dental specialization among the orders is loss of some of the original forty-four. Cows, for example, have dispensed with all their upper front teeth, while a more general tendency, in which man partakes, has been to lose one or two incisors or bicuspids.

The whole class of mammals, then, shares an original differentiation of the teeth which has been exaggerated by specialization in different orders. Altogether, the intricacies of conformation and development in mammal teeth are tremendous. Paleontologists find them of great theoretical interest, and have spilled quantities of ink over their origin and evolution; and they have also come to take them as the final arbiters in the classification of fossil mammal remains.

Warm Blood

So much for the bony structure. But the major and vital revolution wrought by the mammals does not show in the fossils for, as was the case with the emerging reptiles, it was physiological. The mammals are, above everything, warm-blooded. It is simply not possible to overrate this, because it is what gives them their power and activity. Activity comes from a high efficiency in feed-

ing the muscles with energy derived from food, and in being able to release this energy suddenly and in large amounts in response to a nervous command, and it also requires a fullness of nervous co-ordination and development. All of the involved biochemical processes back of this seem to function best in a constant temperature not far from a hundred degrees Fahrenheit. Reptiles are called cold-blooded, which actually means that they cannot properly retain the little heat they generate, and so have more or less the temperature of their surroundings, and they are, in effect, drugged by cold weather. I said earlier that their egg gave them the freedom of the land, but it really only opened the tropical regions to them fully, for they occupy temperate zones at the price of surrender of action for half the year, and to colder regions they cannot go. A secondary advantage to mammals in warm blood is thus being able to go even into arctic seas while retaining their high organization. But primarily mammals live at a higher pitch, a higher turnover of energy, anywhere and all the time.

By what steps they established their high body temperature and the controls which keep it uniform are things which will probably remain as mysterious as the origin of the reptile egg. A large number of their distinguishing characteristics, which are used to define the mammals in zoology, are related to their warm-bloodedness, but not many of them are discernible in the skeleton. Limbs which keep the body off the chill ground are an obvious help. The presence of a bony palate in mammals, to separate the nasal cavity from the mouth, and thus allow an unimpeded intake of oxygen, is another. But the remainder concern perishable parts: hair, which is an insulator to retain heat, and sweat glands, which are a safety valve to lose it by evaporation. And there is a four-chambered heart, which keeps two distinct circuits of blood going at once: one throughout the body and return, and the other to the lungs and return, so that the fresh, bright red blood from the lungs is sent out to the arteries full of oxygen and unpolluted by stale blood on its way to the lungs. Such a separation is not complete below the mammals. These are the outstanding badges of a mammal, but there are also minor ones, such as the diaphragm, a partition separating the digestive apparatus from the heart and lungs, the pulling back or down of which aids in sucking air into the lungs.

The Young Are Born Alive

The second great embellishment of the mammals is live birth. The embryo grows for a long period in a marvelous suit of membranes which clearly betray their affinity with those of a reptile egg. I cannot do them justice here except to dwell on the most important one, which is new in the mammals, the placenta. This is a fat disk through which, from the umbilical cord, runs the blood stream of the unborn young. Through its walls and those of the womb this blood stream comes so nearly in contact with that of the mother that the two may exchange all the oxygen, nourishment, and waste products which the life of the embryo involves. Basically, it thus lives by precisely the same things as its parents. It is as good as being out of doors, and takes no effort. The embryo is, practically speaking, a pure parasite on its mother.

Consider the virtues of this system. The warmth and protection it furnishes the unborn are useful, of course, but the birds attain the same ends in other ways. The main thing is that there is no definite limit either to the amount of nourishment this voracious proto-infant can requisition or to the time it takes to do it. Living in an egg, it would eat its way outward to the shell and then would have to hatch or starve, and the size of an egg certainly has practical bounds. Among mammals, on the other hand, only human beings seem to be putting the principle of live birth to any strain. This carte blanche on time and energy allows the embryo a gradual development to a high level before it must face the harsh world, and provisions have been made to extend this same development for a long time after birth as well. First are the mammary glands, which produce a concentrated food in the form of milk. They give the class its name, of course, even if they are hardly its most important feature. Second are the strong emotions which lead the mother to care for and protect her nurslings in the most devoted and unselfish manner through a long childhood.

The final reason underlying all this seems to be the impulse toward achieving a high development while remaining a generalized animal. Diversified abilities call for the capacity to develop habits, training, and even a little reason, instead of the instincts which carry lower forms along. This capacity, in turn, grows out of a large brain and involved nervous system, and, finally, the building up of this takes a long time. In other words, a simple sys-

tem is provided with definite, unvarying patterns in the form of instincts, which are inherited specializations. A robin, that is to say, makes a typical robin's nest the first time it tries, without having to be shown how by some feathered friend who knows the ropes. But the highest type of nervous system is generalized, creating its own patterns as it develops, and thus retaining the more important ability to make new combinations and paths of voluntary action, which demands an unforced process of growth and integration of elements. To make a vulgar sort of analogy, you can get a living by quickly learning the motions necessary to making a candy bar or tending a bottling machine, but you need a general education to get ahead in the world, and that takes time.

I might add further point to the issue by the following loose recapitulation. Among the amphibians, before the animal reaches maturity, it goes through three transitions: the egg is "laid," or severs its physiological connection with the mother; the creature hatches; and, finally, the larva undergoes metamorphosis to the adult stage. Reptiles lay their eggs but have, in a way, postponed the hatching of them so that it covers the metamorphosis; while mammals have postponed the laying to overlap the hatching, although this calls for filling in with a period of postnatal care until the young can shift for itself.

Mammal Origins

This history of the mammals calls for a dose of geological chronology, which I have waited until now to administer. The life of the vertebrates falls into four recognized periods, successively shorter in time. The Primary, or Paleozoic, which began something under a billion years ago, introduces all of the classes of vertebrates except the birds. The Secondary, or Mesozoic, is the Age of Reptiles or, more specifically, of the dinosaurs. The Tertiary, or Cenozoic, a mere sixty million years old, is the Age of Mammals, and the last million years of the Cenozoic are set off as the Quaternary, and we modestly name it the Age of Man.

The Paleozoic, or Primary, was of immense duration. In the middle of its march the fish appear. The amphibians reigned through the Permian, its last section, but this was a time when generalized forms were progressing fairly rapidly; not only had the reptiles also developed, but one of the first offshoots of these,

the protomammals, as well. (It is a point worth remarking that newer forms do not grow from the highest types of preceding forms, or wait upon their approaching extinction, but grow rather from their very roots.) Thus the earliest mammals, adorning the Paleozoic scene, were in advance of the dinosaurs by not a few million years. But it is hard, again, to visualize the real position of these creatures, living as we do in an age when generalized and transitional types of vertebrates are almost non-existent instead of being the rule. They were not one hundred per cent mammalians; they would at the time have been recognized by us only as reptiles in good standing, or even as pretty typical, except that they had some progressive features of dubious significance.

More and more of these mammal-like reptiles are coming to be known, and they are the paleontologist's joy. Actually, during the time of the dinosaurs they were common. They make an almost complete bridge between classes, and among them it is hardly possible to say where reptiles ended and mammals began. The attainment of warm blood, or at least of constant temperature, would be the logical point if one could find it definitely in the fossils. But one cannot, and the role of witness falls mainly on teeth and bony structure.

The Therapsids of the end of the Paleozoic, not the first of these types, were fairly large lizard-like animals. They had two sets of teeth, with molars which were long from front to back, having several points, and looking a little like a thickened maple leaf. Skull bones were reduced in number. But the extra reptilian bones, though small in size, still lingered in the lower jaw, not having been transferred to the ear. The rest of the skeleton was hybrid but largely reptilian. The mammal bony palate was present, however; this may be a sign of warm blood, or it may be only a prerequisite. Altogether the Therapsids were a mixture of characteristics throughout.

There follows the story of the baby prince who is sent away to be brought up in poor surroundings while his tyrant uncle rules. In the Secondary, or Mesozoic, rose the dinosaurs, who brooked no distraction from their own splendor. The emerging mammals went into something of an eclipse; compared with earlier ones they were smaller in size and fewer in number, and we are blessed with fewer of their remains. They were there, however, in considerable variety, and they had begun to differentiate to a certain extent.

Some of them must still be described as mammal-like reptiles, but along with them, in the earliest part of the age, were various types whose teeth seem to class them as true mammals without any question. Of these in turn certain ones are probably the actual ancestors of later mammals, while others seem to be side lines which petered out. Now the broad crowns of today's mammal molars can be followed back to the Trituberculates (three-cusped) of the Cretaceous, or the late Mesozoic, but the exact derivation of the latter from the early Mesozoic mammals I am speaking of is not certain and is the occasion for some scientific swordplay. In other words, the chain leading back from the fully known mammals of later periods is not complete to the beginning of the Mesozoic, although time will probably fill the gap.

Be that as it may, the Mesozoic mammals were small and inconspicuous. Living in the shadow of the dinosaurs, their mammal status did them little good. They could go into cold regions, it is true, but it is problematical whether this had much to do with their development. They spent, then, the greater part of their span in this obscurity, undoubtedly evolving and improving, but specializing almost not at all, until in their middle age, so to speak, the dinosaurs vanished with the dawn of the Cenozoic, and the world was theirs by default.

Radiation of the Mammals

This Tertiary era began upward of sixty million years ago. Its deposits, with their characteristic animals, are divided into four periods: Eocene, Oligocene, Miocene, and Pliocene, names signifying the dawn of the recent, a few recent types, a minority of recent types, and a majority of recent types respectively; and paleontologists now distinguish a Paleocene at the very beginning. (These are geological periods, but their identification usually rests on the animals in the deposits, and so paleontologists and geologists depend heavily on one another.) As the saurian usurpation ended and Tertiary time set in, the mammals began, after their long wait, an evolutionary radiation on a grand scale of their own. The progress of this is the theme of the Cenozoic, just as formerly the progress of the dinosaurs had been the theme of the Mesozoic, when the protomammals provided only a pip-squeak obbligato.

In the Eocene there were already flesh eaters and grass eaters,

and the evidence of teeth is that both of them descended from insect eaters, most primitive of the lot. All of them were small in size and a good deal alike in appearance. Gradually they branched out as they grew in size, and the forerunners of the main types of modern animals were plain enough in the Oligocene. In the Miocene and the Pliocene they became what we might term full size, and, like a developing photograph, were getting more and more like the types we recognize. An ark full of animals from this last half of the Tertiary could be named off in a general way by any little boy, but their exact appearance, by its unfamiliarity, would make an adult think he was dreaming. Lately there has been only a sort of rehashing of species, without very important changes, and the particular tableau of present mammalian life, in all its details, is a relatively few thousand years old.

It was in the first half of this radiation that radical adaptations appeared, giving rise at once to the major divisions. (There is not complete agreement as to how many orders of mammals should be recognized. Some list as few as nine living orders, while G. G. Simpson gives fourteen living and ten extinct.) There was, even during the Mesozoic, an adaptation in diet. From an original menu of insects and eggs mainly, and also of fruit, a conversion of two important groups to pure diets of meat and of vegetable matter gave rise respectively to diverging stocks, the varied carnivores and herbivores. Others have gone in for other foods: the Rodentia, from mice through rabbits and woodchucks up to beavers, will eat many things, but they have chisel-like front teeth which grow endlessly and serve especially to gnaw through wood and bark; while the Edentata, anteaters and armadillos, being content with insects like ants, which do not even have to be masticated, have degenerate, enamel-less stub teeth or none at all, and tear anthills open with their heavy hooked claws. The Insectivora (moles, hedgehogs, and shrews, all drab little creatures) have, however, stuck to the general diet and the simpler teeth of their far-off ancestors, and to their bodily form as well, so that they are of extreme importance scientifically, in spite of their lack of every other attraction.

Nor have the Primates, and especially man, strayed far away from the selfsame type. A meal of insects does not make our mouths water much, but it invites the palate of a native Australian or almost any African. Civilized taste is no criterion. Italians and Samoans

alike are partial to octopus, and the latter annually gorge themselves on a large fat sea worm (palolo) that would give an American the horrors. Man is particularly catholic in diet; he is truly omnivorous. We like to make fun of goats, and what they eat, but if a goat could look over our bill of fare even he would find something at which he would draw the line. This would apply with greater force to other mammals, who would also be revolted at seeing that we make our food all hot and mushy before we eat it.

Locomotion, or the business of getting about, is the field above all others in which mammals have shown their great adaptability. A good many of them still patter around on the original little flat feet, while others have practically exhausted the more interesting possibilities, short of sprouting wheels. Horses and others are cursorial to a high degree. Various rodents are saltatorial (i.e., they hop). Whales and porpoises are perfectly aquatic, having become fully streamlined (in the proper sense of that battered word). Others, like seals, have taken the same path, but can still go on land. Bats fly, and they also have been partially imitated by flying squirrels, who glide. Moles and others burrow. A sloth proceeds upside down, hanging from a bough by claws like gaff hooks.

The Primates began with the simple walking gait, but adapted it to the trees by the ability to grasp. Monkeys can both run and jump. Apes, however, instead of jumping, brachiate, or swing hand over hand. Man used this last rather unspecialized progression also, while he was an ape, but on becoming a man he suddenly specialized intensely, adopting the strangest gait of all. His uprightness is unique, because he has no hindward prop like a kangaroo, and his legs do not really parallel the landing gear of birds, whose true vocation is flying. His gait is not a simple moving of weight by means of the limbs, as if he were flying, or hanging by hands, or standing on four feet. It is more like balancing a cane on the end of your finger. You shift your weight in the proposed direction first, and then hurriedly move your legs under it again to keep it from falling down. That is what walking is, and a two-year-old will tell you that it is tricky work. And it takes, aside from considerable motor control, strong legs and a well-muscled trunk, especially in the pelvic region.

There is one bone of particular interest in the mammal skeleton, which is almost like the teeth in its variety of form and in the fact of its being specially developed in the class. This is the clavicle, or

collarbone. (Reptiles have more and different bones in the shoulder girdle.) You can trace its course simply enough at the top of your own chest. It is a strut which runs from the head end of the breastbone to a process of the shoulder blade, and it actually creates the "shoulder," by holding the arm socket out away from the chest. A horseman falling on his shoulder breaks his collarbone for that reason. It is a great advantage to an arm which is used in movements sidewise or in several directions, providing a universal fulcrum for it and for all its muscles. But it is of no particular use to an animal which moves its forelimb only forward and backward along the side of the chest, as in running, and accordingly horses and their relatives lack it altogether. It varies among carnivores, who are capable of a certain amount of sidewise and crosswise movements. It is well developed in burrowing, clawing, or climbing animals, but it reaches its greatest length in connection with the sweeping wings of bats and the perfectly liberated arm of man.

Backward Mammals: the Monotremes and the Marsupials

In all this description I have been talking about the typical mammals, those which form a placenta in reproduction and have the other anatomical properties I have described. The placentals dominated the Tertiary stage completely, and this group furnishes the great panorama of our familiar animals. But the class of mammals contains also two minor branches, who do not form a placenta, who differ in other ways, and who are obviously relatives who became separate from the placentals far back in the Mesozoic, or even grew out of the mammal-like reptiles by another evolution. Whatever their genesis, they are put down as subdivisions of the Mammalia, perhaps because of the helplessness of classification in the face of transitional forms. But in another sense they are animals which veer back toward the varied and vanished mammal-like reptiles.

The Monotremes are one group, which takes in two animals only, those well-known denizens of Australia and the Sunday papers, the duckbill and the spiny anteater. They have skeletons which are reminiscent of reptiles and lack many mammal features. And they lay eggs. But when the young one hatches he is nursed by his mother, whom he also finds to be hairy and warm-blooded, though of low degree in this as in other things.

The Marsupials, or pouched mammals, are the other division.

The opossum and a few others are found in America, but all the rest live in the region of New Guinea and Australia. Here they flourish in many guises and are, in fact, the characteristic fauna. The kangaroo is merely the most striking, and there are marsupial wolves, bears, rodents, and others. In truth, the only indigenous placental mammals in Australia are accidents: descendants of wandering bats and castaway rats, and dogs (the wild dingo) who may or may not have arrived in the company of the first men. Marsupials bear their young alive but, lacking a placenta, cannot continue to nourish them internally indefinitely, and must bring them forth in a tiny and undeveloped state. These midgets are stowed away in a pouch, which acts as an incubator, where they live without real consciousness on a milk diet until they have developed about as far as a newborn placental mammal. They then begin to take short field trips.

The marsupial skeleton differs from the placental, but is closer to it than is that of the monotremes. Above all, they have a greater number of teeth than typical mammals, which is primitive, and they also lack a full milk set.

The monotremes could be looked on as being both archaic mammals and advanced mammal-like reptiles, and they almost certainly constitute a hang-over from the very beginning of the Mesozoic. Most unfortunately, however, the modern ones have only rudimentary teeth or none at all, and so lack those paleontological fingerprints which are always the one great hope of tracing a mammal to fossil sources. Thus the exact relation of these animals to the forebears of the mammals in general will never get beyond a sort of moral certainty.

The marsupials, on the other hand, are plentiful in the fossil record. At the end of the Mesozoic, with the passing of the dinosaurs, the marsupials actually seem to have been next to the rail in the race of the warm-bloods, spreading widely, rapidly, and in considerable variety over many parts of the earth, ahead of the placental mammals. The latter caught up with them, however, and apparently because they were bigger brained and better developed for the same purposes, they soon elbowed the marsupials out, pushed them into the southern blind alleys of the map, and finally caused the extinction in the world at large of almost all of them except the tough, generalized opossum. But because of land changes the placentals never penetrated Australia (with the exceptions

noted), and the marsupials, there ahead of them, found a sanctuary from the unequal struggle in which they had, it is interesting to see, a minor radiation of their own, developing parallels to several of the placental orders, in some cases with a striking likeness. To descend to crudity, a carnivore seems to look like a carnivore no matter who his family was.

It has been the traditional view that the full-fledged mammals developed out of the marsupials, who developed out of the monotremes, who developed from reptiles. The placentals must have gone through stages of the sort. But, according to Simpson, it is not necessary to think that they came from the marsupials as the latter are known. It is more probable that both arose from a similar group of the mammal-like reptiles independently, the placentals developing further. The monotremes would be a third offshoot, and perhaps there were others, now extinct. The evidence is not conclusive. It looks as though placental mammals occur as early in the record as do any marsupials, but this depends largely on the teeth, and in any case the teeth of placentals and marsupials become more alike the further back one goes.

But the importance of the above interpretation, and indeed of all of these sub-mammals, is that it suggests that the mammalian warm-blooded, live-bearing type, with modified teeth and light limbs, was not just a lucky accident, but rather the product of evolutionary tendencies that were sufficiently powerful to turn out the same thing more than once, and to produce various mammal-like reptiles first, and then several more or less successful mammalians independently, like the placentals and the marsupials. Such a possibility remains obscured in the older belief that monotremes, marsupials, and placentals are all simply stacked one on top of the other in evolution. Now if some kind of an urge in the direction of warm-blooded mammals and near-mammals has existed, it is something which natural selection cannot very well explain, for selection would clearly favor warm-blooded animals, but only after warm blood had appeared in the first place. It would hardly call it repeatedly into existence.

The possibility of its manifold appearance need not rest on the uncertain case of the several mammal types, for the birds have warm blood also, and there is no doubt that this is an independent evolution. Millions upon millions of years before there was any warm blood in the world the ancestors of the birds and of the

mammals were already two different lines of reptiles. And though both developed a four-chambered heart in connection with warm blood, the other accessories differed. Birds have feathers for warmth, rather than hair, and the great artery takes a different direction away from the heart—non-essential differences which make it clear that warm blood itself was the vital achievement, and that it was no accident, but a sort of necessary, predestined step for the highest animals.

There are parallels elsewhere in the animal kingdom of the duplicate occurrence of obviously good inventions. Insects, like land vertebrates, can breathe air, and have legs and eyes, though the details are all different. Now none of this seems to have to do with man, but it prepares the mind for the possibility that man, given the anthropoid apes, was similarly predestined, and actually appeared, or almost did, more than once. There is more than a hint of this in the little we know of fossil anthropoids. You can't keep a good ape down, or so it would seem.

CHAPTER IV

The Primate Order

THE ORDER of the Primates is gradually becoming democratic. The attention of its most supercilious member is being drawn more and more to its other constituents by the efforts of Professor Hooton of Harvard, Professor Yerkes of Yale, and Gargantua the Great of Ringling Brothers, Barnum and Bailey.[1] Yet it is still an unfamiliar order, in the public mind, compared with such as the carnivores or the rodents. For one reason, we take our own selves very much for granted, and for another the Primates ranking below the monkeys are unspectacular animals who look like nothing in particular, and who come out only at night into the bargain.

The whole order, indeed, is unspectacular, simple and generalized, which is, paradoxically, its main characteristic. Striking features distinguish other orders; for example, the rodents all have long, chisel-like incisor teeth, which never stop growing. But similar peculiarities belonging to all Primates are hard to find.

They live largely in trees (except for rare non-conformists like men and baboons), and their limbs have the power of grasp. This is of great importance. These limbs are well articulated and very mobile. They have retained all five digits of the original vertebrate hands and feet, and these digits can wrap themselves around objects in a strong grip—they are real fingers. Furthermore, the first digit (thumb or great toe) can be twisted on its base until it tends to oppose, or close against, the other four fingers, so that their clasp of a bough is immeasurably strengthened by a sort of lock on the opposite side. The grip is also assured by the padded inner side of the fingers, which have fingerprints, like miniature tire treads, so that the most slippery of objects can be held with little effort or pressure.

[1]There are others to whom credit must go, but they are not so alliterative. Anthropology owes much to the study of the Primates by such men as W. K. Gregory and H. C. Raven of the American Museum of Natural History, A. H. Schultz at Johns Hopkins, C. R. Carpenter of Penn State, and, abroad, Professors Frederic Wood Jones, W. E. Le Gros Clark and S. Zuckerman.

This, of course, is an excellent accommodation to tree-climbing, and there are further accessories. Other animals, like squirrels, climb with claws, which work on the principle of a lineman's spikes. But in climbing by using a grasping hand, claws would be in the way, and typical Primates have flat nails instead; and all of them, at least, have nails on the first toe. I quote the following from Diogenes:

"Plato having defined man to be a two-legged animal without feathers, Diogenes plucked a cock and brought it into the Academy, and said, 'This is Plato's man.' On which account this addition was made to the definition, 'With broad flat nails.' "

This is a pretty trashy brand of humor for a thinker like Diogenes, but it lends point to the lack of features on which a zoologist interested in classification can dwell, not only in man but in the whole order to which he belongs. None of the things I have mentioned are specializations. Even nails, in fact, and the ability to grasp by accommodating the digits to the shape of a bough; were present in primitive mammals. The primate development of them, which is greater the higher up you go in the order, are simply refinements of a primitive condition, and the same is true of other features of the limbs. For example, the two bones in the forelimb are present, and free of one another, in the earliest land vertebrates, but of all mammals the Primates almost alone furthered the ability to twist the radius on the ulna, until the human hand can be flipped over, or rotated, through a full semicircle, without moving the elbow or the upper arm at all. Hold your right elbow with your left hand and twist your right hand to see what this means. Such a mobility is not owned by other mammals, in some of whom the two bones are actually fused together. The collarbone, likewise, is a primitive mammal bone which is strengthened in the Primates but degenerate or lost in certain other orders.

It can be seen from the foregoing how little there is which is really special to the Primates. Almost the only feature by which a tyro could identify the skull of one of them is the fact that a bridge of bone from the edge of the brow to the cheekbone completes a ring around the eye socket, which is open at the side in other mammals. (In the higher Primates the back of the socket also is closed in, as in man.) It would actually be more comforting, though not good zoological practice, to follow Le Gros Clark,[2] and say that

[2] *Early Forerunners of Man*, 1934.

the primate order is distinguished rather by certain tendencies in its development; that while there is a wide range, and some members are very primitive, the whole group has shown an increasing tendency toward large brains, toward refinement of the use of the hands, toward reduction of the number of young born at a time, toward sitting up, toward reducing the size of the muzzle, toward bringing the eyes near each other in the front of the face, and toward dependence on vision rather than on smell. These are the things which mark them, taken all together, and the monkeys, apes, and man most of all. But they are not things which describe a lemur, who has barely made a start along such lines.

With the Primates we are at last getting close on to man, and to understand his arrival it is necessary to know about the order as a whole, and its history. But I shall not try to describe the Primates exhaustively; the reader who wishes to bejewel his dinner conversation with Primatiana is heartily referred to the works of Professor Hooton[8] and others. What follows is merely the plan of classification which is accepted by all students.

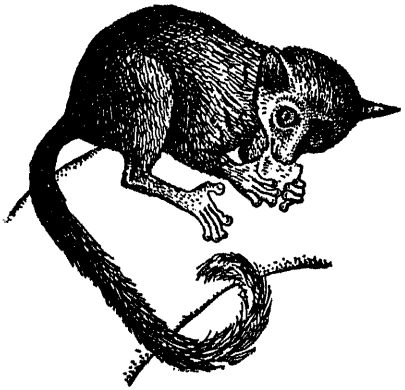
The order is divided, first of all, into three suborders: the Lemuroidea, Tarsioidea, and Anthropoidea. The first is numerous but primitive, the last is numerous and progressive, and the middle one contains a single animal which is specialized, peculiar, and so puzzling as to be the principal bone of contention among students of the order.

The Lemurs

Lemurs (the Lemuroidea) are seldom seen, even in zoos, because they are nocturnal, and in fact it is their soft and wistful prowling which has earned them their name, signifying ghosts in Latin. They are seen the less because they live demurely in the jungles of tropical Africa, especially Madagascar, and in India and the East Indies; but in this wide habitat they are common and varied in form. They look, if they resemble anything else, something like a baby fox which has hands in place of paws. They are furry, with tails of varying length. The size of the snout also varies, but by and large the eyes are placed more to the fore than in their fellow mammals. Some lemurs are as small as a mouse, while others are larger than a cat.

[8]Earnest Hooton, *Man's Poor Relations*, 1942; Ada M. and Robert M. Yerkes, *The Great Apes*, 1929; Belle Benchley, *My Friends, the Apes*, 1942.

There is a general division of some importance among them into two branches, the lemurs proper and the lorises. The former are the more primitive, being bushy-tailed and rather snouty; and they are fairly active, running and jumping from bough to bough, in which exercise a tail is useful for balance, as in a squirrel. On the other hand, the lorises, who are typically Indian and eastern, are not quick jumpers, but deliberate climbers and graspers; they are slender, with spindly limbs and hardly any tails, and their faces



A Lemur

Tarsius Spectrum

are flat, with the eyes close together. This distinction is not a matter of appearance and habit alone, but runs through structure as well. Details of the spine, shoulder, and pelvis all reflect the climbing habit, but there are other differences, such as a smaller number of premolar teeth in a loris.

On the whole, lemurs are friendly and gregarious, though lorises are apt to be solitary. They will eat most foods and are partial to insects. The lemurs proper are thoroughly active at night, although they can be awakened only with difficulty by day. They are good fighters for their size, and have tough constitutions, surviving unexpectedly long when badly wounded or very ill.

But a search for signs foreshadowing humanity will be frustrated. Lemurs have hands, but aside from holding onto boughs with them

they hardly use them to greater advantage than a raccoon does his paws. They are usually used together, rather than independently, and are little employed to carry food to the mouth; instead, the teeth are normally used to kill and feed with, while the forelimbs pounce and hold, as in many other small quadrupeds. Lemurs also have some affecting traits of character, it is true. Taken all together, they have a wide range of vocal ability, with types which grunt, cry, howl, shriek, growl, quack, or squeak, according to Wood Jones. They keep themselves neat, licking their hands and grooming their fur. But they seem to lack profound maternal feelings. Brainwise, furthermore, the Lemuroidea are a disappointment. This is clear to the specialist from the restricted size of the cerebral cortex, or outer shell, of the brain, and from the fact that this is smooth, lacking the convolutions or foldings which add vastly to its total surface area in higher Primates. And the actions of lemurs betray only commensurate mentality, with no hint that they are related to the four most intelligent animals in the world. The lemurs are, in fact, very ordinary small mammals, simple and rather primitive, who have barely enough peculiarities to be classed as Primates.

Tarsius

The Tarsioidea are represented today by a single living genus, the *Tarsius* of the East Indies. This Tarsius, or spectral tarsier, is small, having the size and the tail of a rat, though this tail has a tufted tip. But he does not look like a rat. His face is not snouty but short, and he has enormous eyes and ears. Sitting erect as he does, with his large head, he has a bunchy shape and seems to have no neck, until you observe that he can look directly backward, and has a very mobile neck indeed.

Tarsius is extremely specialized in one respect: his limbs. He has concentrated on the primate power of grasp above all the rest of them, his hands and feet being the more fully adjusted to it because of their small size. The fourth digit, or ring finger, is much the longest, instead of the third, and if you will stretch your own fingers out as widely as you can you will see how this increases the span of his tiny hand. Instead of having the inner side of his fingers and toes continuously lined with friction pads like ours, his pads are large and isolated disks, and very efficient for the animal's size.

More than this, however, it is his talent for hopping which has

made Tarsius peculiar and given him his name. His are not the flowing jumps of other Primates. The Tarsius is quicker than the eye. He will be sitting stock-still on a bough, when he will seem to disappear suddenly and reappear on another bough, perhaps several feet overhead. He is able to do this because of the form of his foot, in which the tarsus, or ankle, has become greatly lengthened. Various other mammals have long feet (horses and rabbits), but they are lengthened in the forward or metatarsal part, corresponding with the instep or the palm of your hand. But in Tarsius it is two of the hinder bones which are extended, so that the working part of the foot remains a grasping, hand-like organ on the end of this long lever. It is this combination which is unique. You have seen clowns at the circus wearing long, stiff shoes, by rising on the toes of which they excite the risibilities of the patrons. To see yourself with a foot like the Tarsius, imagine that two of the bones of the middle and back of your foot are elongated like the clown's shoe, and that you have a hand-like foot on the end of them (the fore part of our own foot actually once was a sort of hand). If you were as small and light as a tarsier, this tarsus would give you the leverage to perform a jump that is almost a snap, and this without sacrificing the primate ability to grasp.

In his hand, foot, and ankle Tarsius is specialized, for a primate, and his limbs reveal still other oddities.[4] But he has no such peculiarities in the rest of his body to equal those in his limbs. His other features are those of a representative primate, but one distinct from the lemurs, and more advanced or monkey-like than they in certain ways. One of the most striking of these is his upper lip, which is like that of monkey, ape, and man. Lemurs, on the other hand, are like typical mammals, having a lip which is split at the front, and a region of naked, moist skin around the nose, like a dog. Furthermore, the lemur's lip, where it is divided at the center, is also fastened vertically to the gum and cannot be drawn up, which means that while Tarsius, like us, can make faces, lemurs cannot.

These differences are impressive to anatomists, as are other simian features such as the kind of placenta formed in reproduction, and the arrangement of some of the bones of the skull. More general signs of advancement are the fact that the head in Tarsius is poised

[4]The two bones of the lower leg, the tibia and fibula, are fused together for stability (against the strain of hopping), and he has a double kneecap, an extraordinary thing.

in a greater degree of uprightness and is rounder, that the face is shorter, that the eyes are large (size being important for efficiency in eyes), and that the bony back wall of the eye socket is practically complete. Certain of the lemurs parallel the above advances, but in none of them have the eyes been so far brought around to the frontal plane that they coincide in their field of vision.

In various details of the trunk skeleton there are further signs of Tarsius' progressive tendencies, but they are not universal; his teeth, for example, are certainly primitive.

Monkeys, Apes, and Men

With the final suborder, the Anthropoidea, we are turning in at the gate, for here are the last remaining Primates from monkeys to men. They are by far the most progressive, but if anything they are more generalized than the others, being possessed of little that is distinctive. The back wall of the orbit of the eye is complete, except for a small fissure; and the eyes themselves have stereoscopic vision. This means that both eyes not only cover the same field, but also produce in the brain a single unconfused image of what they look at. This is largely because the nerve fibers leading from either eye are divided, some of each going to both halves of the brain in such a way that the images received from the two eyes merge in consciousness. And yet at the same time the slightly different direction from which each eye views an object is also registered, as in a stereopticon or a mechanical range finder, which allows a very precise judgment of distance. This is something new under the sun—one more extraordinary achievement of evolution.

From its inferiors the suborder differs otherwise only in degree. The brain is larger, with ever-increasing emphasis on the cerebral cortex, the seat of all higher functions, which extends backward to cover the rest of the brain. (The stages of this expansion advance steadily as you approach man.) The skull has become rounder and more human. Now, the face of man has moved ninety degrees forward from its position in a quadruped, being on a plane with his chest, so that a dog with a human face would be facing straight at the ground. In an ordinary mammal the snout is directly at the front of the head and the joint with the spine is directly at the back, while in the Primates both snout and *foramen magnum* (the opening for the spinal cord) have tended to move downward and

toward one another, under the skull; and these shifts, which are only hinted at in lemurs, and barely expressed in Tarsius, become manifest in monkeys and extreme in us. If they go any further we shall all choke to death on our own spines.

The higher nervous organization of the Anthropoidea is especially reflected in the independence of the hands, not only from the chores of support and walking, but also from each other, which means that we can readily use them to do different things at the same time. It was a great step toward man when primate hands became as interested in grasping movable objects like apples as in grasping fixed objects like boughs. Along with the growth of the brain and of the degree of organization there has been an increase in body size, with four giant animals (orang, chimpanzee, gorilla, and man) at the head of the whole order in both respects. But nowhere in this recital are there clear-cut points of anatomical difference from the lower Primates, and a morphologist is almost driven to the teeth in order to distinguish the Anthropoidea unmistakably.

The Anthropoidea are divided, or classified, in different ways in order to emphasize various distinctions. This can be a little confusing. There are, at any rate, five families: three of monkeys, one of apes, and one of men. There is also a major division among them, into those which developed in the Eastern and Western hemispheres respectively. The former (men, apes, and some of the monkeys) are called catarrhines (downward-nosed) because their nostrils point down and are close together. They also show their relationship by sharing the same dental formula, or count, of the several kinds of teeth (two incisors, one canine, two premolars, and three molars on either side of both jaws),[48] and they are the largest and most advanced. The remaining monkeys, who live in tropical America, are called platyrrhines (flat-nosed), their nostrils facing front and being well separated, with little in the way of an actual nose. They have one more premolar tooth in each series, which is a sign of relative primitiveness.

The New World Monkeys

The platyrrhine, or American monkeys, fall into two families: the Hapalidae, or marmosets, small squirrel-like creatures with red

[48]For brevity this is written: *i2, c1, pm2, m3.*

or yellow-and-black-banded fur and tufts of hair projecting from either side of the head, who hardly look like monkeys at all; and the Cebidae, made up of a number of familiar kinds—the cebus or organ-grinder monkey, the spider monkey, and the howler being the best known—and containing, at any rate, all those which can hang by their tails or use them to flourish a banana.

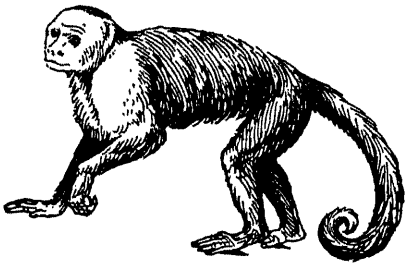
Primatologists are perplexed, at the moment, as to how to interpret the New World monkeys, and with reason. However, there seems to be agreement in a rough way that the two families are fundamentally alike and related, but that the Hapalidae are primitive while the Cebidae resemble the Old World monkeys, not because they are more closely related to them but simply because they have evolved in the same direction. Certainly the marmosets are aberrant and backward. They have claws instead of nails, excepting only on the great toe, and their thumbs are not opposable. Their skeleton is that of a springing animal, not of a grasping and clambering creature like a monkey, and the forelimb is very short. Some writers think they have degenerated, for unknown reasons, while others consider that if the Hapalidae had ever reached a higher plane they would carry more in the way of hidden vestiges of such a state as evidence today, and consequently believe that they have always been primitive. The Cebidae, on the other hand, have masked their humble status very well; the skeleton in many parts is advanced and like that of the Old World Primates, while it nevertheless shows that it is fundamentally different and more primitive. Some are also very bright, with spider monkeys equaling apes in many feats of intellect, which is a rather confounding fact.

The Old World Monkeys

The monkeys of Africa and Asia all belong to the family Cercopithecidae,[5] a name which is an ancient shibboleth for beginning students of the Primates. Undoubtedly the most familiar of them are macaques and baboons. Any large group of monkeys in a single cage in a city or roadside zoo is apt to turn out to be ordinary macaques. Baboons, the largest and fiercest of the monkeys, and perhaps the most intelligent, are, in various forms, almost ubiquitous in Africa; indeed, if I were to choose an animal as an emblem of

[5]Ser-co-pith-*thee*-sid-dee.

this continent I should take the baboon, rather than a lion, elephant, or eland. His name is unfortunate, sounding liquid and euphonious, but silly, and doing no justice to a magnificent and formidable primate. His reputation for cunning has also been inflated beyond what he might wish it to be by stories, some possibly true but mostly apocryphal, of his kidnaping and raising children and of



NEW WORLD MONKEY (*Cebus*)

OLD WORLD MONKEY (*Baboon*)

military maneuvers of groups which include unified command, tactical formations, ambushes, and so forth.

The family as a whole is varied to a degree that would probably surprise most people. Its members have a wide gamut of size but are mostly bigger than New World monkeys. They are also very colorful both as to tints of fur and skin and as to the combinations or arrangements of these, and many of them, both African and Asiatic, are strikingly beautiful. Zoos and children's picture books have hardly begun to exploit the Cercopithecidae.

The Old World monkeys differ from those of the New World, of course, in their form of outer nose and in a number of advanced generalities like size of brain and body. They are also more man-like in a lot of non-essential but revealing internal details. Their hands are typically very human in shape, with good and opposable thumbs and broad nails. Their feet are, of course, hand-like. Their hind legs are somewhat longer than their forelegs; all in all, their limbs are thoroughly generalized. But these monkeys have certain definite specializations, of which three are noteworthy. The most obvious is ischial callosities, a tongue-twisting euphemism for those

two gay and shining patches of bare, tough skin in that region described by Mr. Westbrook Pegler as the sole of the pants. A mandrill, therefore, gives you bright greeting whether he is coming or going; reversing the day, his face, red, purple, and blue, recalls the sunset, while his departing presence imitates the dawn.

Their other two specialties they keep more to themselves. One is a sort of alternative. The African species have cheek pouches, which expand to hold food that cannot at once be chewed and swallowed, and which are therefore useful in a scramble for victuals or on any other prandial occasion when time is at a premium; the typically Asiatic species lack them, however, but have sacculated stomachs, divided into a series of pouches by circular bands of muscle but capable of being greatly distended, upon which these seeming divisions disappear. The other feature is bilophodont, or cross-crested, molar teeth. These molars all have four cusps (except the last lowers, which have five) and are square in plan; and the two front cusps on a tooth are joined by a crosswise ridge, as are the two back ones. Such a pattern is distinct from that of the other Old World Primates, men and apes (and of course from the American monkeys). You can note its absence in your own molars with the tip of your tongue.

The Cercopithecidae are quadrupedal in gait (though of course they are four-handed rather than four-footed). They are typically tree-living, particularly the Asiatic section, and they walk or leap through the trees, and on the ground when they take to it, on all fours. The baboons, however, have left the boughs entirely, inhabiting such unforested regions as North and South Africa and the Abyssinian highlands in particular. They run on the flats of their rather small hands and feet, and it is interesting to see that, living among the dangers of ground life, they have the canine-looking, unmonkey-like long snout of terrestrial animals who fight entirely with their teeth. But when not moving about, the baboons and the others of the family resemble a dog or any quadruped far less, because they squat or sit upright almost invariably.

The Apes

The anthropoid apes make up the family Pongidae (or Simiidae). The reader is implored to assimilate the important distinction at once, and never again to refer to an ape as a "monkey." It would be

a far less hideous blunder, zoologically, to confuse an ape with a man. This can be put in taxonomical terms: G. G. Simpson groups the five families of the Anthropoidea into three super-families, in recognition of the broadest likenesses, and he puts all the New World monkeys in one, the Old World monkeys in the second, and the apes and man together in the third, which he calls the Hominoidea. There is nothing about the Primates which calls for more insistent emphasis than this fact, that apes are more like men than like monkeys. That is nothing new; Huxley said it, but the point has been popularly ignored nevertheless.

The average person, asked for the difference between apes and monkeys, will cast about in his mind and end by responding that apes have no tails. This is quite obvious and true; they have only the same internal vestige (the coccyx) as man, recurved beneath the pelvis and even smaller and more degenerate. But although it demonstrates likeness to man it is a minor matter. The great mark of the apes is that they are invariably upright in posture, and with it are bound up almost all their special and human-like details of anatomy. The monkeys, particularly of the Old World, are erect when sitting though horizontal when walking. But the apes even travel upright, for instead of using all fours they brachiate, or swing hand over hand from limb to limb, and even when on the ground they either walk upright or, because of their long arms, walk in a stooping position only. While they are not truly bipeds, like man, they are nevertheless primarily, if imperfectly, erect.

Their internal organs would, in fact, make them somewhat uncomfortable walking in a horizontal position since, as distinct from those of monkeys, these organs are supported or attached to the chest and spine in a way which accommodates them to the upright posture. Man, who inherited his viscera from the apes without any changes, has precisely the same arrangement.

The general habit of brachiation has served to throw emphasis upon the arms and remove it from the legs. Evolutionarily, the arms have been encouraged to lengthen since, within limits, the longer the arm, the bigger and more effortless the swing, or "stride," it can take. The shoulder, with the clavicle, is also strengthened, facing outward and slightly up, as a pivot for arms which work in almost any direction. The quadrupedal monkeys have a high freedom of the arms, of course, but since they use them to so great a degree as legs, their shoulders remain narrow and face

downward rather than outward, and their chests are deep and pointed.

In sympathy with this use of the arms the whole trunk of an ape is modified in a number of ways, all of which are characteristic of man as well. The shoulders are, of course, broad, with the effect of having been pulled out to the side. The chest has become flattened in front, instead of being pointed, and the breastbone in man and the anthropoids is broad and flat and rather short, while in the monkeys and other mammals it is long and rod-like, with no breadth to speak of.

The spine in a monkey, or any four-footed animal which runs and leaps, is long and springy in its free (non-rib-bearing) or lumbar part; it acts something like a bow with different sets of muscles as bowstrings. But it has no such function in man and apes, in whom it serves simply to support the upper part of the body on the lower or, when brachiating, to attach the lower part of the body to the upper, since the legs merely dangle. A long and flexible lumbar spine in such case would be a weakness, and in the apes, as in man, it has been compacted and solidified somewhat, partly by getting rid of some of the actual vertebrae and partly by widening the remainder. This cutting down of the number of independent units (and thus of the joints between them as well) in the lower spine has evidently been a beneficial strengthening tendency in the anthropoids. It has, at any rate, been constant, and strongest in the orang, the most given to brachiation of the large apes. It has come about by having one or more lumbar vertebrae captured by the sacrum (the block of fused vertebrae which form part of the pelvis), which has become relatively longer and heavier to suit these larger animals. The orang again has evinced a tendency to pass one of the sacral vertebrae in turn off into the remnant of the tail, which is equivalent to limbo.

The anthropoid pelvis, compared to that of monkeys, is broadened out in such a way that it gives underpinning to the swelling torso in its upright position. Monkeys are narrow in the hips, and the blade of the hipbone is extended forward (toward the head) parallel to the spine for the prime reason of giving a decent leverage to the muscles which pull the leg forward. With the broadening of the trunk, these blades of the hip also are extended outward from the sacrum toward the sides, which is something almost peculiar to the anthropoids. This broadening is a help

in maintaining balance when so large an animal is sitting or standing upright, since it gives advantageous points of attachment for trunk muscles which check any swaying of the torso. Putting on weight exacerbates many problems, and not the least is that of equilibrium.

In shoulders, chest, spine, and pelvis, therefore, the apes exhibit a complex of related skeletal features which result from their devotion to brachiation, a habit quite distinct from those of other Primates.[6] The reappearance of the same features in man clearly reveals that he was once a brachiating ape.

Other than this, the apes are not greatly distinguished in an anatomical sense. There is no good explanation as to why they have no tails, but they probably lost them long ago. It might be remarked, of course, that springing animals, from squirrels through monkeys to kangaroos, use their tails as a counterweight for balance in jumping, and that apes do not spring or balance, but hang. Anthropoid teeth are distinctive (though like man's), without cross ridges, and with five cusps on all the lower molars (four in the uppers). But such teeth are not specialized. Wood Jones, in fact, describes the apes as unspecialized Old World monkeys, modified by brachiation. Brachiation has involved almost the whole skeleton in a train of functional development, but not the skull, which has no special characteristics. You recognize the huge and crested cranium of a gorilla as that of a gorilla, but it would be difficult to say in an abstract way why it should be classed as that of an anthropoid ape.

[6]The spider monkey of the New World also brachiates extensively, and it is revealing to find that, making allowance for his small size, he has developed certain functional anthropoid features.

CHAPTER V

Man and the Anthropoids

HAVING DESCRIBED the apes in general, I shall now describe them in particular, with man among them. Not including the latter, the living apes are four in number, with one pair, the chimpanzee and the gorilla, in equatorial Africa, and another, the orang and the gibbon, in southeast Asia and the Indies. There is considerable cleavage between the Asiatics, who are extremely adapted to brachiation, and the Africans, who are the most man-like and who spend a good share of their time (nearly all of it in the gorilla's case) on the ground.

THE GIBBON

Gibbons inhabit all of the southeastern peninsula of Asia, and the islands of Borneo and Sumatra. There are several species, and some writers would divide them into two genera, the gibbon proper and the larger siamang, or would even set off the gibbons as a whole in a family by themselves, the Hylobatidae. It is true that they are primitive and aberrant. They have small external ischial callosities, like the Cercopithecidae, but these may also often be detected, either externally or as a layer in the tissues among the other apes, and, according to some, in man as well. While the giant Primates have only hair, furthermore, gibbons have fur (ordinary coarse hair mixed with thick, very small hairs), which is gray, black, or cinnamon. The skin color is a dense black.

The gibbon is the only small ape, being under three feet high as a rule, and light, long-armed, and wasp-waisted. He is the greyhound of the anthropoids, while all the rest, including us, are big, thick in the midriff, and sluggish. He is the world's finest brachiator and aerialist, and a stunningly graceful thing to see, describing flowing festoons in the air from limb to limb and projecting himself in some cases across fairly wide open spaces. Thus he can travel pretty rapidly, but Dr. Sherwood Washburn, who is nimble

GIBBON

ORANG

himself, tells me that though a nimble man, running in the woods, cannot quite keep up with gibbons, nevertheless they can be followed because they go in groups and do not maintain their best pace for long stretches. With his legs drawn close up, a gibbon looks, when moving, like hardly more than a furry ball slung on his two immensely long, thin arms. So completely is he adapted to brachiating that his hands have the same character as his arms, being long and narrow; his thumb, however, is small, as his swinging is so rapid that he uses his hands merely to hook over a bough, rather than for grasping. His accommodation to brachiation, in other words, has reached the state of a marked specialization.

His canine teeth are long and spiky, while those of the other anthropoids are shorter and blunter, and he can use them to telling effect in an access of ferocity. Gibbons are ordinarily gentle and pleasant, living as mated pairs with several children. They make good pets, being affectionate and intriguing. However, intriguing has two meanings, and a gibbon represents both of them. He has entirely too much intellect to be the perfect household companion, and he has four hands besides, no one of which does he let know what the other three are doing.

Gibbons walk upright readily enough, with their long arms outstretched and their hands dangling, in a burlesque ballet style which helps them balance. This is not like the erect stance of man, however, in whom the body is raised up by means of the bending of the spine at the lumbar curve; the gibbon simply throws his trunk back on his legs—a very imperfect adjustment. He runs along a bough in much the same way. It is doubtful whether ground walking is as natural to gibbons as this seems. Carpenter estimates that they come to the ground for only about 5 per cent of the time; he also says, however, that gibbons who have been captive since they were young learn to walk on their legs more skillfully than those who are captured after growing up in the trees.

The Orang-utan

The misanthropic orang swings through the lowland forests of Borneo and Sumatra, commonly alone. He is the only solitary ape. He is as heavy as a man, with much shorter legs and a much larger trunk. His head is a modest dome, giving him something of a brow, which is without the glowering brow ridges of the other apes and

of primitive man; his eyes are beady and his nose and mouth project sharply. On both head and body he has long hair, which is ginger red, and an orange beard. He is as much given to brachiation as the gibbon, and the effects of this addiction are as marked, but he practices it differently, because of his weight. He moves deliberately and cautiously, in contrast to the carefree flitting of the gibbon. Anyone who saw Martin Johnson's movie of the capture of an orang in Borneo will remember how the latter stuck to his chosen tree like flypaper, refusing to move to another, and being pulled down only with great difficulty. There is a total difference, in other words, between his ponderous brachiation and that of the gibbon.

The orang's arms are exceedingly long and strong and his legs equally small and weak. His fingers are long and hooked, the bones of them actually being curved, enabling him to hang by his hands. That is to say, he cannot straighten out his fingers. Even more than the gibbon's, his thumb is short and degenerate; in fact, in their manner (gibbon and orang) of catching and holding a bough, the thumb is not used and is only in the way. The feet of orangs are of the same form as the hands, and it is probably for this reason that, above all apes, they dislike the ground and detest walking upright, which they can do only by treading painfully and clumsily and standing on the outside curled edges of their feet rather than on the soles. If you can imagine trying to walk on feet which are hands, with long fingers which cannot be flattened out, and with almost nothing to serve as a heel, you can sympathize with the orang. It would be better if he were to leave off his feet entirely and walk on his ankles. His predicament is, then, that he is too much adapted for brachiation to be any good on the ground, while he has become too heavy to be particularly active in the trees. All of this applies especially to the adult, in whom the weight and the curving of the fingers are greatest. The young are much more agile.

An orang has certain peculiarities of construction or specialization other than the ones which, as a general expression of the brachiating habit, he shares with the gibbons. Some of them concern his muscular system: he lacks in particular a ligament (*ligamentum teres*), like a scallop's muscle, which binds the head of the thighbone into its place in the hip socket in the other apes and man; a lack which, though it weakens his leg, allows him to stick it out in directions impossible to us. He has a webbing between the

lower parts of his fingers. His lungs are peculiar, being single sacs, rather than having lobes like ours. His molar teeth differ minutely from the other apes, especially by having in part an irregularly wrinkled surface instead of regular cusps. In spite of their common bent for brachiation and the fact that they live in the same territory, it does not look as if the orang and the gibbon were related particularly closely within the anthropoids.

The African Apes

In the African wing of the family, on the other hand, it is obvious that the gorilla and the chimpanzee are very near kin, and equally plain that they are the two apes standing next to man. Schultz, in fact, in a tabulation of anatomical details (which, of course, obscures the paramount importance of certain features), finds that the gorilla shares a greater number of close likenesses with man than he does with the orang.

Compared to the Asiatic species, these two apes are much more on the ground, the chimpanzee mainly and the gorilla almost entirely, when adult. Even though the chimp is a masterful brachiator, therefore, neither of the Africans has so pronounced a development of this faculty; it seems to have been checked somewhat in favor of a greater ability to travel on the ground. Compared to an orang, their arms are shorter and their legs are longer and stronger. Their hands are not so given over to hooking: the fingers are not bent as to shape, and the thumbs are longer, more opposable, and more useful. Their feet are applied to the ground flat, and the big toe, though it sticks out like a thumb, is long, being almost as long as the others, which are somewhat bound together, rather than free and separable, like fingers. The foot, finally, has a distinct heel; there is no confusing this foot with a hand, even though it grasps like one.

In almost every one of these things the gorilla is the more manlike of the two. His hand is short and broad, with a long thumb, altogether much like a man's in proportion, though of horrifying size. His is the flattest foot, with the great toe most closely drawn in toward the others, and with a heel which sticks backward the greatest distance. This increasing difference in the form of the foot from that of the hand is a very significant one—the most important, to my mind, in the final development of man, from a purely

evolutionary and nonintellectual point of view. But the gorilla's likenesses to man do not necessarily signify that man descended from him. They probably mean instead that the gorilla has been studying life on the ground for a longer time than the chimpanzee,

CHIMPANZEE

GORILLA

and also that his big size more emphatically demands the development of a near-human type of foot, such a foot, after all, being primarily a ground-walking modification, for a largish animal, of the general anthropoid-primate model. However, some of the students most devoted to this particular question feel that the gorilla has taken this tack too late and is doomed forever to flat feet; that a fully human foot could develop only in a somewhat lighter animal, and that where man's parent somehow succeeded the gorilla has already failed, or is destined to; that, in spite of his earnest humanward endeavors, he is never going to have anything upon which he can stride along erect. Certainly both he and the

chimpanzee have adopted a quite different kind of gait, which is a shamble using the arms, resting on the knuckles, for considerable support, though not for a full share of it.

The two apes are a good deal alike in this way of walking. It sounds and looks awkward, but it can be speedy, and it is quite possible that, using it, a gorilla can outrun a man. This is not settled; studiously recorded test cases in natural surroundings on the question are not common, partly because it is difficult to coax gorillas to partake, and partly because it is difficult to coax men to partake. In the latest reliable report that I know of,[1] the result was close but not decisive. The man got away, but only because a non-contestant shot the gorilla—a palpable foul. In any case, when the gorilla wins there is less likelihood of the details getting into the record books, so his interests are prejudiced.

Both the gorilla and the chimpanzee stand erect very readily and even walk this way to some degree. They stand up to feed or look around, or when watching something with interest, and the gorilla, in particular, rises in a defensive attitude, or to thump his chest. Actual upright walking, however, is probably most exceptional in the wild. But the ability is there, for chimpanzees can even be taught to roller-skate.

Together, the two apes have compromised between the trees and the ground, and this is reflected in all of the above details about their limb proportions and their hands and feet. But they are alike, and similar to man, in a good many bodily features which have nothing to do with locomotion. The spine has the same number of vertebrae as that of man, differing only by having one more pair of ribs, and therefore one lumbar vertebra the less. (The orang, on the other hand, has a shorter spine than any.) They have lobar lungs, like man. Details of the brain are similar in all three. The molar teeth have patterns indicating a common parentage—evidence which at the moment is the most definite we possess about man's anthropoid ancestor, who will be introduced presently. One final detail of no importance but of tremendous significance is a little bone in the wrist. This, the os centrale, is to be found as a distinct bone in all primates with only three exceptions: chimpanzee, gorilla,

[1] H. C. Bingham, "Gorillas in a Native Habitat," *Carnegie Institution Publication No. 426*, 1932. This chase, although in the gorilla's native mountains, was along an open and unobstructed path.

and man, in whom it fuses during growth with another bone, upon which it appears as a lump or process.[2]

I said "tremendous significance" a few lines back because these last two things illustrate a major principle in tracing relationship among animals, which is that non-functional likenesses are the more important. If several kinds of flying animals—bats, birds, butterflies and flying fish—all have wings, this does not indicate relationship, because wings are the only feasible means of flying, and are patently a functional character. But a separate os centrale or certain minute details of the pattern of cusps on a molar tooth are of no special significance one way or the other, meaning that they are nothing which evolution would strongly tend either to keep or to discard; consequently if two similar animals share them it almost certainly means that they are both descended from a common parent who happened to have them. The chances of relationship increase geometrically as such features multiply. Man is clearly akin to the Pongidae because of the form of his whole anatomy, but he is obviously especially close to the chimpanzee-gorilla branch by the evidence of these indifferent details.

The Chimpanzee

Rather than describe this pair of apes minutely I have dealt with those things about them that fit them into the scheme which serves as a background for man. But I should indicate that though they are close cousins a chimpanzee is quite distinct from a gorilla. Chimpanzees live in the Congo forest and the more open woods and savannas of West Africa, and are numerous, going in bands of eight to ten on an average, and, as far as is known, never alone. They travel fairly rapidly, mainly on the ground, over long distances, though not necessarily purposefully or in a constant direction. They spend the night in trees, in individual nests of bent or broken branches which they make quickly and in which they sleep in entirely human postures and sprawls. They feed almost continually on wild fruits, and make a great deal of noise all the time, both by shouting and by crashing through the bushes, and even by beating on stumps and logs for pleasure. It may be that this helps

[2]Washburn finds, however, that this fusion takes place, as an individual variation, in a certain percentage of langurs, who are Old World monkeys.

to keep the band from getting separated, since a straggler, picnicking by himself, can always catch up by noting the direction from which the din is coming. They do not mind being near men or villages as long as no attention is paid to them, but they loathe being spied upon. They are very alert to detect this, and when they do, all noise stops at once and every one of them melts into the forest like a Fenimore Cooper Indian.[3]

Chimpanzees vary a good deal in size and also in proportions. On the whole, however, they are distinctly shorter than man, and somewhat lighter, males averaging one hundred pounds.[4] (This applies to adults; most of the apes in zoos or circuses are children.) Some chimps actually have arms which are relatively shorter than man's; their legs, of course, are far shorter. Their heads are not particularly large, but they have fairly prominent ridges of bone over the eyes (which the orang has not), and they are distinguished for their large and handsome ears, which in all other apes and man are crumpled, degenerate, and flattened against the head. Chimp hair is dark brown or black, and is not particularly thick anywhere and is especially sparse on the head in the adults. The color of the skin varies from mottled through brown to black, and there are local differences in this as well as in features of the face. For this reason some authorities believe there should be several species of chimpanzee, while most consider that these differences are merely races, as in the case of man. There is a pygmy chimpanzee in the southern Congo, however, which does seem to be distinct, in other ways as well as in size, deserving to be created a separate species.[5]

The Gorilla

There is a similar discussion regarding the gorilla, who is found in two unconnected habitats. One lot lives in the forests of the Cameroons, at the angle of the Congo and West Africa; these have somewhat shorter hair and less of it. The other type patrols the mountains of the Ruwenzori range, in the eastern Belgian Congo, living in a cold, damp forest at altitudes upward of six thousand feet; and in this form the hair is longer, thicker, and blacker, and

[3]Henry W. Nissen, "A Field Study of the Chimpanzee," *Comparative Psychology Monographs*, vol. 8, 1931.

[4]According to figures collected by A. H. Schultz.

[5]H. J. Coolidge, "Pan Paniscus, Pygmy Chimpanzee from South of the Congo River," *American Journal of Physical Anthropology*, vol. 18, 1933.

with a distinct gray area across the middle of the back which is, however, not a sign of age. Some have considered these as two different species, but most writers take them to be merely races. In this latter case the correct names are *Gorilla gorilla berengei* and *Gorilla gorilla gorilla.* This is so Gertrude Steinish, however, that they are called simply Mountain and Coastal (or Lowland) respectively.

Little is known about gorillas in the wild, and knowledge of their behavior is mostly related to encounters with human beings, when it can hardly be normal. Gorillas are rare animals, and they are now rigidly protected by their colonial governments. But they do not seem to live alone; it is believed that they may go in pairs or in large groups of thirty-five or more, with something in between as the usual thing.

Apparently they live like the chimpanzees, though they show more purposefulness. Because of their bulk they are prodigious eaters, while chimps are merely voracious; and this is particularly so because the soft, lush plants they eat are not especially nourishing. A gorilla will set himself down in a comfortable place and, without stopping, eat every piece of vegetable matter which he can reach with his arms, which are long, so that he winds up in the middle of a sizable clearing.[6] They eat energetically and steadily, with less noise and wastefulness than chimpanzees.

They have been seen to travel for four or five days in a constant direction, quite as if they were on the march to a definite place. In one case two groups joined and went together. On other occasions one or more of the males has been known to howl and scream in order to warn or guide other members of the party. They trample the vegetation along their trail so thoroughly that it does not recover for over six weeks, but they can be extremely silent and careful if they choose to be. Gorillas dislike human company, but show far less inclination to efface themselves than do chimpanzees, and males are likely to challenge the approaches of man by standing up and bellowing. It is sometimes a bluff, but they are apt to charge if a man continues to advance. They may half charge several times, stopping a short distance away, and still out of

[6]These apes are total vegetarians in nature, but in captivity take easily to a human diet. John Daniel, Miss Cunningham's young gorilla, who ate at table, knew the tenderloin from the sirloin side of a steak at sight, and preferred it, and always made a fuss if he was passed a piece of sirloin. Gargantua has a moderate but rich diet of meat, eggs, milk and vegetables.

sight in the thick brush, or they may attack.[7] In this diplomacy the honors are equally divided, the men retiring about as often as the gorillas. The only other solution is almost certain death for one of them. Natives in West Africa have been bitten or mauled by the animals and lived to tell of it, but such people are lucky.

Gorillas sleep in nests, the larger ones on the ground and the younger and smaller in trees; and the pattern of nests of a group has been seen to be much the same on succeeding nights, even to suggestions of pairs of twin beds.

Gorillas are the biggest primates, but so little are they known that maximum sizes are indefinite. They have, of course, been advertised as larger than they are, with unsubstantiated talk of eight- and nine-footers. But some males probably attain six hundred pounds;[8] and in spite of their relatively short legs their torsos are so immense that in height they average the same as man, or more, and run not infrequently over six feet standing. The reach of their arms is the most prodigious thing of all, being nine to ten feet from finger tip to finger tip. Furthermore, as in other apes, the power of the arms is proportionately even greater, being several times that of a man's. Tales of a gorilla strangling a hunter with the barrels of his own gun may be colored considerably, but they would hardly falsify his strength.

Gorillas are mostly black-skinned. Their abdomens are large and their shoulders broad. I have described their hands and feet. Their heads are big and seem higher than they actually are; they have a heavy and very powerful lower jaw, and the muscles which shut it (which in man make a thin layer on and above the temple, where you can feel them when you chew) are so large that they lie thick on the top of the head, about two inches deep, practically obscuring the heavy brow ridge over the eyes which is so prominent on the skull, and giving rise to a bony crest in the middle merely to separate and afford attachment to the muscles of the two sides. The nose of a gorilla is most like man's in one respect: it has large fleshy wings with cartilages in them, which look like the *reductio ad absurdum* of the negroid type of nose. There is no visible bridge, and these wings are the only protruding part.

[7] W. K. Gregory and H. C. Raven, *In Quest of Gorillas*, 1937.

[8] Schultz indicates that captive gorillas become abnormally fat, and is certain that this is true in the case of Toto, who has weighed in at 438 pounds. It was also true of Mbongo of the San Diego zoo, who weighed well over 600 pounds at death. Raven shot a wild male mountain gorilla weighing 460 pounds.

Emotional and Psychological Nature

Temperamentally, the gorilla and the chimp are considered by Yerkes to straddle man, the former being something more of an introvert and the latter more of an extrovert. This is delicate ground, however, and it is easy to misjudge and to exaggerate; to misjudge because either species obviously has as wide a range of personalities (they can all be seen in chimpanzees) as man, and to exaggerate because of the circumstances surrounding our knowledge.

Chimpanzees, on the one hand, are very amenable to captivity, to training, and to games, particularly as children. The apes you see in small zoos, or working in gangs for psychologists, are, therefore, almost always young chimps. These, when left to their own devices, present a picture of ebullient demonstrativeness, imaginative playfulness, and unself-conscious, obstreperous *joie de vivre,* in which every thought is acted upon with gusto, interlarded with the wildest grief or most passionate pleas for forgiveness on being scolded, stuck in a corner, or caught in an unseemly act; altogether they probably outdo a gathering of human children by a slim margin in the energy of their spirits. But when chimps get older they change in the manner of men, putting away childish things and losing the love of play. They become graver and more serious, and do not give vent to their feelings. Nor will they be trifled with. They become not so much short-tempered as dignified, but they are dangerous if seriously crossed; their feelings are what ours would be in a similar case. At this age it is difficult to analyze a chimp's mood, but taking the young ones into account it is likely that the species exceeds the human average in expressiveness.

Gorillas, on the other hand, are, in spite of the varied climate of their natural habitat, delicate and very difficult to keep healthy in cages. None even reached Europe and America alive until about 1900, and it is only in the last ten years or so that any have been raised to maturity, with great care and attention. The situation is revealed in the fact that any carnival has several chimpanzees while Ringling Brothers Circus makes Gargantua, in an air-conditioned cage, its premier attraction, and pays a king's ransom to get him a spouse, one Toto. It can be seen from all this why it is that the gorilla's reputation comes not from real knowledge but from a century of hunters' and natives' tales, none of which have suf-

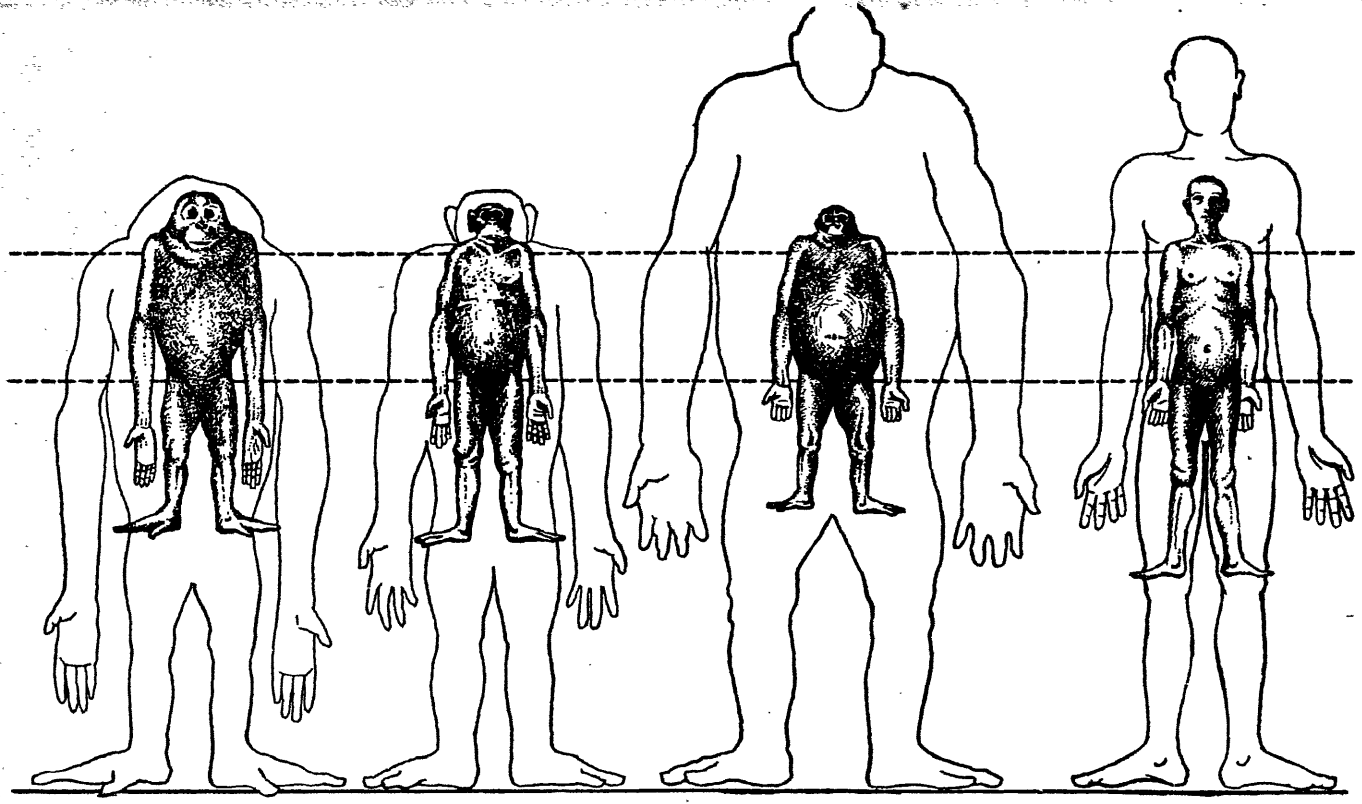
fered in the telling, and which have the poor ape committing the most atrocious murders and compounding them with deeds that would get him lynched in the South, such as carrying off native women tucked under one arm or brandished in the air, in the circus posters. Even if we discount this stigma of wanton brutality, attached to him by men who murder him with firearms, there remains the firm general impression of the gorilla as something less than amiable.

It is quite true that while a wild chimpanzee will flee from a man, a gorilla will remain to dispute, making menacing gestures and frightful noises, howling, chest-beating, and chucking himself under the chin to rattle his teeth. However, the psychological difference between gorilla and chimp has been exaggerated by the natural difference between adult male animals who are being pestered by human beings on safari and juvenile apes who have been brought up in kindly surroundings, with plenty of food and toys. When allowances are made for these things, both apes draw much closer to man temperamentally, from opposite directions. The most careful observations on young gorillas show that, far from being aggressive and intransigeant like the adults, or noisy and boisterous like little chimps, they are like our quiet and sensitive children and are actually rather repressed, being apt to swallow a fright or a sorrow rather than to express it in shrieking, and giving as little sign as possible of the state of their feelings. On the whole, good nature is usual in them. Nevertheless, they invariably become dangerous at maturity, and Carl Akeley, the gorilla's most friendly critic, made no attempt to minimize the fact, only insisting that they almost never attack a man without full provocation.

It would appear that, in their family life and their usual relations and treatment of each other, the apes are really much like man. They thus contrast with baboons, among whom viciousness and force determine everything, with every adjustment accomplished by strife.

Human Characteristics

Man's family, the last of the Anthropoidea, is the Hominidae, represented today by a single species, Homo sapiens. This species is divided by minor variations into races (whose skeletal differences are apparent only to an expert), the most familiar example of the sort of divergence we have already seen to exist among the apes.



PROPORTIONS OF THE GIANT PRIMATES (*after A. H. Schultz*)

The smaller figures have been drawn to make their trunks (from the top of the breast-bone to the pubic symphysis) all of the same height, showing the differences obtaining in the relative length of the arms and legs. At the same time the outlines in the background show how the three great apes and man would compare in actual size if they were standing side by side.

I have indicated early and often that the apes are very man-like, and it only remains now to pile Ossa upon Pelion by saying that man is very ape-like. The human form is so familiar an object that it will hardly do to launch into a straightforward description of it, and I shall instead discuss the things in which we differ from the apes because we walk on two feet, and then our other special features, such as they are.

Man has taken the general physique of the upright anthropoids and pressed it into the special form most suitable for a ground-ape who walks erect, but has achieved, above all, certain real differences in the foot. Among the five animals sharing this fundamental physique, the gibbon is the perfect brachiator and man the perfect walker. Or, taking only the giant primates, it is the gorilla and the chimp who have temporized, attempting both modes of locomotion, while the orang and man have made more definite decisions, the former for arms and the trees and the latter for legs and the ground. There is no doubt, of course, that man was once a tree-living, brachiating anthropoid—his form and posture could only have come from such an animal in its beginnings—but this life had made less of an impression on him by the time he took to the earth below. His limb proportions reflect the situation. His arms are very long, compared to his trunk, for any mammal, indicating that he has been a brachiator, but they are shorter than those of most apes. It is his legs which dominate the scene, being as exaggerated in development as are the arms of the apes, or more so. Probably in no other mammal are there legs which make up such a percentage of the weight, possibly excepting the kangaroo.

But his great distinction lies in his foot, the most peculiar thing about him. This foot has a completely non-opposable great toe and two solid arches, one across and one from front to back—features which mark it off distinctly from other primates. It also has a big heel as the hinder part of the long arch, and none of the bony structure of the foot bears upon the ground between the heel and the broad region of the ball. The bones of the arches are all compactly fitted together, enabling them to bear the weight of the body and to transmit it forward from the ankle to the toes. This is what makes it possible to take long and effortless strides, which an ape with his flabby foot cannot do; he simply cannot rise on the ball of his foot because the middle part of his foot is movable; his step takes place at his ankle, while ours takes place at the base

of the toes. This is a vital difference, because it adds two thirds of the length of our feet to the distance and strength of our stride.

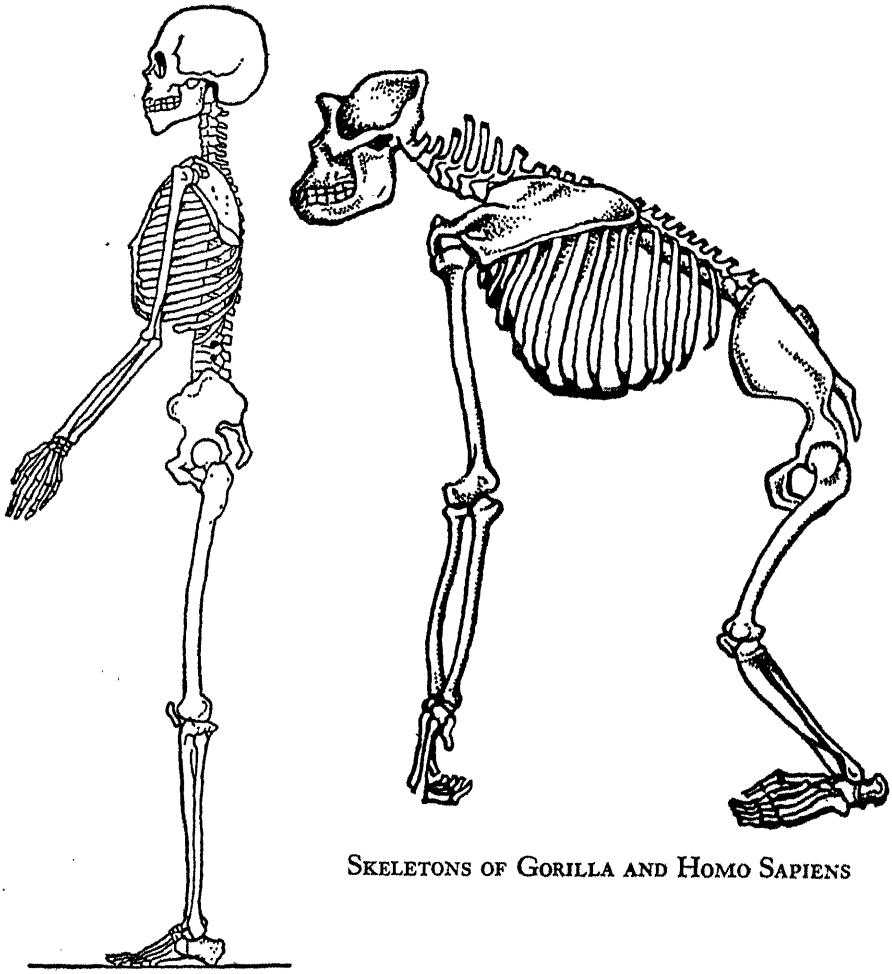
The Made-Over Skeleton

The remainder of the skeleton has accommodated itself to the use of the feet. Man, as I said, has carried the ruling anthropoid tendency toward uprightness to the hundred-per-cent mark, and in the same way has brought certain anthropoid tendencies of skeleton shape to their logical ends. The primary necessity has been to bring the center of gravity directly over the arches of the foot, or the ankles. First of all, the leg bones, somewhat bowed in apes, have been straightened out, and the knee can be locked, so to speak, in an upright position, while the ape knee is at best slightly bent and in a posture which calls for constant muscular effort by the leg. To stand with your knees a little bent is most exhausting, and also persuades you to lean forward somewhat.

Above the legs, it has been necessary to swing the upper half of the body back into a straight upright line, which has had a whole train of effects. Because of the insertion of the hip joint, it was not possible to do this by a simple tilting back of the pelvis, which still faces, as it does in apes, forward at an angle of about forty-five degrees. It was accomplished instead mainly above the pelvis, in the lumbar column of five vertebrae, which on leaving the pelvis has a forward direction, as in the apes, and then turns sharply back to point upward, describing what is known as the lumbar curve, convex toward the front, which is a typically human feature.[9] The rest of the trunk has made minor adjustments to maintain the posture which the lumbar curve imparts to it, as follows:

In the pelvis, the sacrum is moved back somewhat by a bending of those parts of the hipbones to which it joins; and since the sacrum bears the weight of the spine and the upper part of the body, the center of gravity of these is carried back into the proper line, to make up for the forward projection of the lumbar curve. The sides of the hipbones are also curved well around toward the front of the body, supplying more directions from which muscles can serve to hold the trunk erect. At the same time this extension pro-

[9] This is incipient in apes; it is not present when they are standing on all fours, since the whole spine is slightly humpbacked in this posture, but when they hang upright by their arms the dangling weight of legs and pelvis induces the lumbar column to bend forward, and the curve also appears when they stand erect.



SKELETONS OF GORILLA AND HOMO SAPIENS

vides better attachment for the several muscles which pull the legs forward or backward.

The sacrum and the lumbar vertebrae are large in apes but, for greater firmness and stability, exaggeratedly so in man. It looks as though the evolutionary tendency for the pelvis to crawl up the spine, seen in the apes, had been checked, and as if instead of passing vertebrae off into the coccyx, the sacrum had retained them for its own enlargement, and now tends only to grasp still more vertebrae from the lumbar column. Variations can be seen in living men which show different stages of this process, perhaps with a vertebra which is half lumbar and half sacral in form.

The whole chest has been pronouncedly flattened. more so than

in the apes, while the shoulders remain placed well to the side. This narrowing from front to back certainly goes to make balancing in the fore-and-aft direction easier. (The arms I have described. The hands, entirely free from locomotion of any sort, are simple, with broad palms and short fingers; rather monkeylike and showing no discernible effects of brachiation.) Finally, the head has become perfectly poised upon the spine, because the neck is upright and because the jaws have become so small as no longer to weigh the head heavily down in front.

These are changes which have taken place in Homo sapiens. Other, extinct types of man had not developed them all to the same degree, notably Neanderthal Man, with his bowed limbs, barrel chest, and forward-hanging head. Furthermore, it seems likely that in early species of man the feet and legs took on human form first, from dire necessity, and the rest of the skeleton perhaps more slowly, while the head, not having much to do with maintaining the erect posture (and so under no particular pressure from natural selection), could and did remain primitive for a long time, changing gradually at a more even pace.[10]

The Human Skull

Though the erect posture and the feet are what mark us off most definitely from apes, it is nevertheless this other group of features, in the head, which will strike us as the more important; since, after all, it was the enlarged brain that made us what we are today. There have been two concomitant trends: the swelling of the brain, and the shrinking of the face and jaws back under the brain case until the face is nearly vertical and of delicate construction.

As to the brain, there is not much to say except that it has now increased in size to roughly three times that of a gorilla, or chimp, already the largest-brained animals, relatively speaking, outside of man. Furthermore, every type of fossil man so far discovered has a brain larger than the largest in the apes. For a cause, it has often been suggested that as the head became balanced on the spine and the jaws became lighter, the jaw and neck muscles shrank and

[10]Let me repeat (see footnote, p. 15) that in saying that such and such a reason caused such and such a change in the skeleton, I am only using a means of description. Evolutionists cannot show today the relations of cause and effect in these changes in a satisfactory way.

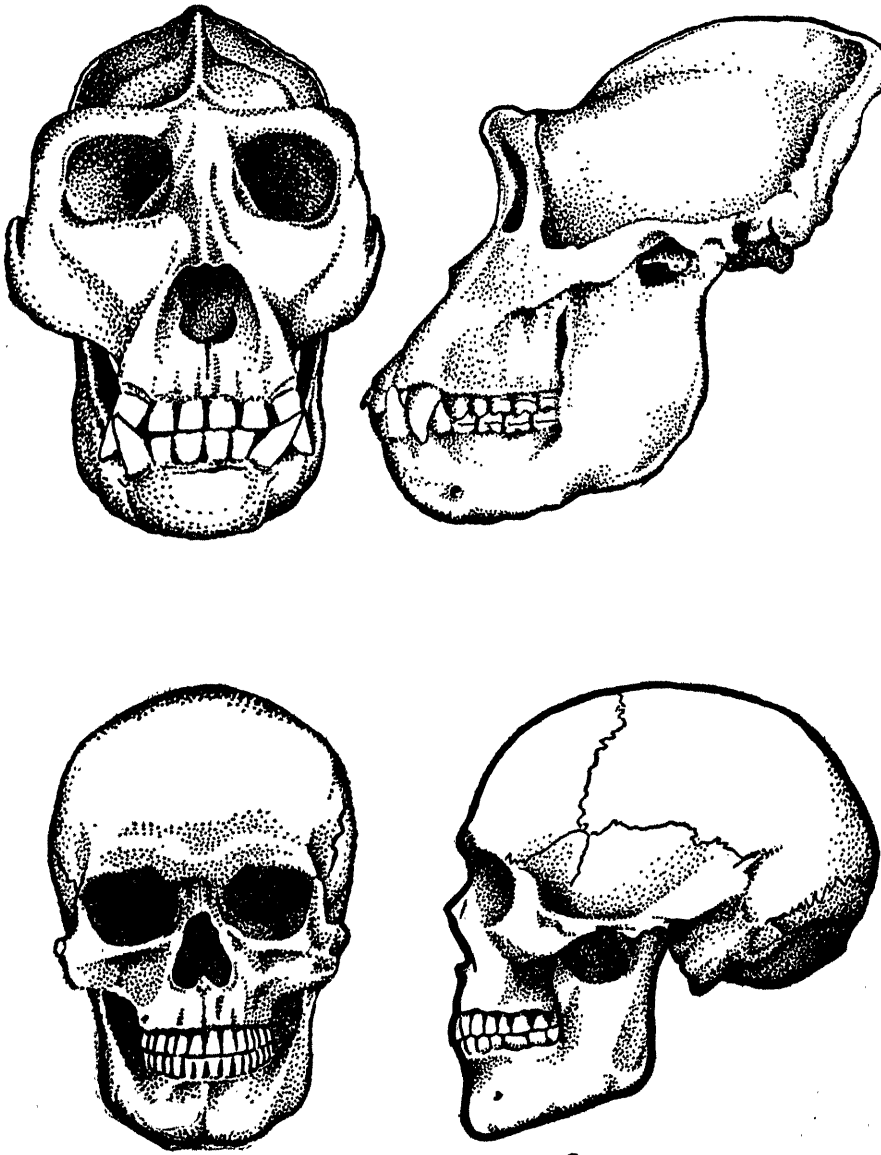
no longer exerted great pressure on the brain case, to which they are attached. This supposes that a gorilla's brain growth is directly repressed by his muscle development—a feeble argument with no proof behind it. There is no proper mechanical explanation for the expanding brain, and most anthropologists confess that, as far as they know, it "just growed," like Topsy. Remember, at any rate, that there is nothing startling or especially human in this cerebral increment, because it is a continuation of a tendency that goes right back through the Primates.

The drastic reduction of the quondam snout is almost as mysterious, though here one may appeal to the vague principle that unused organs of a species degenerate. Man uses his hands for the purposes to which a quadruped puts its muzzle, but so do apes. In fighting, however, the latter use both their hands and jaws, while man has long since passed a point at which, when called to combat, he began to provide himself with some kind of manual weapon, so that he now considers the use of his bare hands to be only a sport, and disdains to bite entirely. The process of change in the snout seems to begin with the teeth, which have become smaller; this has shortened the dental arch, which has been further reduced in length by spreading apart at the back. This broadening is probably connected with chewing; we chew with a swinging motion of the lower jaw, from side to side. We are able to do this because our teeth are all on one level, and our canines do not project, while in apes the long canines interlock, inhibiting the side-to-side motion to a great degree.[11] (As the jaws diminished and the teeth got close to the joint, or fulcrum, the better leverage provided called for less force. The muscles of the lower jaw have shrunk to a fraction of their former size.) Along with the drawing back of both tooth rows the whole face deflated sharply at the same time, and even the eyes have tended to move back under the swelling forehead.[12] But there were two spots which could not very well deflate, which is the reason why we have developed a nose with a bridge, and a chin.

The nasal cavity, or air passage, is a narrow chamber in the middle of the face, like a standing triangle running fore and aft.

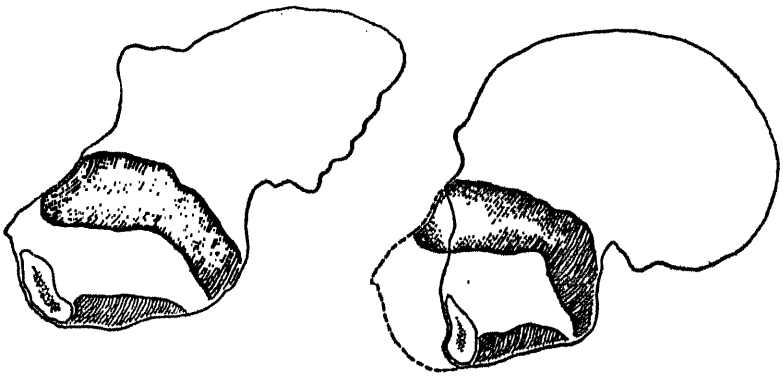
[11]But not preventing it entirely. H. C. Raven has found old chimpanzees in whom the canines were ground off flat, having been worn through by a persistent human-like chewing in spite of the difficulties.

[12]Or, rather, to stay back, since this is the infantile position in man and the anthropoids.



GORILLA AND HUMAN SKULLS

This fits nicely into the sloping profile of an ape's face. But it is unlikely that it could have been much reduced in size along with the rest of the face, in an animal as big as man, without losing its efficiency as a clearing chamber for air coming in. So when the whole cheek region of the face shrank back, the nasal cavity was



WHY WE HAVE A NOSE AND CHIN

The shaded portions in both the gorilla skull (left) and the human skull represent the space taken up by the nasal cavity and the tongue muscles. (The central section of the jawbone is also shown.) The human skull no longer has the protruding profile of the ape (indicated by the superimposed dotted line). But the nasal cavity still maintains its volume by sticking out in the form of a high nose. Similarly, space for the tongue muscles is preserved when the jaw has shrunk, by having the necessary thickness of the jawbone on the outside, in the form of a chin.

left sticking out in its original position under a sort of shed of its own, looking like an annex to the face. This was the only alternative; it could hardly have expanded sidewise.

The chin emerged in similar fashion. In the open space beneath the long and projecting anthropoid lower jaw there is plenty of room for the muscles which work the tongue and help in swallowing. Again, we are animals of giant anthropoid size, and we use our tongues far more lavishly than do apes, so that no reduction of this space below the tongue is possible, such as would have taken place had the jaw begun to diminish without changing its anthropoid shape. What seems, therefore, to have happened is that the lower part of the mandible remained roughly at its original size while the teeth and tooth-bearing part of the bone drew back over it. Furthermore, the whole jaw is a sort of wishbone

shape, with its joints at the very back, and it undergoes great stress in chewing, which calls for reinforcement at the pointed front portion, the weakest place. In apes this reinforcement is provided by the "simian shelf," a flooring of the foremost part of that open inner space below the tongue. But this closed part would have begun to crowd the tongue muscles when any shortening of the jaw took place, and consequently it has apparently been opened out in man, and equivalent extra bone, to buttress the front of the jaw, has appeared on the outside instead.

The nose and the chin, therefore, are signposts to the one-time shape of the face. If you take a human silhouette and extend the outline of the nose, bringing this round in a suitable curve to come back under the chin, you will get a profile which will show you what we started with.

Now it has long and devotedly been argued that the two main trends, the growing brain and the shrinking face, were related to each other, and reinforced each other. A functional background is suggested in the theory of the effects of arboreal life, with which I will deal presently, put forward by the English anatomists. This has certain drawbacks. Though the relation seems logical, nevertheless appeals to functional explanations and to natural selection seem to go awry, and even the mechanics are mysterious. Many ascribe the growth of the brain to still another principle, which is especially impressive to paleontologists studying animal lines through long periods of their history: this is orthogenesis,[13] or the unexplained fact that certain features may develop along a straight line, with a momentum and exaggeration which can hardly be put down to natural selection. Weidenreich[14] ably propounds the view that all of the important differences between the anthropoid and human skull flow out of this one cause, the orthogenetic expansion of the brain, in the following way. Within groups of nearly related mammals (e.g., breeds of dogs), the smaller forms have proportionately larger brains than the bigger forms. Moreover, the smaller skulls differ characteristically from the bigger in ways many of which can be directly connected with their

[13]The principle of orthogenesis has been used to explain how features first develop to a useful stage (wings), or continue to develop past a useful stage (large size, heavy antlers).

[14]F. Weidenreich, "The Brain and Its Role in the Phylogenetic Transformation of the Human Skull," *Transactions of the American Philosophical Society*, vol. 31, 1941.

relatively larger brains, but which are in any case constant; these smaller skulls are higher, rounder, and thinner, with less of external muscle markings and bone crests, and they have markedly reduced teeth and shortened but relatively widened jaws; furthermore, the whole face is similarly shortened and withdrawn beneath the brain case. These differences also distinguish man from ape, but here man is to be considered not so much a dwarf anthropoid as an anthropoid with the special character of a much enlarged brain, so that the same relations and distinctions obtain as between large and dwarf forms in other families. Weidenreich, like others, looks on the large brain as an orthogenetic development, for which no final cause is known, but feels that it is certainly connected with the adoption of the erect posture.

Special Features and Vestiges

To summarize, it can be seen that a good many of our differences from the apes are those of degree only. Such a one is the brain—a matter of size. Another is the limb proportions, with apes and men, all of whom are inordinately long-limbed, varying only as to pattern. If you can suppose that you were the returning ghost of a dinosaur who had never seen any primates at all, that you therefore did not know how big a "big" brain is, and that you had only a textbook description, without pictures, to enable you to discriminate the first man you saw from an ape, you would soon find that you had few definite points on which you could rely. There would be the long arch of the foot and the non-opposable great toe (though not the heel). The lumbar curve is the only sign in the torso. There are the balanced head, and the nose and chin, and the unprojecting canine teeth. You would notice, in particular, one other thing. An ape is hairy, but you would have to look closely at the man to see his rudimentary downy coat, even though its distribution is the same as that of apes; on the other hand, the mane of hair sprouting from the human head would make you scratch your own scaly pate in wonderment.

There is an entirely different sort of knowledge bearing on apes and human beings, which is the way they grow. They are much more alike in infancy than at maturity and, interestingly enough, both are more like a monkey then than either is later. What happens thereafter is that the emphasis in human growth falls

upon the legs and upon the brain, while in any ape it is the arms and the jaws which grow disproportionately. It is a commonplace that newborn human babies have puny legs but powerful arms. All of this is clear indication that both apes and men have developed in different directions away from an intermediate anthropoid ancestor, their common parent, which obviously had ape-like legs and human-like hands, and was more primitive than both in many ways.

Finally, there is a whole locker-full of odds and ends which reveal our descent. I have mainly tried to show how the important body structures have been made over from an ape or lower form to our own special uses. But in the same process various other unprofitable organs were discarded through disuse without being eliminated—put in the attic rather than thrown away. Darwin himself went so fully into this matter of vestiges, and many of them are so well known, that I do not care to mention more than examples. We have, for instance, along with our little tails (which are not little in prenatal life), the remains of the muscles with which we once waved them. Although the fashionable forearm is no longer hairy, the down which still persists upon it does not grow in the direction from elbow to wrist, as you might think offhand. It grows outward toward the side. This seems odd, but were we apes, and did we sit in trees in the rain, holding onto a bough, this arrangement would shed water in a very practical fashion. I speak of these features only to show that they still exist, surviving here and there in the body in places where they can do no harm.

CHAPTER VI

Primate Evolution

THE FOREGOING DESCRIPTIONS of the Primates are so full of implications as to their past that he who runs may read. There is no mistaking man's position among them, close above the apes, or the anatomical signs that indeed he once was an ape. But we have seen none of the evolutionary ancestors which led up and out to the very different divisions of the present day, nor the actual history by which the trees, during the Mesozoic, received man as a little quadruped and millions of years later—only yesterday—deposited him once more upon the ground in an upright position on two feet.

After the fashion of an old-time movie serial, I should like to recall the precarious situation in which we last saw our emerging mammal ancestors: unarmored, small, and beset by dinosaurs. They were already partly arboreal, probably for protection, and would have looked something like opossums. We know little about the earliest of the mammals, but it is likely that no sooner had they appeared than they began to differ among themselves; and somewhat later, with the Tertiary, the bulk of them left the trees, increased in size, and luxuriated in form.

THE ORIGINAL INSECTIVORES

This is a way of saying that the various orders of mammals are almost as old as the class itself. Some of them have changed amazingly, into such creatures as horses and whales, and others have changed less, like the rodents. But the one order which has changed least of all, and in truth practically represents the first mammals in living form, is that of the Insectivores. (These are moles, hedgehogs, and the many types of shrew, few of which are at all large.) Among all the mammals there is one type which has not changed since the Mesozoic, when the dinosaurs lived, and this is an insectivorous shrewmouse. Furthermore, there are

other families among the Insectivores, and even genera, which can, without difficulty, contain side by side fossils from the Mesozoic and living species of today; something which is true in no other order. Generalized and simple, without distortion or loss of parts, the Insectivores are and always have been the perfect textbook mammal, and they are clearly the parents of all the rest. That is no mere inference, because the tooth forms of the other animals, if traced steadily backward, point toward an insectivore pattern.

Next to the Insectivores, the orders which have changed the least, and which are most like them, are the Cheiroptera (bats) and the Primates, and they, too, are both basically tree-living. The bats have developed membranous wings, of course, which are a specialization of the highest degree. But in the rest of their structure they are generalized, and the skeleton is gruesomely human, like that of a winged homunculus. While they might be called flying insectivores, they are also so much like the Primates that Linnaeus, who first conceived of classifying animals, put them together.

Those insectivores who evolved into the Primates did not take to flying, but simply became accustomed more and more fully to life in the trees. While remaining simple they showed a great inclination to progress. This tendency, however, was much more evident in some lines than in others, and there is such a difference today, such a wide range from the most highly organized to the most primitive, that the Primates almost grade into the Insectivores even now.

This is the more so because of a particular family of the Insectivores, the Tupaiidae. They are the tree shrews: active, furry little animals who look something like squirrels, though some of them have naked rather than bushy tails. These are the animals who extend back, almost unchanged, to before the Tertiary. With all their primitive mammal form they have, nevertheless, some of the features of a primate.[1] Their brain and eyes are somewhat enlarged. They will eat fruit with their forepaws, and have been seen to oppose their thumbs slightly in doing so. They are clawed, as few primates are, but one of their fossil species seems actually to have had nails. And one of the living ones has a bony ring completing the outside of its eye socket—a primate feature. This group of shrews has, of course, always been classed with the Insectivores, but several authorities now, in something of a quandary, are in

[1]See W. E. Le Gros Clark, *Early Forerunners of Man*, 1934.

clined to put them in the Primates, below the lemurs. For us, the interest is less in a taxonomical dispute than in an example of the continuity of evolution and a sign of the insectivore origin of the Primates.

Lemur and Tarsius

There is more to the connection than this. As I have said, there are today two distinct kinds of lemur: the more primitive lemurs of Madagascar who jump like a monkey, and the lorises of Africa and Asia who climb deliberately, rather like an ape. (This comparison does not mean that they led respectively to monkeys and apes, but only that they have followed similar habits to some extent.) Neglecting a few recent ones, there are no fossil lemurs between the present and the Eocene, at the beginning of the Tertiary, when they reappear in somewhat more primitive form. Le Gros Clark thinks that they may even then have been distinct as to the two branches, at the very opening of the Eocene, when we lose them again. If that is so, it does not appear that either branch developed out of the other, which is tantamount to saying that if you could trace them back all the way to a common parent, a basic primate, in the Mesozoic, this ancestor would be recognized as an insectivore rather than a primate. In other words, starting as something like a tree shrew, these two lines, with others, all independently developed in a similar direction, all becoming the more advanced group known as the Primates.

The situation of Tarsius is somewhat the same. While, as we have seen, he has features like the monkeys, he also is lemur-like and primitive in some ways and specialized in certain others. Not long ago the tendency was simply to classify him as a lemur, because he looks like one; but now, on closer acquaintance, opinion has changed, putting Tarsius close to, or even with, the Anthropoidea, and making a primary division in the primate order between him and the lemurs, who are grouped below the salt with the tree shrews. The suggestion is, in other words, that one very ancient insectivore stem became the tarsioids and the Anthropoidea (monkeys, apes, and man), while a separate stem divided into the two kinds of lemur. It follows from this, according to Le Gros Clark and Wood Jones,[2] that man and the higher Primates never passed through a lemur stage, but developed independently

[2]Le Gros Clark, op. cit.; F. Wood Jones, *Man's Place among the Mammals.*

out of another, if similar, line of insectivores. The sense of such a philosophy is that there is a strong potentiality in tree-living insectivores to progress in a monkey- or ape-like direction; and although these authors maintain that the lemurs are too specialized to have been the ancestors of the monkeys, it is true that the modern lemurs also have developed strongly toward the monkey form away from their known Eocene ancestors, by a sort of parallel evolution. Some recent fossil forms were even more monkey-like. Dr. Gregory thinks that Wood Jones has pressed the separation of the lemurs and the other Primates too far, but most people agree that at worst he is probably erring in the right direction.

This discussion is rather involved, and amounts to expertizing on fine points by brilliant paleontologists and anatomists, some of whom are interested in teeth, others in bones, and yet others in soft parts. When such people disagree, their differences of opinion show that there is not a great deal to choose in primate relationships, while they implicitly agree on the simple insectivore origin of man and the Primates and the fact that the divisions of the Primates are very old.

The development of the higher Primates is much of a mystery because there are no early or primitive fossils of the Anthropoidea. In spite of his obvious importance, Tarsius is almost more of a hindrance than a help in this question of their ancestry. As to his own, he is represented by a single genus in the East Indies today, and his past is a blank all the way back to the Eocene, at which time it appears that the tarsioids were widespread animals, of whom at least half-a-dozen genera each in Europe and North America have so far been discovered. But even in that day they were already specialized: too much so to be the parents of the monkeys or ourselves. What we need, for an ideal ancestor, is a generalized, non-hopping Tarsius, a creature which is as yet only a figment of paleontological wishfulness.

The Arboreal Theory

Although this creature has not been discovered, and although we do not know the actual causes of primate evolution, nevertheless Wood Jones and others (including the late Sir Grafton Elliot Smith) have brilliantly expounded how such an animal might have

been impelled to evolve into the form of the higher Primates by life in the trees. A tree, to us something lovelier than a poem, and a provider of shade and perchance of sustenance, was to the primate order in its early days more like a gymnasium which, because of having special equipment, encouraged the development of particular abilities and faculties. For this arboreal history of man let us again imagine that changing human ancestor who has come up from the fishes to be the first mammal—a simple, arboreal insectivore—and who now begins to emphasize certain qualities, like brain and grasp, which mark him as a primate; at the same time growing in size, which means that his safety in the trees depends on ever-greater skill, strength, and niceties of adaptation of his body, his senses, and his limbs. According to the arboreal theory, his evolution now proceeds as follows.

The Opposable Thumb

The thumb and the big toe herald further developments by beginning to oppose the other fingers and toes; and even in marsupials and tree shrews these first digits can be widely separated from their fellows. Now a terrestrial animal goes about with no concern over falling out of a tree, and without attempting to grasp the ground with its feet or even to choose its footing with especial care. The natural working axis of its foot is the middle, so that the digits on either side are of less importance and may even be lost in evolution. But this is not so in a little tree animal which, to assure its footing, is trying to cover as much of the curve of a bough as possible. It has happened, probably by accident, that in most of the Primates the working axis falls between the innermost digit and the rest,[8] this inner one being set off from the others. When an animal puts weight on such a foot in such a position, on a rounded bough, the first digit (thumb) and the others tend to roll a little in opposite directions, and thus to oppose each other, no matter how flat the foot was to begin with.

The "Differentiation of the Limbs"

This makes a creature which proceeds through the trees on four clutching hand-like paws, and whose digits wrap themselves around

[8]Not invariably: howling monkeys oppose the first two digits to the others.

whatever they can grasp. Like a squirrel, it goes headfirst both up and down. Its forelimbs are the explorers, while the hind limbs are always in territory which the forelimbs have already covered; if the tree is unfamiliar and the footing uncertain, the grasp of the forefoot is, theoretically, the more tentative, and more conscious and careful attention is paid to it. The support of the body, therefore, particularly when resting, comes to be mainly the responsibility of the hind limbs, which become heavier and lose some of their freedom of movement. The forelimbs, however, evolve in an opposite direction, becoming more mobile and less used for support. This is all a tendency which would be natural if not inevitable in arboreal animals with grasping feet, but not in ground animals.[4] The process is what Wood Jones terms the "differentiation of the limbs," as something of great importance, pointing out that to be four-handed is as bad as to be four-footed, to an animal with aspirations.

"Emancipation of the Forelimbs"

Hot on the heels of this is a consequent tendency, the "emancipation of the forelimbs." The more the hind limbs accept the chore of supporting the body, the more the forelimbs have other opportunities. They are still used, of course, for locomotion, but they are freed for a certain amount of purely academic investigation as well: touching, feeling, and testing. This is another aspect of the differentiation of the limbs, and the more pronounced it becomes, the more the creature tends to sit upright when not on the move, perching on its hind legs and using its forelimbs freely, as true arms and hands. It can use them to feed itself, to hold and feel objects, and to scratch, which is no mean educational pastime. Supposedly, then, arboreal life opened new vistas for a developing hand. Only grasping paws and sensitive fingers could have started such a train, and only through this train could man have developed.

The Upright Position and the Effect on the Senses

Wood Jones traces concomitant developments in the spine and the rest of the trunk as a result of this third event, sitting up. He

[4]The exceptional parallels in kangaroos and dinosaurs came from different causes and did not achieve the same results because of the uselessness of the forelimbs.

also thereby serves his argument that it was the erect-sitting Tarsius, and not the laggard lemur, who gave rise to the more highly organized Primates.

But it is the skull which is the great area of the further theoretical effects of arboreal life after the hand has tasted freedom and the animal has sat up. It will be remembered that progress in the Primates toward man is marked by an ever-larger brain and by a diminishing snout (although there is nothing pinched about the jaws of the anthropoids). A snout exists in an ordinary four-footed mammal for a variety of purposes. It does almost everything connected with eating: the mammal arrives at its food, whether animal or vegetable, on its legs, but the latter are of no further use; the game is subdued or killed, or the fruit or herb plucked, and it is broken up and chewed, all by means of the jaws and teeth. In leisure moments also the muzzle is the most useful part of the body, because an animal, investigating something, does so by smelling, by nosing, by licking, or by nibbling. Thus it is that the snout is long for various reasons: partly to give the jaws power for fighting, killing, and crushing, and partly to put distance between its tip and the eyes, so that while the owner is exercising the senses of smell, touch, and taste, it may also use that of vision, and see what it is doing. This would not be possible were the mouth directly under the eyes.

It is actually difficult for us to imagine how the powers of perception in ground mammals are concentrated in the snout. But consider how matters change in a tree, and for an animal with a grasping hand. In the first place, the olfactory sense loses a great part of its value. The air that blankets the unbroken ground surface is a world of smell, but in the trees there is far less for scent to cling to, and the paths of travel are very narrow; therefore the power of smell has hardly more than an aesthetic excuse for being. Second, see how the snout is discouraged from being used for feeling. A creature walking gingerly along a bough cannot sniff and nuzzle everything that excites its curiosity without losing its balance and falling out of the tree; however, it may touch or pluck far more of such things if it can use its hands to this end. And it can hold these things, be they buds, fruits, insects, or eggs, and turn them over or pull them apart, at various convenient distances from its eyes instead of only at the fixed focus, so to speak, of the eye-snout combination. Therefore, a fuller co-ordination is pos-

sible between sight and touch, particularly when stereoscopic vision is thrown in (see p. 50). Certainly our own education is of this kind: as infants we touch things and look at them simultaneously, until we have gradually learned to tell how anything would feel just by looking at it; and on seeing something unfamiliar we automatically reach out and feel it. But we seldom smell it, and we know really very little about how things smell. In all of this we are simply acting like Primates.

Reduction of the Snout

The trees, therefore, diverted their primate guests from smelling with snouts toward feeling with forepaws. As the snout became less important to the senses, it also became less important in eating, because the developing hands could be used to convey the food to the mouth, in place of the older fashion of conveying the mouth to the food. This being so, the jaws did not have to procure the food but only to chew it, and the eyes, therefore, did not have to watch the snout but watched the hands instead. The higher Primates eat precisely as we do, if less fastidiously. We, or they, ensnare a piece of food in the hand, or some extension thereof, like a fork. We then look at it, instead of smelling it, and having approved it for consumption, stow it in the mouth and chew it up. The snout, once responsible for all of these operations, now performs only the last.

A long muzzle, instead of being necessary, thus becomes excess baggage, which is the evolutionary signal for its reduction, and this is the theoretical explanation for the shorter faces of the higher Primates. There is a seeming embarrassment in the fact that the great apes have massive jaws, but Weidenreich demonstrates[5] that within a group of related animals the large forms have disproportionately heavy facial skeletons; and in any case the apes do not have snouts in the primitive sense, since their faces, like ours and monkeys', are somewhat bent down, with the eyes brought together at the top.

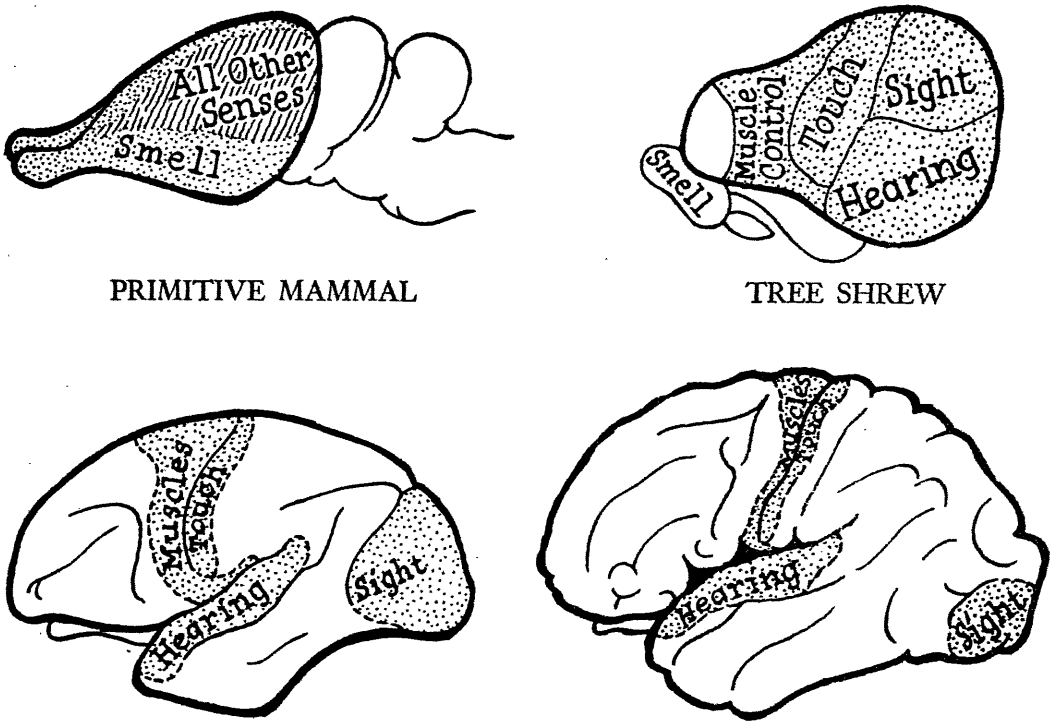
The Influence of Arboreal Life on the Brain

The brain, finally, under the benign influence of all of these other changes, expands. (Remember that the arboreal theory is

[5]See page 79.

a functional one, rejected by those who explain the growth of the primate brain by orthogenesis, or some mysterious internal reason.) On the one hand, it has been suggested that the brain's development had actually been repressed by heavy jaws, in the belief that the muscles of the latter constricted the skull in its growth, and also that these muscles had appropriated the lion's share of the blood supply of the head; until retribution arrived with the shrinking of the jaws, and the situation was reversed. This is a weak contribution. The main argument is that the brain was positively stimulated in powerful ways by the developing senses—a hypothesis that has been stated very precisely by Elliot Smith.

This has to be explained in terms of the cerebral cortex. It is the cerebrum, or outer shell of the brain, which is in control of our senses, our muscles, and our "thoughts." Not only that, but it is now fairly well known which parts of this shell control a given sense or muscle—sight, hearing, arm, or tongue—while at the same time there are large areas of which the functions are understood little or not at all. Now in a primitive mammal's brain the cerebrum is small of size and is dominated by that part of it which has to do with the sense of smell, and it perches at the front of the whole brain, overlapping the other two portions only slightly. In the highest Primates, however, and particularly in ourselves, the cerebral cortex is far larger and has extended back over the other parts of the brain, the cerebellum and the medulla, like an envelope, so that they are practically hidden inside. Furthermore, the areas of this cortex which have to do with sight, hearing, and touch are enlarged, with that for smell being far smaller, so that there is a more even balance of all the senses. These spots are isolated from each other, and surrounding each there is a generous territory in which things learned, or impressions received, by the sense in question are stored. Conscious movements also have an area which controls them, which runs right over the top of the brain from ear to ear, and this also has a surrounding territory in which remembered movements are filed away. But these various centers are like islands, which have drawn apart from one another as the brain expanded, leaving still further intervening areas about which little certain information exists. They are, however, the "association" areas, in which memories and impressions, both of the senses and of the motor centers, all come together to form brand-new combinations. To quote Wood Jones roughly, the



THE BRAIN AND THE SENSES (*after Wood Jones*)

As the cerebrum expands, covering the other parts of the brain, the portion devoted to the sense of smell ceases to dominate the whole, while at the same time the greatest relative growth occurs between the sensory portions, in the "association areas." (In these drawings the fore part of the brain faces left.)

original centers are those by which an animal knows what it is seeing and doing, in the surrounding parts it remembers what it has seen and done, and in the intervening association areas it imagines what might be seen and done.

Thus there has been in primate evolution a bringing of the other senses up to and beyond the level of the olfactory, together with an enlargement of the brain as a whole; above all by expansion of the non-specific areas where generalized associations can form. These are matters of fact. Now this has been brought about, supposedly, by the force of a peculiar combination: the action of a special environment (the trees) upon a refined hand (free and grasping), coaxing the latter to all sorts of uses. There is no "hand" in an ordinary mammal, and as for the snout, no matter how sensitive it is for feeling, smelling, and the like, it is not much of an instrument and cannot be employed in a great variety of ways. But a true hand has a far greater range of movement, and it can open and shut, turn and twist, push and pull, all with greater facility than a pair of jaws, and all in greater co-ordination with the eyes. This jack-of-all-trades gives the brain a larger field of activity and more complicated functions to perform. But if that causes the brain to improve, then the brain once more, in turn, endows the hands and eyes with greater sensitiveness and ability. So skill imparts wisdom and wisdom imparts skill, and a sort of blessed upward spiral is instituted, resulting at last in the inflated brain of the Hominidae.

Criticisms of the Arboreal Theory

The foregoing is the arboreal theory in a condensed version. The transformation starts with a prehensile hand and an opposable thumb, which are as legitimate examples of evolutionary adaptations (in this case to the trees) as one can ask for. From here on, however, the theory gets increasingly tenuous. The differentiation of the limbs and the promotion of the emancipated hand over the snout are logical enough. But the resulting influences, the shrinking of the snout and the growing power of the senses and of the brain, progressively get nearer the deep end; that is, they depart from the Darwinian idea of simple adaptation through selection, and go in the direction of the outlawed Lamarckian tenet that, regardless of selection, the more an organ is used by individ-

uals, the bigger or better it will get in the species, automatically.

This philosophical jay-walking in the theory has brought down upon it the scorn of Hooton (among many), who accuses Wood Jones of having created a "Just-So Story" of primate evolution. In one ironic synopsis which makes the bodily parts sound like actors in a pantomime, he says:

"As the jaws shrink, the temporal muscles relax their constricting grip on the skull vault and reluctantly retreat down the parietals. This, of course, gives the brain its chance. But the modest yet ambitious neopallium [higher-association areas] has other incentives for expansion. The investigative digits seek and acquire in the brain cortex not only motor representation but also adjacent areas of pictured movements; now the animal can not only see what it is doing but can also recall to the mind's eye past actions and can even build castles in the air. Naturally association areas then spread like a rash; the neopallium becomes furrowed with thought; the brow bulges with cerebration."[6]

There certainly is a difficuty in the matter. These are the possible extremes of view. Either the theory may be taken at its face value: all these effects stem from tree life and from each other, forming a connected skein throughout; or the connections are an illusion: the brain simply had an inherent (orthogenetic) tendency to expand, and the jaws to reduce—tendencies which merely dragged the hand and the senses in their train. Neither opinion is satisfactory. The second explains nothing, and the first is based on assumptions. Did the brain really grow as the hand widened its interests? This would seem logical, but we are not assured that nature uses our kind of logic. We have simply landed again in the quagmire of whys in evolution. Let it be remembered that even so respectable and obvious-seeming a thing as natural selection has been unassailably demonstrated in only a handful of test cases. All we can say is that an important set of changes has certainly taken place in the Primates, with tree life being probably the main controlling influence. The arboreal theory, at least in its soundest portions, is the best thing we have with which to fill a yawning gap in primate history.

[6]From E. A. Hooton's *Apes, Men, and Morons*, 1937, pp. 66-67, *reprinted by permission of G. P. Putnam's Sons.*

CHAPTER VII

Fossil Anthropoids

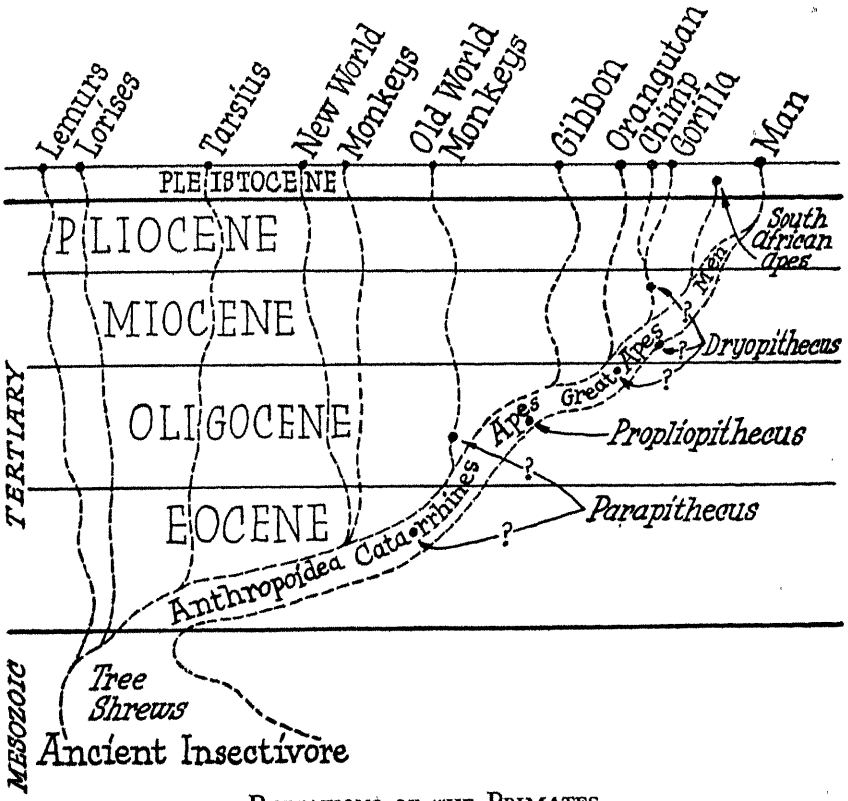
THERE ARE MISSING LINKS aplenty in the ancestry of man, but the biggest hiatus is not from man down to ape; it is rather from ape down to simple primate. This is why the paleontologists appease themselves with a rigged-up, unspecialized Tarsius for an original ancestor; and even if we accept this we still have to use the arboreal theory as a cockhorse on which to ride the rest of the way up to meet the monkeys and the apes. Of these higher forms there are no early (Eocene) fossils, as there are of the lemurs and tarsioids, nor even any really primitive ones. When we find them in the Middle Tertiary they are already separated into the present three lines: the New World monkeys, the Old World monkeys, and the apes. Man, of course, is not yet distinct from the last of these

THE ANTHROPOIDS APPEAR

Practically all that we know about this was learned from the lower jaws of two animals who lived in the early Oligocene in that rich side basin of the Nile, the Fayum. One of them was a tiny but unquestionable ape, probably not more than eighteen inches high. It was doubtless the ancestor of the gibbons, and quite possibly of all of the other apes and man as well, though it lived and died in ignorance of its name, *Propliopithecus*. The other of the pair was *Parapithecus*, who was even smaller and so primitive that one can say with certainty only that it was a catarrhine (as opposed to the platyrrhines, or New World monkeys), since it had the same tooth count as man. It might have been an Old World monkey or it might have been an ape, or even the parent of both.[1] It was not specialized (the molars not being bilophodont, or "cross-crested" [see p. 54]) like the later

[1]The fact of its living at the same time as Propliopithecus, already an ape, does not mean that it might not have been the latter's parent at some earlier time.

monkeys, but there is, however, nothing especially ape-like about the teeth except for the presence of five cusps on all the lower molars; and this is a fairly strong argument, since monkeys have five cusps only on the last one. Parapithecus at least shows that catarrhines and platyrrhines had become distinct, while Proplio-



RADIATIONS OF THE PRIMATES

pithecus demonstrates the existence of an ape side by side with a possible primitive monkey. So, taken together, the two fossils show that the New World monkeys, the Old World monkeys, and the apes must have separated by the beginning of the Oligocene, which means no later than during the Eocene, while all were small and rather primitive animals.

For the New World monkeys there are no significant fossils. But the opinion of most people, though vague, is that these monkeys do not take a place in human ancestry; that the higher Primates of the Eastern and Western hemispheres descended sep-

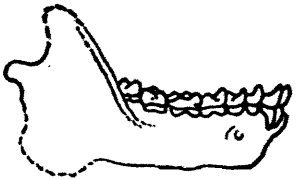
arately from the unidentified ancestor of all of them. (There once were more primitive Primates—lemurs and tarsioids—in North America, all of whom are now extinct.) Half of the New World monkeys, the Hapalidae, have stayed very primitive, while the others, the Cebidae, continued to evolve along the same lines as the Old World monkeys and apes, whom they resemble superficially. This parallel evolution, by the way, favors the argument of the potent effects of arboreal life.

If the New World monkeys are a side branch, it is likely, on the other hand, that the apes began as something which might be called an Old World monkey. Wood Jones, indeed, thinks of the apes as fundamentally being monkeys which are not specialized (without cheek pouches or cross-crested teeth, and having less developed ischial callosities), but which are, however, adapted for brachiation. But the separation probably came early in the line, with the anthropoids becoming confirmed brachiators and losing their tails while they were yet small in body size. The ape stem, therefore, is supposed to have passed only through a very shadowy and general monkey stage, probably represented by Parapithecus, so that this is as much of a "monkey" as man has ever been.

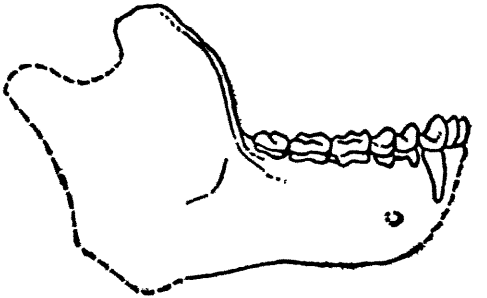
The monkeys are thus no further interest of ours. Long before the Oligocene the divisions of the Primates had become set, with no primitive forms remaining. Throughout most of the Tertiary, therefore, man's story is concerned only with apes.

Apes Flourish in the Miocene

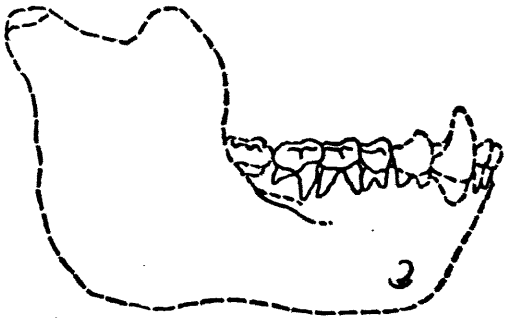
Propliopithecus makes a lone sentinel well back in the first half of the Tertiary. After him, the anthropoids drop out of sight, as far as the fossil record goes, and do not reappear until the Miocene. But they have prospered meanwhile. In the shorter last half of the Tertiary (the Miocene and Pliocene) the Eastern Hemisphere seems to have been full of them. This is important to recognize: that they were successful and numerous, though they have since almost disappeared. There are now four apes (four or five genera) confined to the southeast tip of the Asiatic land mass (to which the Indies properly belong) and to a belt across the waist of Africa. But with those fossils which they have so far discovered paleontologists have made out about fifteen genera existing in the later Tertiary. They have been found in Africa from Egypt to the



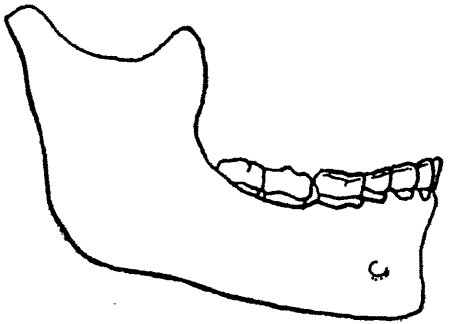
PARAPITHECUS



PROPLIOPITHECUS



SIVAPITHECUS



MAN

JAWS OF FOSSIL ANTHROPOIDS AND MAN (*after W. K. Gregory*)

lakes, and all across Europe and Asia, in Spain, Germany, India, and China. Considering that fossils are preserved and found only under favoring conditions of climate, this means that they were practically universal, and that there must have been many more types than have been discovered. The Pongidae were an impressive family of mammals.

It is unfortunately true that all of this knowledge is based on teeth alone, since no other parts of the skeleton have been found. However, the fact remains that teeth are the most reliable single indicator of relationship, because they change their patterns only slowly and regularly in evolution, while at the same time these patterns are complicated, giving the student plenty of ground to work on. They make it perfectly clear that there were gibbon-like descendants of Propliopithecus in East Africa and Egypt, chimpanzee-like and gorilla-like forms in Europe and Asia, and orang-like ones in India and China. Their luxuriance need hardly be insisted upon. It is only recently that the anthropoids have become provincial.

One of the apes of this time stands out in importance. This is the genus *Dryopithecus*. Some half-dozen species have been assigned to it, from Europe, Africa, and Asia, and another important genus, *Sivapithecus* of India, is very closely allied to it and has several species itself. Nor is its wide spread its only significance. Professor Gregory and Dr. Milo Hellman have made it a sort of rallying point by their studies of its molar teeth. Analyzing the arrangement of cusps, ridges, and fissures, Dr. Gregory has discerned what he has named the "Dryopithecus pattern," and he has shown how this pattern exists today in modified form in man, gorilla, and chimpanzee, and, less definitely, in the orang-utan. In other words, here is an ape who lived throughout the Old World and was almost certainly the ancestor of the chimpanzee[2] and probably of the gorilla and of man as well (and even of the orang, though there are other candidates for this last office). It is a real "missing link" in one of the customary senses of the term. Furthermore, a possible arm and leg bone of Dryopithecus have also been found. If they belonged to him, they show that he was more man-like in his proportions than the modern apes, with a shorter arm and a longer leg; and he could, therefore, have taken more easily to walking on two feet. Unfortunately, we actually

[2]There is an intermediate form leading to the chimp, named *Proconsul*.

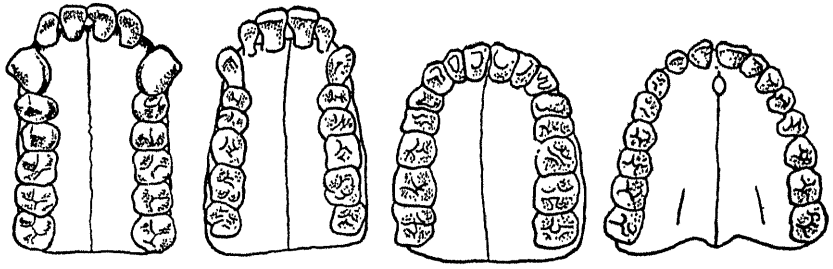
know nothing else about his body form, having only fragments of jaws to accompany the teeth.

Whether or not the Dryopithecus now known in the Miocene was the common ancestor of the man-chimpanzee-gorilla clan is not of vast importance, since it was something very like him; he shows, at least, that a form from which all of them might descend had arrived. Another such ape goes even further in the special direction of man. He is *Ramapithecus*, whose jaws and teeth were found in India, and Gregory calls him almost human dentally. Conceivably he might be the ancestor of man, but there are still other possibilities.

The South African Man-Apes

Following the end of the Tertiary, in the Pleistocene (the Ice Age), the apes did not fare so well as formerly and became extinct in many places. Aside from the living ones, and in another region —South Africa—one other small group of Dryopithecus descendants nevertheless survived almost to the present. Here have been found three related types which are so human in many ways that Dr. Gregory generally refers to them as "man-apes." I shall do the same, because their proper names are *Australopithecus, Plesianthropus,* and *Paranthropus.* As fossils, these are better specimens than the Miocene apes, respectable portions of their skulls having survived as well as their teeth. This is in spite of, rather than because of, the manner of their discovery. The first two were found in stone quarries, the second as a by-product of blasting with dynamite, and in each case the face was largely or wholly retrieved and, though the brain case was damaged or missing, there was a natural rock cast or impression of the brain itself. Paranthropus, on the other hand, was found by a schoolboy who was making a short cut over the top of a hill. He saw the skull embedded in the side of the hill, and removed it then and there, as a schoolboy would, by hammering it loose with a rock, which improved it not at all. But this schoolboy will go to heaven nonetheless, because he gave a piece of his broken fossil to the same man who had previously found Plesianthropus in the near-by Sterkfontein caves, who took the new find to Dr. Robert Broom, who already had the other finds in his charge. Dr. Broom saw at once that it was as fragmentary as a Sapphic ode, and Dr. Broom

is known as a man of purpose. He put the South African miles behind him until he had found the house of the boy's mother; he learned that the boy was at school and thither repaired forthwith; he got an immediate audience with the boy and found him, as he says, "with four of what are perhaps the most valuable teeth in the world in his trouser pocket." Going then to the original site, he picked up further anthropoid debris where the discoverer had left it, until the whole skull can be properly restored.



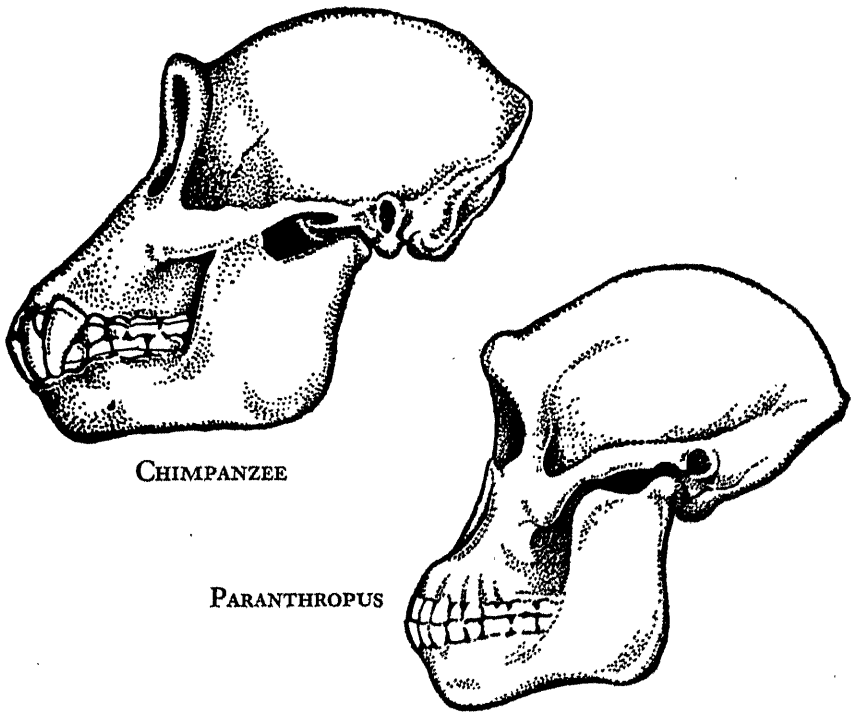
GORILLA | *Dryopithecus* (*Sivapithecus*) | MAN-APE (*Plesianthropus*) | HOMO SAPIENS

HUMAN AND NEAR-HUMAN DENTAL ARCHES

The gorilla exhibits the pronounced ape pattern, with a long U-shape, large canines, and a marked pre-canine gap. Dryopithecus possessed a more generalized version of the same form. Man has a parabolic form without large canines and with a rounded incisor region, to which the South African Man-apes made an astonishing approach.

These several types of man-ape vary among themselves somewhat but have a similar character. All were larger than a chimpanzee, being near or at the size of a female gorilla, or of man. Australopithecus was a child (possibly the young of one of the other two, since the exact type of adults cannot be told from immature specimens), but his already erupted "six-year" molars were of gorilla size. But the remarkable character which they all have lies in the array of features in which they were definitely more man-like than any other known apes. Two of them (not Plesianthropus) had brains somewhat above present anthropoid limits of size, and broader in the forehead region. Their faces were flatter, more upright, and shorter, with less protruding jaws. Very importantly the shape of the palate or arch formed by the teeth (what a dentist gets in an "impression") is more human in outline, being broad across the back and rounded in front. In living

anthropoids, on the other hand, the upper dental arch is long and narrow, flattened in front, and with definite right angles where the canine teeth are set. The teeth themselves exhibit a wealth of transitional characters too numerous to deal with. But the canines are relatively small, and in general the molars have moved away from the Dryopithecus pattern in a human direction. It is the judgment of Drs. Gregory and Hellman that the teeth are closer to man than to the apes. The fact that the tooth surfaces are worn flat also indicates that they chewed in the somewhat cow-like fashion of man.



A comparison of the skulls of a modern ape and of one of the South African Man-apes. (Following the restoration of Paranthropus by Broom, Gregory and Hellman)

There are further special details in the bony structure (particularly in the region of the ear, an important area) which bear out the impression that the South African apes were human-like in every department. To cap it all, it is possible or even probable that they walked erect. In Paranthropus the occipital condyles (the rockers by which the head sits on the spine) are moved well

forward under the skull, as in man, a clear sign that the head was poised in a more upright position than in apes. Furthermore, Dr. Broom has turned up three significant bits of the rest of the skeleton. One is a probable toe joint bone of Paranthropus: it is like man's, though somewhat longer. Another piece is the elbow end of his humerus or upper arm bone, which is formed as in a free arm and not like those of chimpanzees and gorillas, which are used as an aid in walking. The last one is the knee joint of the thigh-bone of Plesianthropus which is practically human. It was probably used for walking upright, though with the main part of the shaft missing this cannot be certain.

Now here is a pretty problem. Are these apes or are they men? Are they to be put with the Pongidae or with the Hominidae? Those parts of the skull which are known now are fundamentally ape-like, though strongly human in many details. But if they were erect groundwalkers? Zoologists have never yet bothered to select one single feature to differentiate men from apes, one definite line at which to take a stand, because they were not faced with the necessity. But forced to the choice, most of them would say that man zoologically became man when he first walked erect on the ground, or at least developed an arch to his foot.

However, even if these man-apes be actually put with the Hominidae, we are not rushed to the conclusion that we have found man appearing in South Africa. These particular apes cannot have been our ancestors, because when they lived there were already full-fledged men in existence. Gregory and Hellman look on them as another group of Dryopithecus descendants, belonging to the gorilla-chimp-man clan, and by far the nearest to man. They also call them a second attempt by nature to produce man out of the ape stock, independent of our own true line.

This opinion of theirs thus carefully avoids any suggestion that here we have the missing link, and instead puts great faith in the idea that development toward men is a ready and natural channel for evolving apes, and might take place in several different groups. In this they may be overcautious. If the South African apes had been found to belong to an earlier period, before man is known to have been present, they would almost certainly have been welcomed into our family tree with a twenty-one-gun salute. In other words, if not the missing link themselves, they may be descendants of an actual missing link, who need not have lived in South Africa.

CHAPTER VIII

The Descent of Man

WHEN, WHERE, WHY, and how did man first actually appear? The answers still elude us, but the lines are drawing tighter. A great difficulty lies in the problem I have just mentioned: how will we know him when we see him? If we say: because he will be wearing a human foot, then we will have to wait for a fossil foot, something which is almost never found. If we retreat to the teeth, we are in another kind of a dilemma, because we have a gradual and almost unbroken series of changes in teeth from ape to Homo sapiens, and a dividing line could be settled upon only arbitrarily. The same is true of the skull in general, for there is not a great gap between the man-like South African apes and the ape-like Java Man. The time is coming when man and apes can be put in separate families only if we ignore the fossils.

The thing to do is to be bold about it. Man was much the latest primate to become distinct, which he did by turning into a two-legged ground animal. Practically everyone agrees to this. His foot underwent a radical change therein, from absolute necessity, getting arches and a large heel, and drawing the great toe in alongside the others. Dr. Dudley Morton has shown how in spite of its seeming difference man's foot could only have come from that of an anthropoid, and we still retain remnants of the muscles which once worked the big toe like a thumb. Everything we know points to the conclusion that the foot and the rest of the body must have evolved first, and as a rapid development, for if the erect posture had not been an immediate success, man himself would have been a failure, just as the gorilla has been. There was, on the other hand, no such overwhelming need for intellectual polish, and so the brain and the rest of the skull evolved less precipitately.

Time

When did this event take place? Probably in the Miocene, since this was the time when the apes were evolving in all directions. We have actual evidence of man's existence only for the Pleistocene, or the last million years, but well back toward the beginning of this time he seems already to have been fully developed except for his skull. Hooton thinks it would have needed at least the relatively short Pliocene period (six million years) to bring him to this stage, which is a reasonable presumption, particularly since there is no necessity for being miserly with time. (Dr. Helmut de Terra believes that it was the conditions of the Ice Age itself which brought us out of the trees, making us less than a million years old, but this would seem to be cramping things too much.) Finally, man must have come from a generalized ape resembling Dryopithecus, whose arms and legs were about the same length, instead of from the recent long-armed species. This would also push him back in time.

Size

What size was he? Probably nearly what he is now. His fossil forms were full size as far back as they can be traced through the Pleistocene. Man has the features of a giant primate,[1] and especially of the Dryopithecus descendants. His legs have undoubtedly grown considerably in the process of becoming a man, but his trunk is about the size of a chimpanzee's. The foremost dissenter from this idea is Wood Jones, because he believes that man derives directly from a primitive Tarsius, far back in time, and not from the apes at all.[2] Dr. Morton also objects, on mechanical grounds: in showing the derivation of a human foot from that of an ape, he gives his opinion that arches could not evolve under the weight of an animal as large as the present anthropoids, and Le Gros Clark agrees with him. But the almost gorilloid South African man-apes would seem to have knocked this objection into a cocked hat by their own indications of erectness. We cannot

[1] Although Le Gros Clark says that these are due to parallel evolution only, being connected with large size.

[2] This is because he cannot reconcile certain differences in the arrangement of skull bones in man and apes with the doctrine of the irreversibility of evolution. Others are baffled by the large canine teeth of apes, on the same ground. All this, says Hooton, is to swallow a camel and strain at a gnat.

say if they had arches, but it appears possible that they may have walked upright all the same.

Another argument could be made against man's having appeared as a large animal. Giant size (and none of the big Primates could get much larger, considering their general structure) seems to be a sign that an animal's evolution has taken to a set groove and cannot make radical shifts thereafter, such as that from brachiating to walking. If so, this would call for separating man from the apes even below the Dryopithecus stage. But there is no positive evidence on the point.

The Reasons

Why did our anthropoid ancestor come to the ground? Everyone has had a guess about this. Some say because he grew too big for the trees. This is unlikely, because he could not have been much larger than a chimpanzee, who does very well in his leafy abode. Others, somewhat like De Terra, suggest that a disappearance of the trees in his homeland, because of changing climate, forced him to the ground. Specifically, it is the opinion of certain people that the late Tertiary Himalayan uplift isolated a Dryopithecus stock to the north and cut off rain-bearing winds from the south, so that in this region, north of the mountains, the woods first dwindled to sporadic glades and then vanished. Hooton, however, says this is ridiculous, since such a change would either have been gradual enough to let the apes hie themselves to denser forests, or else so rapid as to destroy them entirely before they could adjust themselves to terra firma. "A cat does not become a walrus because of an inundation; it either drowns or scuttles away to dry land."[3] He suggests instead that these anthropoids, having become large enough to be fairly safe from predators on the ground, and so big-brained as to feel that tree life was cramping, took to the earth of their own initiative, realizing the greater scope which it afforded; "they wanted to live their lives more abundantly." It was thus a move which was intellectually conceived.

Yet Hooton elsewhere has derided Elliot Smith for suggesting that intellectual exercise was conducive to the original expansion of the brain. I detect an inconsistency of moods, and it is with the

[3] *Up from the Ape*, 1931, p. 115.

latter mood that I agree. I do not believe that man has ever had enough sense to do himself so much good all at once, and especially not in the Miocene, and I do not think he would have renounced the trees except under some pressure. I conceive of the transition as much like that which brought the lobe-finned fishes out onto the land. Probably a lightening and thinning of a forest region, leaving open gaps between groves, would have caused the local apes to become used to the ground, if only to get from grove to grove. Varying kinds of food probably made life on earth attractive, until they became more habituated to it and used the trees only as occasional places of safety. In this way the deforestation need not have been radical or complete. The chimpanzees of West Africa, in fact, live in the sort of open woods which would answer the purpose, and they spend two thirds of their waking time upon the ground, using a tree mainly for a bunkhouse.

But there is a vital difference between our ancestor and the chimpanzees, for the former, on coming to the ground, began to walk truly erect. Undoubtedly this is because, being an anthropoid, his internal organs, his senses, and his whole constitution necessitated his being upright, while his legs were as long or longer than his arms, so that he could not be erect on all fours. You can imagine the sensations of unpleasantness that might have influenced him if you try to walk for any length of time on your hands and feet (not knees) together, though of course you will have these sensations to a higher degree. The chimp, on the other hand, is so much the slave of brachiation that, with his long arms and short legs, he is comfortably upright even when he is leaning on his hands.[4]

The Place

Where did man evolve? This is a side issue, but an interesting one. It is generally approached by elimination. We can rule out Australia, which had no higher mammals, and the Americas, which had only the lowest monkeys, even though it may have been the ancient first home of the Primates. (We can also rule out Antarctica, which had nothing but penguins, and Atlantis, which wasn't even there.) This leaves Asia, Europe, and Africa, all of

[4]Wood Jones thinks our ancestors (tarsioid) had an apprenticeship in the trees of walking upright along boughs, but this is because he thinks we never brachiated.

which were roamed by the Miocene anthropoids. Asia is the automatic choice of most people. It is the center of the land areas of the globe and it is huge. It would have provided more chances for groups of apes to become isolated in different kinds of changing environments, through such events as the rising of the Himalayas. It contains, especially when Java is included, the most primitive human types yet discovered, and though there is little to prove it, it looks like the center from which the modern races have spread. As to Europe, there is no argument in her favor which does not favor Asia more, in spite of the larger number of fossil remains of man found there later on in the Ice Age. Africa, however, is as thickly studded with Primates, both apes and monkeys, modern and fossil, as is Asia; it also has a very primitive human skull in Africanthropus (to say nothing of Rhodesian Man), and in the South African man-apes it has the only concrete example of the emergence of nearly human anthropoids—something which is hard to deprecate. There is really no ground for making a decision, but Asia still enjoys an edge which is hardly more than a prejudice.[5] The chances favor some region north of India and the Himalayas, since in the more heavily forested south apes would probably have remained apes.

Good-by to the Trees

Man's family history is blurry in spots, but the general form is clear enough. There is no difficulty in showing, in full detail, that a primitive insectivore is a hairy, four-footed, air-breathing, warm-blooded, live-bearing, tree-going fish. The first and worst gap is here, from this insectivore to a small and generalized monkey which nevertheless has a good brain, stereoscopic vision, and a marvelous grasping hand; a gap which is spanned not by history but by the somewhat romantic arboreal theory, propped up in the middle by the puckish Tarsius as its only material support.

From this monkey, as history resumes, three lines descend, so that by the beginning of the Oligocene the Primates consist, besides the older lemurs and Tarsius, of two kinds of monkeys and the ape family. Still there is no sign of man. The little apes are

[5] Weinert, an excellent authority (*Entstehung der Menschenrassen*, 1938), believes, because there is so great a difference between the orang and the African apes, and because the latter are so closely related to man and the man-apes, that Africa is the only possible choice for man's origin.

a departure, a brand-new product of arboreal life because, probably more or less by chance, they begin to brachiate. This is added to the older influences outlined in the arboreal theory. They become so adjusted to being always in an upright position that their viscera are rearranged. Because of brachiating their legs and spine shorten, while the pelvis and shoulders broaden, the arms lengthen, and the shoulders face somewhat upward.

By Miocene times the anthropoids have become large and numerous. The stock seems to have an evolutionary *élan* which gives birth to a variety of vigorous forms, and so prolific are they that they are found in every part of the Old World. In one region, and perhaps more than one, members of the most important genus, Dryopithecus, begin to live mainly, and finally entirely, on the ground. They are specialized (internally) for an erect posture, but they are not so far specialized for brachiation that their arms are very long or their legs very short. Consequently, when they walk they stand upright on two feet, of necessity. There is nothing else for them to do.

In doing so, they make another new departure. Brachiating has had its effects, but these are halted, and others, brought on by walking, begin to be manifest. Of course one result of brachiation has been the upright posture, and the effects connected with this are not halted but intensified, since a more perfect balance is needed in standing on something below than in hanging from something above. The pelvis becomes broader, and the chest flatter, and the head more balanced on the spine. On the other hand, the legs grow stronger and larger, the opposable toe is done away with, and the arches of the feet appear, along with a big heel. The hand, coming from the agile, educated, "emancipated" forelimb of the higher Primates, is finally free in the fullness of perfect liberty, and the last excuse for long canine teeth and a long jaw has vanished.

These various changes also take place in another gap in the actual record, but this time it is a gap of only a few million years. And we shall be fortunate indeed if we ever find more than the teeth of our transitional ground-ape forebears. We have already been lucky in the case of the South African apes who, if they are not the crucial find, are at least a near miss. At any rate, by a million years ago men are at last unquestionably present. Some of them are rather like the Minotaur, with an ape-like in-

stead of a bull-like head, but appearances indicate that unmistakably human bodies have already existed for some time.

The Failing Apes

The story of the apes in the same interval since their Miocene heyday seems to be a tragic one. The living ones, from our point of view, have overshot the mark. Brachiating had been a sort of virtue up to the time of man's appearance, but it has since become a vice, because the apes are now so adapted to it that a really successful ground life is beyond their power. They have become top-heavy, with ever-weaker legs and longer arms; and they have even tended to diminish their thumbs, which are of no particular use in brachiating. The gibbon has remained primitive and the orang has progressed, but both are specialized. The chimp is the only relatively unspecialized ape. The gorilla is more man-like, but, like the others, he has brachiated too long to walk like a man and he has grown too large to live in trees, so that he has got himself into a bad corner.

The survivors of the Miocene anthropoids are thus a ground stem, man, and four arboreal or compromise stems. Like other mammal tribes they have undergone a tremendous loss of species. It is possible, in the light of the South African man-apes, that more than one group took to the ground and even walked erect, though I doubt if more than one is ancestral to any known men. Others, like the gorilla, may have botched the attempt to assume terrestrial life. Giants are always exposed to giant-killers, in the form of food shortages or changing conditions. It was almost certainly the end of the equable weather of the Tertiary which was the great blow to the apes. The four advancing and retreating glaciers of the Ice Age brought alternating periods of extreme cold and warmth to northern regions like Europe and similar alternations of rain and drought in the south, particularly Africa.

Anthropoids could not have survived in Europe in this period, and forest changes nearer the equator must also have been severe on them. Perhaps a marked dwindling of the African jungle at some period in more recent times was responsible, for example, for the splitting apart of the lowland and mountain gorillas. At any rate, it is significant that the southeast of Asia and the equatorial belt of Africa, the present habitats of the apes, are the very regions

where forests would have persisted throughout the climatic vicissitudes of the Pleistocene.

It is one thing, then, to say that, given a family of large anthropoids of considerable evolutionary vigor, some of them were bound in time to take to the ground and be transformed into something like men. But, as it happened, man must have been so nearly pressed by the oncoming Ice Age that he really had a pretty close call.

PART II

Man and the Coming of Homo Sapiens

CHAPTER IX

The Pleistocene

WE HAVE COME to the end of the Tertiary, and thus far our history of mankind has been simply the history of the animals who were its ancestors. We have as yet come to no evidence of real men. I feel strongly that Hooton is right in insisting on six million years of Pliocene time for our development, but nevertheless anyone may question this opinion, saying, "Where are the fossils?" The remains of the earliest true men—Hominidae—are all confined as yet to the last million years, the Pleistocene. It is extraordinary that the sudden, severe Age of Ice, a mere pinpoint in time, should have coincided with the very period, also short, when man at last was rapidly becoming what he is today. Furthermore, the Ice Age is so important to the study of early man that we must leave his actual physical evolution aside for the moment and consider the climatic setting in which it took place.

Wits may allege that speech was invented so that man might talk about the weather. If there is any justification for the idea, it is that when language was being invented the weather was certainly something to talk about. During the sixty million years of the Tertiary the climate had been warm and stable, and for many million years before that it had been even warmer. Then in the space of a single million it suffered a violent shock. The temperature fell and the precipitation of rain and snow increased, and in the colder regions and high altitudes of the world the snow persisted through the summer and became compacted into great sheets of blue ice which, chilling the air still further, spread and swelled to become the continental glaciers; not the minor streams of ice that today flow out of the mountains of Switzerland and Alaska, but enormous expansions of the polar cap which were like the great cake which covers everything but the shore of Greenland, and a mile or so thick. Partly forming from snow and partly moving their grinding weight across the face of the map itself, they came down over most of Europe and parts of Asia, and over Canada and the east-

ern United States; and at the same time smaller icecaps formed in sympathy in mountain regions farther south.

Four times the glaciers waxed and blanketed the northern parts of the continents. (You can look down on central Wisconsin from a plane and see how the last glacier combed the whole countryside out in one direction.) But after each advance of the ice there was a reaction to higher temperatures, to a climate actually warmer than that of today, so that the Ice Age is to be looked on less as an era of cold than as one of mysterious oscillations between warm and cool. During the three interglacial periods the ice sheets melted entirely away and animals typical of warm places roamed northern Europe and the British Isles. The second interglacial in particular seems to have been very long, and altogether there was as much time during the Pleistocene when the climate was warm as when it was cold. The fourth and last glaciation was fairly recent; remnants of the actual continental glaciers linger in one or two parts of the world, and the temperature is not now as high as it was during the interglacials. No one can say whether climate has struck a happy medium or whether there is more of the Ice Age still in store, after an interglacial period which we may only just have entered. The latter is only too probable.

Nor is it known for certain what caused the Ice Age. It was not a sign of a dying sun or of the end of the world. It was too sudden, and besides there have been several other such short periods of glaciation well back in the earlier life of the earth. Actually a drop of only a few degrees in the annual temperature would cause more polar ice to form in winter than is melted in summer, and cause it, therefore, to spread, pushing arctic and subarctic climates ahead of it toward the equator. And the fall in temperature might, it has been suggested, follow in turn merely from an increased fall of rain and snow in the storm belts. There were widespread earth changes in late Tertiary times, with the rising of mountains and the formation of the Rift Valley of Africa (which sends the Nile on its unnatural course through a desert). Possibly this led to abrupt changes in precipitation and in the pattern of winds and storm cycles, and so to the first glaciation. Then came a series of reactions, first to warmth and then to cold again, but the lessening violence of the swings may show that equilibrium has been, or is about to be, restored.

However, the causes of the Pleistocene glaciations are not im-

portant in the annals of mankind. The effects are. We know too little of the life of the times to say what these effects were on the human family itself, but judging from other animals they must have been great. In the capture of the northern continents by the ice sheets, or at least by an arctic barrenness, species perished by the hundreds—witness the anthropoid apes—so that Africa is the only place where the mammals continue to flourish today in something like their Tertiary luxuriance. Man himself must have been under the impact of all this as well, not only from the rigors of nature and from enforced migrations, as the ice drove him south or the warm weather led him north once more, but also because he depended to so great an extent on other animals for food.

But our present interest in the Ice Age is that it gives us a time scale for the last million years, to which events in human history can be referred. During the Tertiary, the age of any particular find, such as a fossil ape, cannot be fixed with great precision, but due to the peculiar circumstances of the Pleistocene glaciations, human fossils or the tools of man can, ideally speaking, be placed within a few hundred thousand years. Of course, knowing an exact age is not really the primary aim; what is important is being able to put different finds of men in their proper relationship and order. The facts that make all this possible are geological, zoological, and archaeological; for the Pleistocene had a wealth of direct effects on the earth's surface and worked a series of rapid changes in the animal kingdom. Furthermore, during the Ice Age man began to leave his own special signature in its deposits, in the form of stone tools, and these likewise serve in some degree to mark time levels, since he made different implements at different stages.

Direct Effects of the Ice

Its geological effects are the ones which can be most directly traced to a particular phase of the Pleistocene, and are also those by which it has been possible to distinguish the four great advances. The creeping ice scoured the landscape, grinding rock into gravel and pushing or carrying it along, leaving a breastwork of this, a moraine, to mark its furthest advance. Then, as the glacier waned, the melting ice fed rivers which carried vast amounts of gravel out and away from the glacier. As the sea level rose and the water slackened, this gravel would be deposited in valley bot-

toms, raising them and broadening them, and would form characteristic gravel layers which could be traced for long distances. Such a gravel-filled valley might be eroded and deepened again by the heavy volume of water coursing through it when a subsequent glacier began to melt; in which case any surviving remnants of the first gravel plain would appear as a terrace along the sides of the valley, even after the second cycle of melting had finished and the valley had again largely filled up with bedded gravel. Many of the river valleys of Europe contain such a series of descending terraces, in which the highest is the oldest, and it is the work of the glacial geologist to connect these different terrace systems with one another and discover to which glacial stage each terrace is related. Therefore, any tools or bones of man found lying on such a terrace may be dated as coming after its formation, and those found within it dated as preceding its formation, and so placed roughly in their proper place in the Pleistocene.

The river terraces make one example of the sort of cyclical phenomena which are related to the glaciations, occurring in a series traceable in many parts of the world because the glaciers themselves were cyclical and world-wide. There are various others, and they are not confined to glaciated regions, for climate also varied sympathetically elsewhere. Present-day dry areas like the Sahara, even though far from the ice sheet, had a heavy rainfall during the glacial phases, and consequently have bedded and therefore datable deposits. Certain other regions, however, were dry and cold, and here in places loess was formed from wind-blown dust, another kind of material which was associated with the several glaciations and of which the relative age can therefore be made out. Forests shifted north and south with the temperature and rainfall, and different types of soils formed at different times. Land rose and fell, so that shore lines and beaches along which man once lived and left his implements may now be found hidden a hundred feet high in the glens of northern Ireland.[1] Geologists are constantly giving us new means of reading clues to age. In the use of any one of these means, something pertaining to man is shown to have reached its resting place at a particular phase in the rapidly shifting events of the Ice Age.

[1]See H. L. Movius, "The Chronology of the Irish Stone Age." Occasional Paper No. 3, University of London, Institute of Archaeology, 1940.

Changing Faunas

The varied animals of the Pleistocene, discovered in fossil form and often found in the rubbish heaps left by man himself, are another important guide to the approximate time when, for example, a particular group of men was accumulating a particular pile of rubbish. Throughout the Tertiary the mammals of the world had evolved at a slow and fairly regular pace in any one region, but the advent of the ice created confusion. Most animals were driven out of the north by the cold and drawn back again by the warm interglacials, and these upsetting circumstances extinguished many species even while new ones appeared, so that the whole group of animals found together in a given cave or layer are apt to be recognizable, from the way they are combined, as belonging to a definite stage of the Pleistocene. Some students, in fact, depend on animals to define the Ice Age itself, or its divisions. In general, the Lower Pleistocene had many Pliocene species now extinct, but added to them were certain new animals not found before the Pleistocene, notably modern horses, camels, and elephants. In the Middle Pleistocene (the second glacial and interglacial) the Pliocene varieties had largely vanished, but animals, such as the hairy mammoth, which mark the Upper Pleistocene (third and fourth glaciations and the intervening period), had not yet put in an appearance. This scheme, it should be said, differs in detail between the Old World and the Americas.

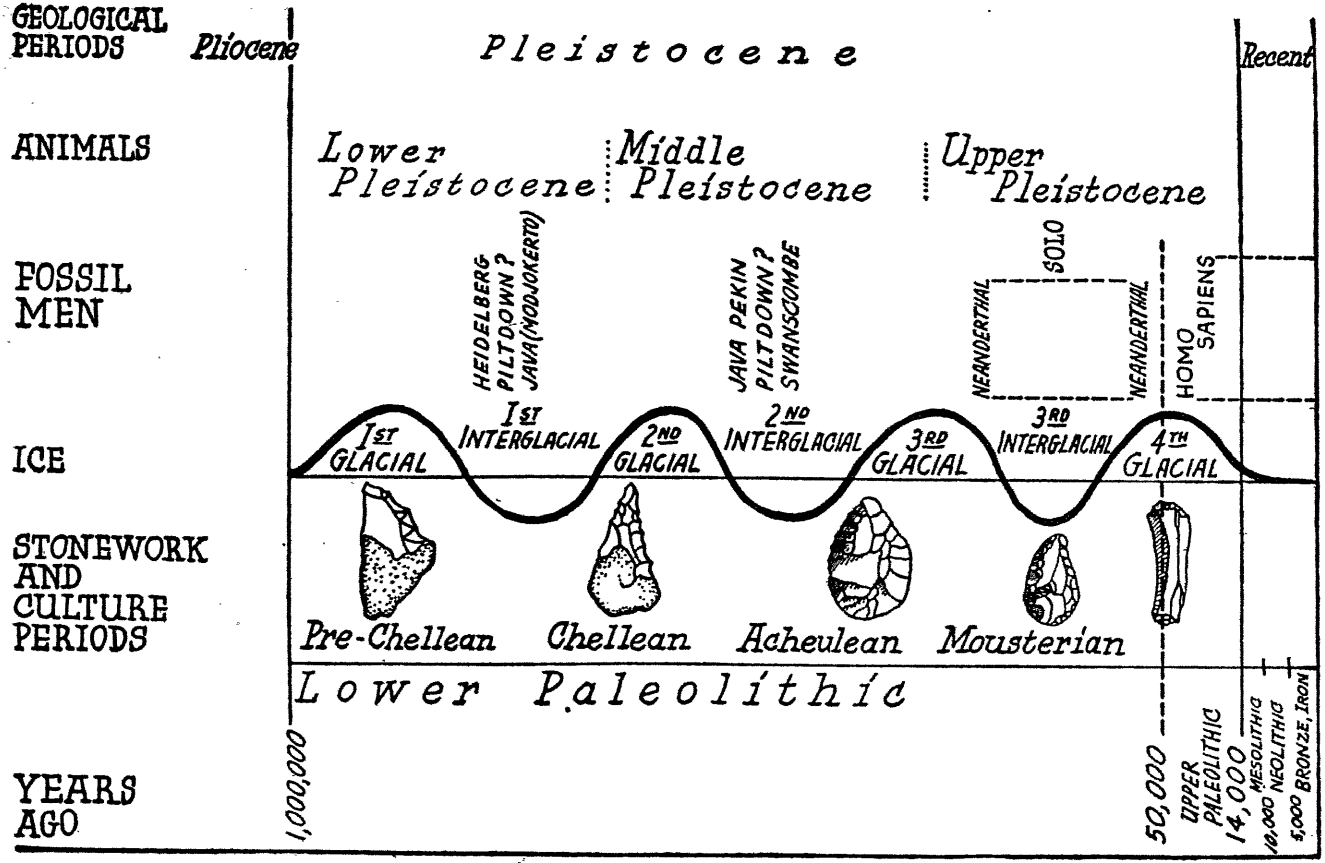
Nor is this all that the animals reveal, for they tell a good deal about the climate of their time. If you find the bones of a hippopotamus in a desert this leads you, like a trout in the milk, to suspect the presence of water in times past, and even of broad rivers and savannas. Quantities of deer and other ruminants indicate grassy plains like the parklands of Africa, whatever the countryside may be like at present. Animals that love cold or warmth tell of the temperature, which can even be fixed rather closely with the finding of mollusk shells in former riverbanks, et cetera, since the water temperature in which the same varieties live today may be known. Other such inferences may be carried to considerable lengths.

The Implements of Man

All these things, the kaleidoscopic changes in the animal world, and the modeling and remodeling of the earth's own face by rain and snow, are phenomena of nature. Not so the third source for the Pleistocene history of man. This is archaeological: the imperishable remains of his poor worldly goods, these remains being almost entirely stone, except for the most recent. Stone implements naturally tell nothing of age or climate in themselves, but when a stone culture or industry (the usual terms for a group of tools or a distinctive manner of stoneworking) is clearly fixed in time at one place, it is safe to use it as a guide in other regions. Above all, these artifacts serve as the footprints of early man, so that his presence anywhere can be detected even though his fossil bones are extremely rare. And, even though a stone tool does not in itself reveal the form of the man who made it, knowledge of cultures may do so. For example, the territory lived in by the last Neanderthal men can, to a great extent, be made out simply from their cultural remains.

No human tools have been proven, to the satisfaction of all, to have come from Pliocene deposits, so that to this day there is no absolute proof, either bony or stony, of the presence of mankind before the Pleistocene. The first implements appear early in this period. How early is not clear, but we may consider the Paleolithic, or Old Stone Age, to have begun together with the Pleistocene. These earliest tools were large nodules or flakes of stone, preferably flint, which were given a crude shape and a cutting edge simply by holding the tool in one hand and knocking off coarse chips from it with a hammerstone. For Europe, the characteristic tool of the time was the fist ax, made from a piece of natural flint about the size and shape of an ostrich egg, pointed on one end by flaking and so heavy as to be surprising, for the men of the age were surely not monsters. Other implements were crude knives and hide-scrapers.

Very gradually skill in producing this stone cutlery advanced. The fist axes shrank and became oval and flattened, with straight edges, until the latest of them were apparently no more than spear points. The trick was also learned of retouching, of producing small and more regular flakes by pressing with a piece of bone and working the tool on an anvil, instead of simply striking free hand.



A Diagram of Pleistocene Time

Another trend of discovery managed to avoid a lot of preliminary shaping by laborious chipping; instead, the makers roughed out a core in such a way that they could strike off from it a flake of usable size which was then made into the tool desired by retouching. These industrial developments occupy the Lower Paleolithic.

In the Upper Paleolithic there was a considerable advance in stonework. The artisan reached great heights in his ability to strike off long, fine, knife-like flakes from a core—something which calls for tremendous skill. Typically these flakes were then readily fashioned by a little chipping into a large variety of tools, corresponding somewhat to all of the awls, nail files, and so forth in Boy Scout pocketknives, and were used to tip spears or to work wood, skin, or bone. Mastery in secondary flaking characterized some industries, like the Solutrean, which were able to produce leaf-shaped blades of perfect symmetry and regularity of flaking over the whole surface. But even where this perfection of appearance is absent, the facility and the ability to control the work are manifest to a student of technique. Apart from stonework, other inventions had arrived in some parts, including, apparently, the bow and arrow and the domestication of the dog, so that late Paleolithic life was perhaps much the same as that of a few primitive peoples of today.

The Paleolithic came to an end with the final retreat of the last glacier, about 14,000 years ago. In Europe there followed an ill-defined period of varied stone industries, the Mesolithic, apparently marking a shuffling of peoples and the introduction of new facets of culture, one of them being a taste for shellfish. After several thousand years the Neolithic period opened a great new epoch for man, with domesticated animals and plants for his food supply, even though he still lacked metals. These latter followed in due course, in the Bronze and Iron ages, though they were less important to human development from every point of view.

Time and Tempo

Let us now look at the question of time. From the beginning there had been a speeding up of the rate of progress in culture, which became very marked at the end. The last four stages, Mesolithic, Neolithic, Bronze, and Iron, have together taken up only something between ten and fifteen thousand years (the post-Pleistocene,

or Recent geological period). If, therefore, the time since the Pleistocene began is about a million years, then the crude Paleolithic took up some ninety-nine hundredths of it, and all that has happened since has happened in the last one per cent.

Nor is that all of it. The Upper Paleolithic marked a fairly definite advance over the Lower, not only in stoneworking skill but in hunting skill as well, judging from the variety of tools that were made, including such things as bone harpoons. And here again the later, better culture occupied only a fraction of the time of the older and clumsier: the Upper Paleolithic began probably not more than fifty thousand years ago, and so it was only about one twentieth to one thirtieth as long as the Lower. During the latter, development in the known artifacts was exceedingly slow, and the fist ax and crude flake were the banners of material achievement for hundreds of thousands of years. Culture has thus been picking up speed for as long as we can see it. The more it has to grow on, the faster it grows.

What does this mean, now, about early man himself? I think that much of the slowness of Lower Paleolithic progress can be set down to the probability that the man in the Lower Paleolithic street was still an underbrained beast, but I do not believe it is well to generalize in this fashion. In any case, that is not the important point. The main thing is what we might assume about the actual age of humanity.

It is safe to say that man used no tools of any kind before he left the trees; that is, while he was still an ape. It is also safe to say that he did not immediately begin to make definite tools when he did come to the ground. But the earliest fist axes and choppers in the collections are already artifacts of a set form, not simply knocked into something which could be used, but worked into a predetermined shape, an accepted cultural form, with distinctive features as to the size and regularity of the flakes removed. Some of the earliest are appallingly primitive and might not be recognized by the non-specialist as anything but natural accidents, but there is no doubt to a trained archaeologist that they are man-made.

However, it is obvious that there must have been a period when stones were chipped to shape them and sharpen them but not to produce intentional, recognizable forms; a period between the momentous birth of the idea of stone flaking to begin with and the time when this flaking had become channelized into conven-

tional shapes which can be spotted when they are found at random in the earth. In fact, there is a whole group of artifacts called "eoliths" (supposedly belonging to an Eolithic or Dawn Stone period), deriving from the early Pleistocene or possibly the late Pliocene, about which opinion has long been divided. The faithful believe that the constancy of form and the direction of the flaking on these stones set them apart from those which have been broken and ground by ice or running water, and that they can have been made only by human hands. The scoffers, on the other hand, assert that eoliths can be reproduced by putting a barrowful of flints into a cement mixer, and certain of them have tried it, with some success.

In a broad sense it does not matter which side is right. The situation is what you might expect. The earliest and vaguest of the Lower Paleolithic tools must have been preceded by others so clumsy and indistinct in form that the conservatives would refuse to recognize them.[2] The argument is not so much whether man ever made tools of this sort, but rather whether the eolith-sniffers have identified the right ones; whether, indeed, it is possible for them to do so.

We have, then, the Paleolithic, yielding tools of a definite form, of which even the earliest are advanced enough so that an untrained person has difficulty copying them. Before this we plainly have a period in which man deliberately chipped a piece of stone before attempting to put it to use, without doing this chipping in so sophisticated a way that we can recognize his effort. But this must have followed still another period. Apes in nature use objects in the sense of a tool practically not at all and certainly not consistently (even though they show a good deal of ability under training). Therefore, early man must first of all have had an apprenticeship in picking up natural objects (rocks among others) and using them as they were, before ever there crossed his none-too-fertile mind the cosmic notion that, if he did not spy the kind of

[2]Someone periodically suggests that the "Stone Age" must have come after a "Wood Age," of which, of course, we have no traces. This idea is based on something of a misconception because, as among modern primitive peoples, wood must always have been of immense importance and would have been used side by side with stone. It is true that there were probably peoples at various times and places in the Stone Age who managed without stone entirely, using only wood, bone, and shell. But, on the whole, wood and stone are the mainstays of primitive life. Wood needs stone for cutting, and stone needs wood for hafting.

rock he wanted, he could invariably manufacture it by breaking a less suitable rock to make it smaller or to make it sharp.

Now we have seen how, in later times, each lower or more primitive phase of culture was many times longer than those that followed, and how the Lower Paleolithic dragged on for perhaps nineteen twentieths of Quaternary time (Pleistocene and Recent). And I have pointed out how we can assume two earlier unidentifiable stages of tool-using which, doubtless being proportionately longer and slower in development, must have been of immense duration. Some think from the evidence[8] that the Lower Paleolithic did not begin before the second interglacial, and therefore does not go all the way back to the beginning of the Pleistocene. Even if this be so, I am prepared to believe that man had been hopefully handling rocks for some millions of years of the Pliocene before he made something which the most devoted archaeologist could claim as the handiwork of one of the family. But this is a matter of faith, without Pliocene bones to back it up. The fact remains that all the existing evidence is contained in the Pleistocene.

[8]H. de Terra, "The Siwaliks of India and Early Man." In *Early Man*, edited by G. G. MacCurdy, 1937.

CHAPTER X

Fossil Men

THE LAST GAP in our history, that from ape to Homo sapiens, is filled with the relics of early men—first of the Hominidae—and poorly filled at that, for these relics, the brass rings of paleontology, are exceedingly rare. But the scarcity is not surprising. For one thing, man has not existed very long and has not had time to sow his bones in many geological deposits. For another, early man was probably not a common animal, unlike the great herds of African mammals. And, finally, he has doubtless always been clever enough to take good care of himself, neither falling into swamps or lake beds, nor allowing himself to be killed and carried off piecemeal into the cave lairs of carnivores. It is a pity, for those are the sort of conditions under which bones may become mineralized and turned into fossils,[1] while any which are exposed on the surface of the ground or buried in shallow earth simply disintegrate without fossilizing. And even though burial of the dead is sometimes favorable to the chances of fossilization, it is a delicacy which seems to have occurred to humanity only in relatively recent times.

Because fossils of early man will always be rare, it will be difficult satisfactorily to interpret those we have. It is especially important to bear in mind the sort of pattern into which the scraps of evidence might fit. For a detective does not really solve a crime from a single hair; he solves it from a single hair plus a number of other hairs with which he compares it, to say nothing of a technical knowledge of hair in general, along with a microscope and other aids. In the case of early man the background of understanding rests to a great extent on the principles which govern the evolution of other animals.

[1]A fossil bone is simply one in which the bone tissue has become impregnated or replaced entirely by mineral salts, and thus, while retaining its shape, is turned to rock and rendered imperishable, instead of decaying and disappearing. This process takes a long time, but is not a fully reliable sign of great age.

Perhaps the most important principles of all are the ones expressed in the spruce-tree illustration on page 4, or the abiding tendency toward divergence. Now the first form of man, a species of animal which was still almost an ape, would, in the course of evolving from its first estate in the direction of our own type, have been expected to split up into several distinct species, closely allied, of course, but still distinguishable. We should, therefore, be prepared to discover that this was the case, and to explain the differences between some of the fossils in this way. In classifying man we speak of the species Homo sapiens, and of the family Hominidae. Now, *Homo sapiens* applies purely to the modern, living type of man, and to those skeletons which, no matter how old, are unquestionably of the same kind in all details. But *Hominidae* is the name of a family and not merely of a species, and it takes in all the men who ever lived, no matter how primitive. And there is plenty of room in this family for beings who were certainly men but whom it would be biological blasphemy to label Homo sapiens, to say nothing of the pain to our pride. To make a long story short, that is exactly what we find to be the case.

In other words, there cannot have been anything fundamentally peculiar about the evolution of the human family, and in interpreting it we can safely fall back on the general laws which we have seen to prevail throughout the rest of man's ascent. At the same time, there is no question but that our remotest ancestors in due course adopted certain oddities of behavior which may have had considerable influence on their development after that, and which may, therefore, be worth recounting. They were, in particular, refinements in food, clothing, and shelter, and man became in time the first domesticated animal. This is a point on the importance of which Professor Boas long insisted, since it is true that domesticated animals increase in physical variation, and in other ways depart from their wild parents.

Food and Fire

One such change was in diet. Apes are vegetarians, and so must man have been, but he became essentially a meat eater; this is particularly true of man nearest to a state of nature, and even among more civilized tribes there are none who subsist on vegetables alone. However, this may not be of any great significance in his evolu-

tion, since apes can adapt themselves to a meat diet. It may have had more importance in assuring him of a supply of food on the ground, and particularly in plains or in cold regions, where fruits and edible vegetables are rare. But the extraordinary and unexplained element in our diet is the advent of fire, because while all men today eat meat, no men eat it without cooking it, and the veriest savage braises his portion as thoroughly as the most epicurean European, so that it is no mere custom, or a mark of civilization.

When I was a little boy I read a story about the origin of cooking, which had it that a Chinese farmer inadvertently burned down his pigpen and, being thrifty, ate the pigs who had roasted to death. He liked the meal so much that he held another barn-burning, and invited his friends, and soon all the pigpens in China were ablaze with the craze. I believed this story implicitly at the time, but I have since realized that it is silly, for man cannot eat his pigs raw, and so he would never have domesticated them had he not learned to cook them first. We have no way of telling at what point in his development man took up cooking, why he did it, or what the immediate consequences were. We do know one thing, however: the knowledge of fire is nothing recent, for as we shall see the primitive Pekin men had it long before the middle of the Pleistocene, and if man was possessed of fire in so simple a stage of culture he may have had it far earlier in his career. Cooking would also have been established very early, because the making of fire must have been hideously difficult, and a labor to which our dim-witted forebears would not have subjected themselves had it not become a necessary one. I doubt if they used it primarily to keep themselves warm.

Language and Tools

Nevertheless, fire probably did have its other uses. In some regions it would have enabled man to pre-empt the habitable caves, in competition with four-footed carnivores. This, with such other first elements of culture as toolmaking and speech, constitutes the essence of domestication, which is simply breaking the absolute dictation of environment over an animal. In domesticating animals we feed them regularly (or else lead them to food), protect them against natural enemies, and oversee their breeding, and

we began by doing this for ourselves first of all. We perhaps look on these, our earliest achievements, as symbolizing the birth of a true intellect, without being fully aware of their practical importance. The use of even the crudest stone tool in the nimble hominid hand must have been a distinct advantage in the pursuit of game, and thus have done much to increase the actual amount of meat resulting from a given quantity of human endeavor. And language, while partly the symptom of an advancing intelligence, was a device which enormously enlarged the efficiency of the joint efforts of a group of men who, to judge from the apes, were naturally co-operative to begin with.

This embryonic culture expanded from that day to the present and has had the effect increasingly of removing man from the world of nature and of natural selection. But this effect, during the major part of man's existence, can only have been superficial. I have tried to give it its due, but it should not obscure the purely biological foundation of man as an animal. Evolution did not carry life through a billion years of progress only to repeal its laws when, to use an expression of Hooton's, a tree-lorn ape blundered into intellectuality. I think that fire and flintworking, speech and society served more to increase humanity's numbers than to change its physical form.

In short, what I have tried to say above is this: that in looking at fossil man it is necessary to have a feeling for the world of natural history to which he belonged, to expect the Hominidae to have had the same kind of a background as any other family of mammals. At the same time we should be aware that, as he developed, man began to surround himself with a thin shield of culture: to supply some of his organic needs—warmth, covering, and fighting power—by means which were not part of his own physical make-up as they are in other animals. We cannot say what the effect of these things may have been.

Fossil Evidence

What actually did happen can be made out only from the fossils themselves. These are often mere scraps, but luckily they are most apt to be parts of the skull or teeth. Now a great legend has grown up to plague both paleontologists and anthropologists. It is that one of these wondrous men can take a tooth or a small and broken

piece of bone, gaze at it, and pass his hand over his forehead once or twice, and then take a sheet of paper and draw a picture of what the whole animal looked like as it tramped the Tertiary terrain. If this were quite true, the anthropologists would make the F.B.I. look like a troop of Boy Scouts, and it has led to a certain amount of skepticism in the lay mind regarding the restorations of early man which have been made. But it is not quite true.

The restorations of fossil skulls do not really go beyond what is reasonable; in fact, there are one or two cases in which a restoration has been made on a small part of a skull, only to have another specimen turn up to give the true form; and in these cases the resemblance has been good. A tooth, all by itself, may speak volumes, but only about teeth. Someone like Dr. Gregory would say that it came from a primitive human being who stood in such-and-such a relation to others, but he would probably rather be shot by the American Association of Physical Anthropologists than try to say what this tooth-bearer actually looked like. However, if a respectable portion of the jaw or of the skull is present, a student who knows the functional relations of all the parts and their exact form among the apes and man can safely say what some or all of the missing portions must have been like. Many such restorations are, in fact, the result of several qualified people arriving at the same thing.

The one kind of reconstruction of which anthropologists are universally suspicious is that which tries to show a fossil man in the flesh, desirable though this is, especially to the public. The reason is that there is no possible way of judging what the soft parts were like, while at the same time these soft parts determine the whole impression which the thing creates. On the same skull two different and equally possible coverings of flesh can make the individual look brutal and apish or human and refined. Suppose only that your own face were tinted and bewhiskered like Gargantua's, and you will see the force of this, to say nothing of substituting his lips and ears for yours.

Guides to the Ape-Men

How, then, are fossils of man to be interpreted? We have seen, in a preceding chapter, that there are specific bodily differences between man and the apes, and students of the subject know these differences and their significance very minutely. If fossil men are in

any sense ape-men or "missing links," then their features will fill in this gap between the living apes and living men, and it is only a question of judging their proper position relative to each. It is as if you made a measuring scale, like a foot rule, for any part or feature of the skeleton, and put the most representative ape at zero and modern man at the twelve-inch end, and then read off the status of your fossil type somewhere in between, as a point in the process of change from one to the other.

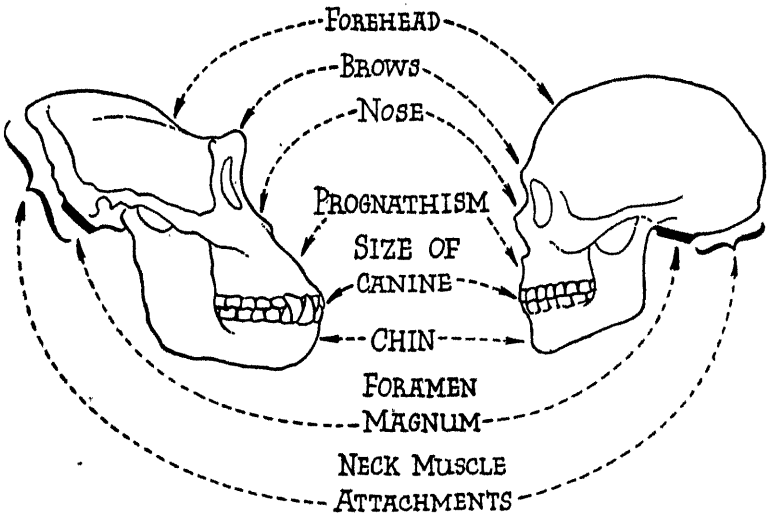
Now the different features of any given type do not necessarily all show the same degree of advance. This is scarcely odd. There is no reason to suppose that tooth reduction, brain increase, and straightening of posture would all have proceeded at the same pace, especially if different species of men were appearing. It is what Hooton calls the "asymmetrical character of human evolution." The plainest example is to be seen in the difference between limbs and skull form. I have already pointed out how the skeleton probably reached a definitely human form before the skull; how, on man's leaving the trees, natural selection would have worked first of all upon the legs and trunk, to perfect their uprightness.[2] Various people like Dr. Weidenreich suspect, in fact, that it was becoming erect which somehow stimulated the growth of the brain. In any case, such evidence as we have does seem to show that our forebears were more human below the neck than above it.

The reader will probably never be called upon to examine a freshly discovered fossil of man and deliver an opinion as to its significance, and I shall therefore do no more than indicate those revealing points to which his attention would naturally turn. If this fossil should be a bone not belonging to the skull, the degree of its humanity would be revealed by its general straightness and lightness and, in the case of the thighbone, by the well-defined markings of the attachments of the strongly developed leg muscles. All these things are directly connected with a truly upright position of the body. And even if the fossil is the skull alone, it is possible to tell to some extent the posture of the body. If the *foramen magnum*, where the spine and skull join, is directly under the whole skull, so that the head balances at this point, then obviously the head was poised in life in this way, erect upon the spinal column. This opening (*foramen*) faces more to the back in apes.

Other evidence is found in the attachment of the muscles of

[2] P. 103.

the back of the neck, which may be seen on the hinder part of the skull. They cover a large area and run high up on the back of the anthropoid cranium, to support it in its thrust-forward position, but in our own case the muscles are fairly small and weak, and low on the skull. Now of course the head may hang forward in a brutish manner in an otherwise erect animal, so that a hangdog head is not necessarily the sign of an ape-like stance below. But if,



POINTS OF DIFFERENCE IN THE SKULLS OF APE AND MAN

These are some significant details in the study of fossil human skulls.

on the other hand, the head itself perches aloft in soldierly fashion, it shows beyond question that the body, missing though it may be, was also fully upright in its bearing.

Brains, above all else, are the mark of a man. It is true, as I said, that ours are not basically different in form from those of apes and so do not furnish the kind of distinguishing mark which zoologists want for classification. By the same token it is practically impossible to make out anything of the mentality of early man from the vague impressions of the brain which can be seen on the inside of a skull. But sheer quantity is a very different thing, and without our abundance of brain we would not have our capabilities. Our brains are just about three times the size of those of the big anthropoids, who are large-brained animals. If you take a skull, turn it upside down, and pour something like lead shot or mustard seed

through the foramen magnum until it is full, and then in turn pour the shot off into a graduated glass, you will have a measure of the capacity of the brain cavity. If the skull is that of the average man of today, this measure will be 1,450 cubic centimeters (that of a woman would be less, because of her smaller body size—about 1,300). That of an ape would be 500, more or less. And, quite naturally, those of our primitive ancestors come somewhere in between.

Now there is one point about this which should be made plain, and it is that the size of one's brain is not an exact index of one's mental powers. There is only a slight relation among modern men between the two, and individuals with normal intelligence occur whose cranial capacity is less than 1,000 cubic centimeters, or halfway back to the apes. The fact remains, however, that the size of man's brain is the key to his progress, and that its excess in bulk over those of the apes represents the difference in intellect fairly enough. A whole species of man, therefore, whose mean brain size was intermediate, must have been neither so dull as an ape nor so sharp as Homo sapiens.

The belief that character can be read from faces is an old wives' tale to anthropologists, except as it applies to fossil man, about whom you can safely say that he was as ape-like as he looks. The amount by which the teeth and the face had shrunk in a fossil type of man is expressed not only by the whole appearance of the skull but also by that of individual features. There are, of course, the teeth themselves: their size, and whether the canines rise above the rest. The shape of the dental arch, too, has changed from a long one with parallel sides to a short one which is more like the top of a Gothic arch, broad at the back. The chin, of course, is very revealing in its size. There may even be an anthropoid "simian shelf" (see p. 79).

The nose is a good giveaway as to how much the upper face has diminished, since it makes a sort of base line from which this shrinkage started. But perhaps the most striking of these physiognomic measuring sticks is the brow, with its bone ridges, and the forehead. In chimpanzee or gorilla the brow ridges are heavy arches of bone across the top of the eyes. The powerful jaw of these animals, in chewing, gives rise to a terrific pressure upward against the face, and the brow ridges make a strong upper border which absorbs it. Behind them the fore part of the brain case is so low and sloping

that it would be sheer flattery to call it a forehead. In man, however, the high and bulging ("noble") forehead rises directly above the eyes and is quite capable of dissipating the force of the puny human bite without assistance; and our brow ridges, instead of forming a well-marked bar, are mere vestigial bumps, just above our eyebrows.

CHAPTER XI

Pithecanthropus and Sinanthropus

WHAT WOULD be more natural than that fossil hunters, finding the ancestors of other animals, should also find our own? Yet such discoveries came about only slowly and in an aura of disbelief and passionate argument. For the stage was not yet set for the proper entrance of antediluvian man until Darwin had had his say, and Darwin himself talked about the missing link as a purely hypothetical creature even while an important skull lay unnoticed in the possession of the Gibraltar Scientific Society.

This skull, that of a woman of the Neanderthal species, was found in a cave on the Rock of Gibraltar not later than 1848. It did not arrive in England until 1862, and even then for a long time it gathered more dust than notice. Thus it was that a different skeleton, recovered through the watchfulness of a local doctor from the Neanderthal cave in western Germany, gave the species its name. This happened in 1856, still before the effect of Darwin on the subject, but it marked the beginning of interest. Virchow, one of the leading anatomists and anthropologists of Germany, explained the skull, with its thickness and its peculiar face, as that of a victim of a disease. Huxley scouted the idea and refused to go even that far afield, though evolution never had a greater advocate than he; Huxley regarded the Neanderthal skeleton as one of modern man, extreme in its features, but still Homo sapiens. Only Dr. William King of Galway gave it as his belief at the time that a human species different from our own had come to light, and he called it Homo neanderthalensis. More finds, a generation later, showed that he was right. These were also Neanderthals. But the find on which world-wide interest in early man had been waiting was none of these: it was that of the Ape Man of Java.

THE DISCOVERY OF JAVA MAN

Here is the greatest story of serene confidence I have ever heard. The confidence was that of Eugene Dubois, who, at nineteen,

began to specialize in anatomy and natural history at the University of Amsterdam in 1877. As he went on to begin a promising career as a teacher, he became engrossed with the notion of finding a really primitive and ape-like fossil of man, and it seemed to him that the East Indies might be the place to begin the search. He tried to get the Dutch Government to provide him with an expedition, but if you were a Hollander whose official business it was to disburse money on the prospect of finding the bones of a purely imaginary creature in the vast islands of the Indies, just because a young professor asserted that it would be a likely place to look, you could have but one answer: "No." Compared to such a commitment, Columbus' proposal to sail around a flat earth would have sounded like a horse race with only one horse in it. The dauntless Dubois, however, sought and was given a post as army surgeon in the colonial service in the Netherlands Indies, and resigned his appointments in Amsterdam. His friends and associates tried to dissuade him. My researches have not disclosed what they thought when he told them in so many words that he was going out to unearth the missing link. But it is most gloriously recorded that he found it!

There was, of course, some method in his mad pursuit. Let no one gainsay it: the idea called for twice the self-assurance of Columbus and its execution for four times the perseverance of him who finds a needle in a haystack. Nevertheless, it was known that in the river valleys of the Indies there were rich fossil-bearing beds of about the right age. Dubois patiently searched in these, and with astonishing promptness found what he was looking for.

He was working near the small village of Trinil on the Solo River in north central Java. Along this river, just at the height of the water, lies a bed with animal remains, which Dubois then thought to be late Pliocene, itself covered with a good many feet of water-laid deposits. In the fall of 1891 he found an ape-like tooth and then, within ten feet, other teeth, and the treasure of them all, a brain pan (everything above the ears and eyes, but not the rest) too large to be that of an ape and too small to be that of a man, but just exactly right to be a missing link. The next year, forty-five feet away but in precisely the same level, he brought to light the thighbone, or femur, of a man. In 1894 he described the Java Man in a paper. Borrowing the name which Haeckel had

already used to designate the missing link when it was still missing, he christened it *Pithecanthropus erectus* (erect ape-man), and placed it in a position midway between man and ape, primitive as to its cranium, but an upright, human walker, a diagnosis which still prevails.[1] The whole thing was a brilliant feat.

In the open arena Pithecanthropus did not fare so well and during the next forty years he underwent some embarrassing moments. In 1896 Dubois assembled the opinions of nineteen other authorities on the find: five of them thought the skull to be anthropoid, seven human, and seven considered it intermediate. To the anti-evolutionists, of course, the whole thing was an illusion, and even those who were willing to gaze upon it at all were able to find at least fifteen grounds on which to quarrel.[2] Perhaps the most important question was whether the skull and leg bone were actually parts of the same person, because of the apparently higher status of the leg, because of differences in the amount of abrasion the two bones had suffered, and because they were separated, when found, by a distance of forty-five feet. The first two points are inconclusive, and the separation is a matter of prejudice also, since the bones were deposited by running water which might be expected to strew them widely (we shall see this again), and in any case nobody else has been found in the bed to whom the leg might have belonged.

Other disagreements were plentiful. Some said the skull was that of an idiot, others that it was normal. Some said it was human, others that it was a monkey, a chimpanzee, or a gibbon. The Java Man could speak. The Java Man could not speak. Dubois seems to have had his fill of this, for after a while he retired from the fray, and he took Pithecanthropus with him and locked him up in his house for twenty years. When Pithecanthropus emerged again there was more of him than before, for the cautious Dr. Dubois produced a piece of the lower jaw about the status of which he had always been in doubt, though he had brought it back from Java with the rest. In the meanwhile the controversy had dwindled

[1]Dubois actually thought Pithecanthropus should have a new, intermediate family to itself, which he designated Pithecanthropidae, instead of accepting the find as a lowly member of the Hominidae, as is generally done now. But his estimate of its general morphological position and nature is about that which is held today.

[2]See Gerrit S. Miller, Jr., "The Controversy Over Human 'Missing Links,'" *Smithsonian Institution, Annual Report for 1928*, 1929, pp. 413–65.

away, and Dr. Dubois' first judgment was accepted everywhere. One voice alone now cried that the Java Man was not a man, but a giant, tree-walking gibbon; that the skull was what one might expect in a gibbon of such a size, and that the femur showed signs of a different type of use from that of man. And here it was that Pithecanthropus felt the unkindest cut of all. For the voice was the voice of Dr. Dubois himself.

This was a strange thing. Dubois, who had been steadfast while others argued, began to vacillate when everyone agreed with him. Shortly after restoring the Java Man to society he changed his opinion of his status, making him more human. But he changed it again, and finally came to the belief that Pithecanthropus was a true ape, after all, supporting it by several new fragments of femurs which he produced from his fossil collections and by ingenious hypotheses regarding evolution which have not been widely accepted by his colleagues. Dr. Dubois died at the end of 1940 after his splendid and fruitful career. His changeability was not really extraordinary, considering the variety of opinion which Pithecanthropus evoked in others; nor was it unique, for fossil men seem all to be touched with a curse worse than that of Tutankhamen, giving rise to endless arguments and indiscretions.

After a long while Pithecanthropus had his vindication. For more than forty years the Trinil finds stood alone, during which time the general uproar was gradually replaced by a peace of unanimity wherein the rest of the world watched apathetically while the elder Dubois broke lances against the younger. A second expedition to the site, under Madame Selenka in 1906, brought back a wealth of mammalian fossils which were indispensable for the study of the age of the deposit, but it found no further trace of Pithecanthropus.

In recent years, however, a young geologist, Dr. von Koenigswald, has worked steadily in Java on this single problem, supported by the Carnegie Institution, and in 1936 the luck changed. At a place some miles from Trinil but at the same level in the valley terrace system, a good part of a lower jaw was found.

The next year brought a new skull, more complete than the original one. It was more complete, that is to say, when it was

*Excepting for a few important authorities who to this day believe that the femur does not belong with the skull. This, of course, does not affect their estimate of the importance of the skull. See footnote, p. 138.

uncovered, but Von Koenigswald had made the mistake of offering his native workmen a bonus for important pieces, and consequently when the skull arrived in his hands it was in roughly as many parts as there were workmen. No real damage was done, however, because the breaks were fresh ones and easily glued together. Since then three more skulls have appeared, one being that of a small child or infant and the latest having, at last, part of the face. This was in 1939, when Von Koenigswald found an upper jaw with most of the teeth, which he took to Pekin to make use of the excellent laboratory where Dr. Weidenreich was working on the remains of Pekin Man. Here they noted signs of fresh breakage on the fossil, and Von Koenigswald therefore telegraphed back to Java, telling his foreman to search carefully at the original spot. The foreman shortly recovered most of the back of the head, obviously belonging with the jaw. These pieces showed dislocations strongly indicating that the skull had been crushed, and its owner probably killed, by a blow on the forehead; and for a short, exciting period before the bone was properly cleaned of matrix it was thought that the weapon was still fixed in the wound. This was the last find of Pithecanthropus up to date.

There are now, therefore, no less than three adult skulls in fair shape, and parts of the upper and lower jaws with a number of teeth. (The original teeth found by Dubois have been assigned to a fossil orang instead, upon comparison with the new ones, and upon greater acquaintance with extinct anthropoids.) The material shows that Dubois was practically right in the very beginning. The new and more complete skulls are exactly like the first one in type, demonstrating that Pithecanthropus was not an ape, an imbecile, or a freak, but a brutish human being who held himself erect. There is a difference, in other words, between an isolated fossil and an animal which can be studied from the remains of several individuals, so that one can be sure of the average or typical form. The moral is this: Do not try to make an ape out of Pithecanthropus, or Pithecanthropus may make a monkey out of you.

The Type of Pithecanthropus

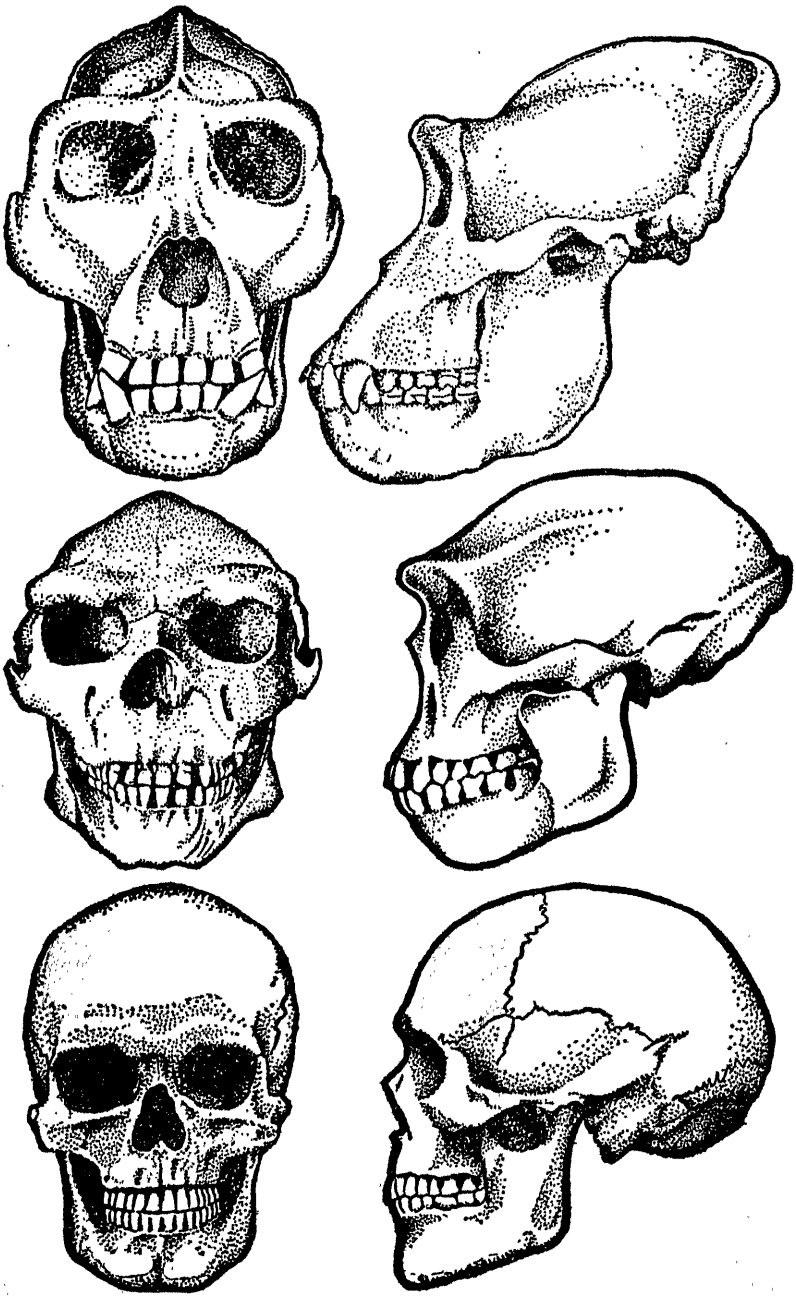
This primitive species of man was of the same size as the modern one. That is shown by the leg bone, which indicates a height of five feet six inches or more. It is human in every way, as to its straightness and the forms of its joints. It also shows that Pithecan-

thropus walked erect.[4] But even the head practically assures that, since the *foramen magnum*, with the joint for the spine, is placed well forward and the neck muscles did not lie as high on the back of the skull as they do in an ape. However, they were placed high enough, and were extensive enough, to indicate that the head was carried in a rather primitive and forward position. Another point bears on this: We have large mastoid processes behind our ears, from which on either side muscles run down in a V shape to the top of the breastbone, well developed because they are useful in turning our fully balanced heads from side to side. But in an ape, whose head is held up almost entirely from behind, such muscles are less useful and their attachments, the mastoid processes, are small or absent. And they are small, for a human being, in Pithecanthropus, a fact which may be taken to reflect the posture of his head.

His skull was tremendously thick and heavy. The forehead is so low that it cannot be said to exist, and the profile is strongly ape-like. All of this is most pronounced in the last skull, which is male. The original cranium found at Trinil thus for more than forty-five years had given us a less brutal impression of the Java Man than was actually correct. As for the all-important brain, this would appear to have been about 900 to 1,000 cubic centimeters in volume, perhaps on the whole a little less than half the way from ape to gentle reader. But the possibility does exist that Pithecanthropus had the power of speech. At least that is the opinion of a few brain specialists, based upon the development of that part of the frontal lobe with which speech is associated.

His teeth were large, his dental arch was long and narrow, and his jaw was heavy and chinless—ape-like features all. And between his upper canines and the incisors was a wide space, or diastema (which apes also have, to accommodate the large lower canine), the only appearance of this hiatus in any creature ever accepted as a man. But in spite of this his canine teeth were not long. Other

[4]Drs. Weidenreich and von Koenigswald do not accept the Trinil femur as a Pithecanthropus fossil, partly for the very reason that it seems too modern for the skull and partly because it differs from that of the related Pekin Man, which has a flattish shaft. Their opinion is worthy of deep respect, but I do not believe myself that the difference in the shaft shape is very significant, because such a difference can be found between two modern femora. In the light of the slightly primitive Pekin bones, however, the completely modern form of the Trinil femur does indeed become more of an objection than formerly, before the Pekin bones were found.



THE SKULL OF PITHECANTHROPUS, COMPARED WITH MAN AND GORILLA

Top, gorilla; *center*, Pithecanthropus; *bottom*, Homo sapiens. (Following the restoration made by Dr. Franz Weidenreich).

human characteristics occur throughout, and there is no simian shelf behind the chin region. Altogether the jaws, like the skull, are those of a being standing midway between man and ape.

The face of Pithecanthropus was reconstructed for the first skull (in which it was missing) partly as a matter of speculation, by creating something suitably primitive. But the recovery of the lower and upper jaws, including a little of the base of the nose, shows that the first estimates were too sympathetic. The middle of the face is still missing, but from the rest Dr. Weidenreich, than whom nobody is better fitted to do it, has made a restoration which must be fairly close to the original, and the impression one gets from it is that of a pug-faced ape. The face is surmounted in all the skulls by enormous brow ridges, which differ from a gorilla's mainly in that they protrude forward rather than up, showing a changing form. Below, the face is shorter and broader than an ape's, though flat, probably with very little nose. The jaws, of course, project, but there is a hint of a straighter chin than is customary in apes. All in all, this visage is large, but somewhat spoon-faced rather than heavy-muzzled. Now the fossil South African apes had something of this flatness of face and indeed seem to stand between their living cousins and Pithecanthropus in their general appearance as well as in many details. Everything that has been found in recent years, therefore, continues to reinforce the belief that in the Java fossils we have found a creature whom we call a man, because we know he walked like one, and who in the evolution of his skull had advanced beyond the stage represented by the man-apes to a point halfway to Homo sapiens. Someday we shall find men more primitive than he, but not much more, for there is not a great deal of clearance between him and the South African apes. Now, fifty years after the great find at Trinil, the gaps are rapidly filling up.

Life and Times of the Java Man

Of what the Java men were capable mentally we do not know. I am satisfied that they had their own society, since even apes have that. But I could not guess whether, if we had them with us today, we could somehow fit them into our own world or whether we would be forced to put them in some kind of asylum, not because they were temperamentally different from ourselves but

because, like chimpanzees, they did not understand us perfectly enough to be reliable citizens. It may be that they had language, but the fact that the proper convolution of the brain was enlarged is no proof of it. Furthermore, allowing that they did speak, we are utterly unable to imagine the nature of their language. For, in spite of baby talk and pidgin English, we have no notion of a really primitive speech; all the languages of Homo sapiens, whether Eskimo or English, have the same potentialities, the same dimensions and scale, and we have nothing by which to judge how spoken expression would be restricted among a kind of men whose normal intelligence was lowered halfway to that of the inarticulate apes. In any case, when you consider how little we can understand the minds of living men of our own sort, you can see the futility of trying to look into the heads of another species of man which died out half a million years ago.

Tools are another matter. There was that brief, delirious moment when it was thought that the stone ax which brought death to Pithecanthropus IV, as the latest individual is known, still lodged within the skull. This would have been what the archaeologists call a "cultural association," and an absolutely perfect connection between an ancient man and his implements. But when the tough matrix was cleared away it was seen not to be so, and no artifacts have yet been found with the fossils. However, perfectly recognizable implements have been turned up in levels apparently of the same age, and it is possible that Pithecanthropus made them. I should consider this to be better proof of speech than any markings on the inside of the cranium, for I have said that even the crudest stone tool which we can recognize is in reality an advanced technical job and one which I do not think could have been developed and standardized without language.[5] But for the same reason it might be odd if the primitive Java Man had such well-made tools. However, as I said, we cannot judge his mentality too closely from appearances.

What, lastly, is the age of Pithecanthropus? This is a vitally important matter, but there is one thing to remember, as in all such cases: the date and the place of any fossil bones are simply the date

[5]A chimpanzee, trying to explain the workings of a problem machine which yields bananas and which requires two apes to work it, to an uninitiated comrade, without the use of speech, would agree with this suggestion. See M. P. Crawford. "The Co-operative Solving of Problems by Young Chimpanzees," *Comparative Psychology Monographs*, vol. 14, 1937.

and the place in which those fossils came to rest in a geological deposit. They do not say whether the animal they represent also lived earlier or later than that date, or in other regions as well.

Dubois and others thought that his bone bed belonged to the late Pliocene, though no human artifacts had been found in Europe to be older than the Pleistocene. However, in present-day opinion the Pithecanthropus remains are not so old. Long and careful study of Javanese geology has distinguished three "zones," or levels, with their characteristic animal remains. These are named Djetis, Trinil, and Ngandong, and are believed to belong to the Lower, Middle, and Upper Pleistocene respectively (first glacial and interglacial, second glacial and interglacial, and third glacial and later times). The adult fossils of Java Man belong in the Trinil zone, and thus in the rainy period which corresponded with the second glacial stage in the north, toward the middle of the Pleistocene or a little earlier. But the one infant skull, found at Modjokerto near Surabaya, comes from the Djetis zone, and is thus early Pleistocene. If this was a true child of Pithecanthropus,[6] and there is no good reason to think he was not, then he shows that the species existed in Java throughout the first half of the Ice Age.

Pekin Man

Pekin Man is the second primitive species of great importance, and comes also from the Far East. He is a relative newcomer to the anthropological scene and he underwent no such harsh baptism as Pithecanthropus, but was received with understanding and respect. For Pithecanthropus and a number of later fossils had borne the brunt of the incredulity and inexperience of earlier savants and others, and the partisans of doubt and of wild conjecture were chastened. He was also most fortunate in the choice of his sponsors, Dr. Davidson Black and Dr. Weidenreich. His story is less lurid, therefore, than that of Java Man, though it has its moments.

Forty-two miles from Pekin, near the town of Choukoutien, there are banks of ancient limestone at the foot of the Western Hills. During the Pleistocene, fissures and natural caves formed

[6] It is not possible to be sure exactly what adult species an infant skull belongs to, in most animals. But this skull had a far smaller brain than a present baby of its probable age, and was certainly not Homo sapiens. Equally surely, it was not an ape.

at different times in this limestone, and then filled rapidly up with earth, bones, and fallen pieces of the roof until they were caked solid and hardened by lime salts. For a long time the limestone has been quarried, and the great pillars and lobes of bone-bearing material, which had formed in the fissures, attracted paleontologists, who have been working at Choukoutien for more than twenty years. They early noticed pieces of white quartz here and there in the deposits, and since this does not occur naturally at the place they began to watch with especial care for traces of the men who must have brought it there. After several years an apparently human tooth turned up in a collection which had been sent to Sweden. Interest increased, and aid was lent by the Rockefeller Foundation. Then, in 1927, a molar tooth was found at the site and brought to Dr. Black, who was in charge of the diggings. And here is the sort of gesture which sometimes makes a paleontologist look like a true seer. Figuratively, Dr. Black nailed to the door his opinion that there had been discovered a new being, definitely a man but one different from any known, and deserving to be given a new genus and species. What he actually did was, after examining it, to christen this single tooth *Sinanthropus pekinensis.*

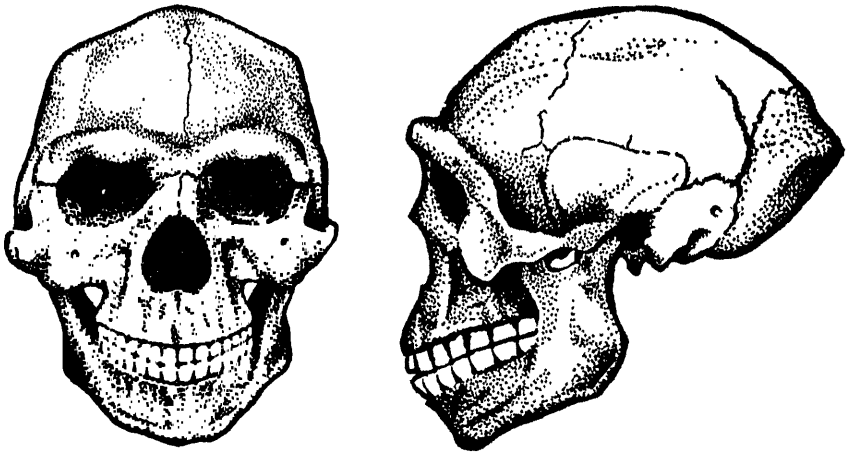
He was perfectly right. The next year more teeth appeared, followed by a youthful jaw and part of another. In 1929, on the afternoon of the last day before stopping work for the season, in a shaft which had been carried down one hundred and ten feet, the top of a skull was found and Sinanthropus lay revealed. During later years, since Dr. Black died, more skulls, teeth, and jaws have been found by Dr. Weidenreich and his associates, until there are traces of something like forty individuals. This is not the wealth it may seem to be, for only a handful of facial parts and very few skeleton bones exist. But there are half-a-dozen skull vaults in good shape, and plenty of jaws and teeth, making Sinanthropus the best known, except for the Neanderthals, of all the fossil men, and showing that there was a definite community of Pekin men in the vicinity. Work at Choukoutien has, of course, stopped, but Dr. Weidenreich has been carrying on his researches at the American Museum of Natural History.

The Type of Sinanthropus

For the skeleton, the mutilated shafts of a few leg and arm bones and a single collarbone are less than we would like to have. Even these, were they more complete, might tell us much about the development of details of our present frame. But as it is, the fragments demonstrate the humanity and upright carriage of Sinanthropus. They are short and heavily constructed, and indicate that the Pekin men stood, roughly, only just over five feet. But they are straight. There is a pronounced flattening of the upper part of the shaft of the femur, which Dr. Weidenreich takes to be a primitive character; but I am inclined to think, from its occurrence in other groups, that it is associated with straight and upright legs, and thus may be actually rather advanced. The main feature of the bones is their heaviness. Though they are of the same outward size as ours, the hollow canal inside the shaft is smaller than in a modern bone, and the wall, therefore, is thicker. They also reveal, by X ray, a slightly less efficient arrangement of the internal lines of stress in the region of the joints. But all this is hardly more than detail. The interpretation of the Pekin bones seems to be that they are thoroughly human and not at all ape-like, but that by comparison our modern bones have, through a process of evolutionary refinement, come to fill the same mechanical requirements with a somewhat lighter construction, calling for a lesser growth of bone.

The skull shows that Sinanthropus was very much like the Java Man in type but somewhat more advanced in character. The brows were equally massive, and the bone of the vault as thick. But the brain capacity was probably something between 1,100 and 1,200 cubic centimeters on the average for males (let us say 1,150 for a single figure); it was thus perhaps 200 cubic centimeters larger than in Pithecanthropus, though still far below later men, who have almost 1,500. With this bigger brain, the brain case, therefore, is a little fuller and higher, and there is a slight angle in the profile which suggests a forehead. It is possible that his head as a whole was not slung quite so far forward; at any rate, the mastoid processes are fairly well developed. Apart from these things there are a number of marked likenesses in the Java and Pekin skulls in minor features of the lower part of the brain case which indicate relationship.

The face exhibits, if anything, a greater amount of progress over that of Pithecanthropus than does the skull vault. Although it is wide, with big brows, it is more shrunken back and, in Dr. Weidenreich's reconstruction, has a slightly raised bridge to the nose. The palate or dental arch is shorter and rounded in front, and the lower jaw is likewise shorter and, unlike an ape's, spreads out somewhat in back. This mandible is distinctly human in type; it



SKULL OF SINANTHROPUS

Drawn from the restoration by Dr. Franz Weidenreich.

has no proper chin, but it is, nevertheless, rather upright in front; it also has no trace of a simian shelf inside, but has, instead, a definitely human feature: small spicules of bone to which the tongue muscles are attached, known as genial tubercles.

The Sinanthropus teeth are undeniably primitive; they follow the Dryopithecus pattern and are a progressive, generalized, human-like derivation from it. The canines have very large roots, something which may have lingered on after the crowns of the canines had become smaller. There are various other primitive details, some more so than in Pithecanthropus. But unlike the latter Sinanthropus had no gap between the upper canines and the incisors. Furthermore, in the Java jaw the big molar teeth get progressively larger from front to back, as they do in apes, so that the wisdom tooth is the biggest of all. But this tooth is the smallest of the three molars in Pekin Man, showing that the human tendency to reduction had set in. Altogether the dentition of Sinanthropus was one in a transitional evolutionary stage, certainly human, but

so distinctive that Dr. Black could recognize from a lone molar a hitherto-unknown form of man.

The Relations of Pekin Man to Java Man

Having the existing remains of the Java and Pekin men to study and compare, we know a great deal more than was possible in the days when the lone Trinil specimen turned everyone's imagination loose. Even today, however, there is little agreement as to where they belong in human history. They float too freely in the void of our ignorance, and we shall have to find other ape-men in other places before we can anchor these. Some believe, and especially Dr. Weidenreich, that Sinanthropus might have developed into Homo sapiens, and thus be a true ancestor of ours, while others think he was too specialized in some respects, having features which, judging from living men, our own primitive ancestor must have lacked. Most seem to doubt that Sinanthropus was descended from Pithecanthropus as we know him.

But practically everyone is agreed about a few things. Some of our true ancestors would have been a good deal like these two. And they are certainly related fairly closely to each other, whether Java Man was the direct forebear of Pekin Man, or whether he was more like an uncle. Dr. Black was quite justified when he named Sinanthropus from a tooth. But if he had forborne to give his find an actual classifying name, with a whole genus (Sinanthropus), Pekin Man would doubtless today be named Pithecanthropus pekinensis by sticklers for correctness, putting him in a genus together with the Java Man, though as a different species (pekinensis). This has been suggested by several people. Dr. Weidenreich would go further and put them both in the genus Homo, along with ourselves, but it hardly seems as though a fellow with a pre-canine gap in his tooth row should be piped aboard just yet.[7] There are, on the other hand, writers who would go so far as to eject the two of them from the whole human family, but I believe that the Hominidae will someday have to receive, as walking animals, creatures who are even more ape-like than this pair.

This discussion of the right Latin names for these "prehominids," as Weidenreich also calls them, may seem like a

[7] See p. 138. Remember that even the South African man-apes lacked this mark of the beast.

niggling business, but it is a device by which students find out in what ways they agree or disagree, and express those differences. In plain words, the Far Eastern fossils are two examples of men in a primitive stage, but not too far from the line which our own descent must have followed; and they also happen to be closely related to each other, probably by common descent from a still earlier type.

The finds in Pekin and Java do not mean that the primitive forms of men were quartered exclusively in eastern Asia, or that man evolved there. Those simply happen to be the special localities where, by lucky accident, some of their bones were preserved as fossils and, also with the aid of luck, have since come to light. This is illustrated by the stories of their discovery. Pithecanthropus remains, it is true, have been recovered from several places in Java, but the Pekin material all comes from a single cave structure and tells nothing as to how widely Sinanthropus, as a living creature, might have ranged. We can confidently expect that further men of their same general nature will turn up in the future in other parts of the world. One such, known as *Africanthropus njarasensis*, seems already to have been identified in East Africa. In 1935 fragments of skulls were found weathering out of the sandstone of an old lake bed on the east shore of Lake Eyassi (or Njara). The fragments were heavily fossilized and thick, and the restored type appears to resemble the larger of the Pekin skulls, having less of a forehead but being fuller further back. The few people who have examined it would, at any rate, align it with the Java and Pekin species as another "ape-man." But nothing has been given out about the brain size, and little else in the way of detail, and since the specimens are in Germany it will be some time before we learn more.

Life in the Pekin Caves

We are not yet finished with the men of Choukoutien. We have looked them over as physical specimens and we have compared them with their Java cousins. But one more thing which makes Sinanthropus perhaps the most important fossil of them all is that we are lucky enough to know something about his way of life. He lived (at Choukoutien, at least) probably about the same time as Pithecanthropus, or perhaps a little later. What we decide as to date must depend entirely on the animals whose bones are found

along with his, because this is a cave deposit, and there is nothing which will connect it directly with the glacial series. Among the animal types are a wolf, a dog, a fox, hyenas, and three bears, two of them big ones; also various cats, one of them being a tiger and one being still larger. These are all cave-using animals and do not help us much. But the others are not cave-living, and are rather too numerous in their remains to have been brought in by the carnivores, and so they must have been carried there by Sinanthropus himself; furthermore, they reveal facts about climate and time. Such are deer, sheep, buffalo, bison, and rhinoceros, as well as a very large horse, a camel, an ostrich, and an elephant. On the face of it such a group points to warmer weather than prevails there today, and at the same time the present country would not graze so large a number of ruminants, so that there must have been more rainfall. Moreover, the whole list of animals seems to be just in the middle between the known fauna of the Late Pliocene and that of the Upper Pleistocene, being closer in its make-up to neither. The general opinion is, therefore, that it, with Sinanthropus, belongs in the early Middle Pleistocene: second glacial or early second interglacial. This is not established—it is simply the best judgment of the moment—but it seems to place the Pekin and Java fossils side by side in time.

Sinanthropus had fire. Of that there is little question, for areas of blackened earth were found in many places in the cave, seemingly the remains of ancient hearths on which he cooked his meat. As I said before, this is the earliest sign of man-made fire we have, and shows that so lowly a creature as Pekin Man was capable of making it. Even more important are the implements which were recovered, since we not only know that he could make tools, but we also have a representative collection to compare with others. For materials he had sandstone, quartz, and chert, the latter being like flint but inferior to it. He flaked boulders of these into heavy, squarish chopping tools, and also into smaller, better-made scrapers of a number of shapes. These tools are of a simple Lower Paleolithic style, but are by no means the crudest known. They fall into several distinct types which can be easily recognized, and the whole group of them belongs with the sort of industry which is beginning to be known for the Old Stone Age elsewhere in Asia, as opposed to Europe. Finding this stone culture is of immense

significance, and will prove even more revealing when it becomes possible to delve on a large scale into the archaeology of Asia. For the present, two other little inferences may be drawn. One is that we need not be surprised if we find that Java Man also made relatively good tools. The other is that, judging from the flaking of the implements, Pekin Man was right-handed. This itself was probably an important step in human evolution, like speech, since it seems to be essential to have one hand dominant over the other if you want to use the two of them to do different things efficiently at the same time, as when you draw a bow or light a cigarette.[8]

Having shown him to be an enterprising fellow for one so handicapped in the volume of his brain, I now hope that the reader's sympathies will not be alienated when I reveal that Sinanthropus seems also to have been a cannibal. Examining the few limb bones, Dr. Weidenreich points out that the ends have been chewed off in the typical manner in which carnivorous animals begin on a bone, a somber comment on life's hazards in ancient Choukoutien. But the shafts have also been split lengthwise in a fashion which no animal can manage, but which has been used by man to get at the marrow of a bone in other times and places. And this is only a hint, for it is the skulls and the way in which they were found which mainly testify to the dreadful deed. Nowhere in the deposits were two human bones found in their natural relation. Instead, pieces and teeth were found at random throughout, which means that none marks the resting place of its owner, but rather that every one was dropped or thrown aside by other living things. Though there were half-a-dozen skulls of which the vault was more or less intact, every single one had the base broken out. This is a striking fact, as is also the small number of skeleton bones which were found, compared to the many parts of the skull. The solution seems to be that the men of the cave sometimes killed strangers in the vicinity and picnicked on their remains at the scene of the killing, but brought home the heads in order to open them at leisure and feed on the brains, perhaps in the cool of the evening. In mitigation Dr. Weidenreich allows that the heads might have been trophy heads, from which the brains were removed, and Ashley-Montagu suggests that the skullcaps were

[8]You will see that this is really not an easy matter if you try to make your hands perform still more independently, as in the children's game in which you pat your head with one hand and rub your stomach in a circle with the other.

meant to be drinking cups, both of these ideas being based on similar customs among modern savages.

The best way to relieve Sinanthropus of the stigma of cannibalism is to assume it ourselves, and this has been done in our behalf by several writers. That is because men of our own type have also been found at Choukoutien, though in other cave deposits belonging to a much later date. The suggestion is that this same Homo sapiens was also present far earlier; that it was actually he who was living in the main cave, building the fires and making the tools and bringing in the game; and that Sinanthropus was merely a simple ape-man living at the same time in the open, who, like other creatures, sometimes fell before the spears of this fierce marauder who was more intelligent and better armed. It is a nice question whether eating a man who is not strictly of your own species constitutes cannibalism. It is alleged, at any rate, that that is what was going on.

By this suggestion Sinanthropus would be shorn of all his pretensions to human culture and practically reduced to the level of the wild beasts among whose bones his own are scattered. But there is no evidence at all of the presence of Homo sapiens in the same cave. It seems to be simply a belief favored by those who doubt that Pekin Man could have had so good a stone culture. The only fact is that somebody was eating Sinanthropus, and it is all too likely that it was Sinanthropus himself.

CHAPTER XII

Piltdown Man

You may join with those who would take Java Man's leg bone away from him, or you may say it is mayhem. You may blush at the thought of Sinanthropus devouring his own kin, or you may blush at the thought that the culprit may have been someone very like yourself. These are relatively minor disputes and will do little to affect our understanding of the main relationships among early men. They are as nothing to the bonfire of controversy which has never died down, and onto which more paper has been thrown annually, ever since the discovery thirty years ago of *Eoanthropus dawsoni.* Such are the peculiarities of this fossil, known also as the Piltdown Man[1] and the Sussex Woman,[2] that twenty years of battling over the Java remains were not enough to draw the sting of what was to be said over this new unburied Caesar. It is not surprising. For what you think of Piltdown Man greatly influences your interpretation of all the fossil men taken together.

It was Mr. Charles Dawson, a lawyer of Lewes, not far from the channel coast of England near Brighton, who made the providential discovery in 1908 at Piltdown. I shall quote, as others have done before, his own description of his first find because it reveals how valuable to science such an amateur may be, and because, as Sir Arthur Keith points out, it also shows how rare and fortunate such fossil finds are apt to be, and how often priceless remains must have been unwittingly turned up only to fail of recognition and be lost.

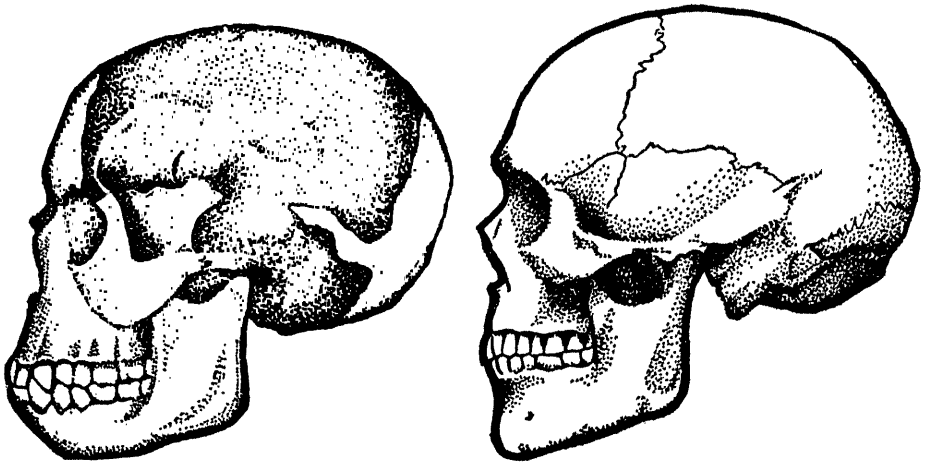
"Several years ago I was walking along a farm road close to Piltdown Common, Fletching (Sussex), when I noticed that the road had been mended with some peculiar brown flints, not usual in the district. On inquiry, I was astonished to learn that they were dug from a gravel bed on the farm, and shortly afterwards I visited

[1]After its family.
[2]After its sex.

the place, where two labourers were at work digging the gravel for small repairs to the roads. As this excavation was situated four miles north of the limit where the occurrence of flints overlying the Wealden strata is recorded, I was much interested and made a close examination of the bed. I asked the workmen if they had found bones or other fossils there. As they did not appear to have noticed anything of the sort, I urged them to preserve anything that they might find. Upon one of my subsequent visits to the pit, one of the men handed to me a small portion of an unusually thick human parietal bone. I immediately made a search, but could find nothing more; nor had the men noticed anything else. The bed is full of tabular pieces of iron-stone closely resembling this piece of skull in colour and thickness; and although I made many subsequent searches, I could not hear of any further find nor discover anything—in fact, the bed seemed quite unfossiliferous."

But luck, which had brought Mr. Dawson to the scene and had enabled one of the workmen to distinguish a flat piece of a human skull from among many similar pieces of flint, had done all that was necessary. Mr. Dawson came again and again to the small pit where the men had been working, and after three years, in 1911, he found on a dump pile a part of the frontal bone of the skull, including the outer upper corner of the eye socket. With this much to go on, and spurred by the thickness of the bones and their apparent great age, he took his material to Sir Arthur Smith Woodward of the British Museum, who agreed with him as to its importance, and the two of them decided to hire their own workmen and look through the pit and the accumulated dump heaps in thorough fashion. Next spring the dump heaps yielded more parts of the upper portion of the skull, and of the ear region, while in the pit itself, in the lowest, brown-stained gravel layer, Smith Woodward found a portion of the occiput, or back of the head, and Dawson found half of the lower jaw, both of them within a few feet of the spot judged to be that where the first piece had been found four years earlier. It may be that these last pieces were in their original positions in the gravel, and that all the fragments were spread through this small area, but it has also been thought that the workmen unknowingly broke a more complete skull and scattered its pieces. In any case, it appeared from the site and the state of bones that they all came from the same level.

Smith Woodward produced a restoration of the Piltdown type from the fragments, and he and Mr. Dawson made it public in 1912. They continued also to look in the pit, but with only slight further success. In 1913 the two nasal bones, forming the bridge of the nose, were found. The same August a young French priest, archaeologist, and paleontologist, Father Teilhard de Chardin, paid a three-day visit to the pit, during which he picked up a canine



PILTDOWN SKULL AND HOMO SAPIENS

(The shaded portions of the Piltdown skull are those actually recovered, as seen from the left side.)

tooth. Father Teilhard is today one of the leading archaeologists of Europe, and has for a number of years been working with Dr. Weidenreich at Choukoutien and is the authority on the fossil animals of the Sinanthropus cave. This makes him, as far as I know, the only man ever to have participated in the actual finding of two different species of fossil men.

No more has ever been recovered from the original pit. But Mr. Dawson's attention had now been drawn by a plowed field, two miles away, which had flints in it of the same color and type as those among which the skull had been found. Mr. Dawson, as we have seen, was like Dr. Dubois in one respect: when he was looking for a needle no haystack could dismay him. At an opportune time, when the stones of the field had been raked into heaps, he managed to find among them three small pieces (and the exact nature of these bits is important): the inner part of the right side

of the forehead and brow, a piece of the middle of the occiput, or back of the skull, corresponding in part with the occiput from the gravel pit, and a lower molar tooth.

The Nature of Piltdown Man

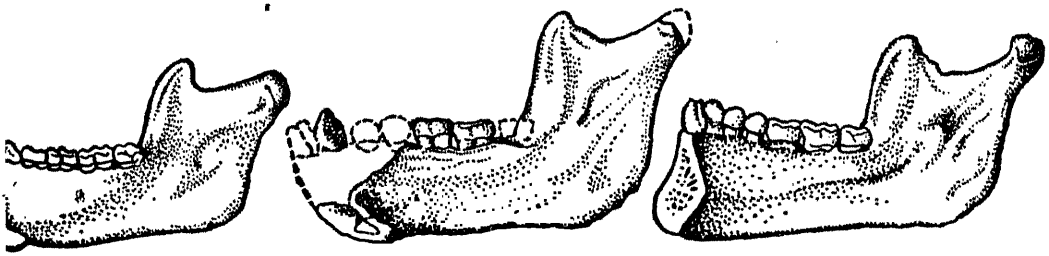
Let us look now at Piltdown Man himself, and see what caused the furore. The skull is indubitably thick-walled—about twice as thick as a modern cranium—but is also, without question, thoroughly human in its general form, and by that I mean like ourselves. It was obviously well filled out, with small brows and a forehead which was quite upright; and the *foramen magnum*, the mastoid process, and the muscle markings at the base of the neck are just as ours are, showing a fully erect carriage of the head. A faintly primitive impression may rise from its appearance and, according to Keith, from the internal brain markings, but there can be no denying its general modernity in size and shape. This is why the jawbone is such a surprise, for the jaw would pass for that of an ape. Alone among fossil human jaws it has the signs of a simian shelf (see page 79) in the front angle, and it has no suspicion of a chin in the front at all. In form the rest of the existing part is rather like the same thing in a chimpanzee, and there are various details of the structure of it, even including those which can be seen internally by X ray, about which the same may be said. I could not go into these without taxing the reader's patience and interest, but they are admirably set forth by Sir Arthur Keith in his great book, *The Antiquity of Man*, of which his study of Eoanthropus forms the central part.

Of the teeth, the canine is rather like an ape's in form but is intermediate in size, being in its thickness, the height of its crown, and the length of its root greater than the same tooth in a modern man but smaller than in a female anthropoid. That part of the jaw in which it belonged is broken, and its exact position cannot be told. The first two molar teeth, which are in the jaw, are ape-like in the fullness of their cusps and in being relatively long from front to back, while ours are shorter and wider. However, they are ground flat on the tops of the crowns, which is an indicator of the typically human manner of rotary chewing, even though it may occur in occasional chimpanzees.[8] At any rate, it would seem to

[8] See page 76.

be in the teeth, if anywhere, that the jaw as a whole looks from its anthropoid status in the direction of man.

This is a meager description of the specimen, but how the jaw struck the experts will be shown by what they said about it. The whole dilemma of Piltdown Man rests on this: that while in the Java and Pekin crania you have what can be called ape-men, in



CHIMPANZEE PILTDOWN HOMO SAPIENS

The Piltdown jaw compared with chimpanzee and human jaws sawn in half at the midline.

Piltdown you have the skull of a man with the jaw of an ape; a combination of two extremes rather than a mingling.[4]

The Jaw and the Skull

There have really been two controversies over Piltdown Man, and it is the first of them which has the incongruous mandible for its theme. In this, the question at issue is whether Eoanthropus represents a single creature or two different ones. Half of the body scientific accepted the find at its face value, but to others the idea of so human a skull having so simian a jaw was too great an outrage to credulity, and they rebelled, with justice. Two camps formed almost at once, one being predominantly British and the other mainly American. Sir Arthur Smith Woodward, Sir Arthur Keith, and Sir Grafton Elliot Smith downed any qualms they might have had, and each proceeded to make a reconstruction reconciling jaw and skull. In America, however, Gerrit Miller named the jaw *Pan vetus,* thus making it a species of chimpanzee, and Dr. Gregory for a brief interval agreed with him, and in his important study of the paleontology of the Primates described the

[4]For excellent descriptions of the bones and of the controversy, see W. K. Gregory, "The Dawn Man of Piltdown, England," *The Journal of the American Museum of Natural History,* vol. 14, 1914; Gerrit S. Miller, Jr., "The Controversy Over Human 'Missing Links,'" *Smithsonian Institution, Annual Report for 1928,* 1929; A. Hrdlička, "The Skeletal Remains of Early Man," *Smithsonian Miscellaneous Collections,* vol. 83, 1930.

jaw as an ape's, separately from the skull, which he assigned to Homo sapiens. Dr. Osborn, Dr. Hrdlička, and Dr. Matthew supported this point of view and there was, and is, much to be said for it.

Quite apart from the disharmony between the two parts in their anatomical nature, the jaw is rather light in comparison with the vault fragments, the reverse of what might be expected. Further, the socket for the jaw joint (*glenoid fossa*) is to be seen on the skull, but the corresponding condyle, or upper tip on the jaw itself, is most unfortunately broken off; were it present, the whole matter might be settled by whether the joint matched the socket or not. Finally, all the pieces rested in a stream-laid deposit, and their exact relations, from the manner of their recovery, will never be known.

Granting all this, said the Englishmen, the fact remained that the jaw was found in place, near one undisturbed piece of the skull and in the midst of where the others must have lain. Besides, no other trace of a fossil ape has ever been found in England, yet here, as Keith says, we would have to suppose that a somewhat primitive man lay cheek by jowl with a somewhat man-like chimpanzee, both of them in a bed which was poor in fossils of all animals anyhow. Notice also that there is no duplication of parts, always a weighty argument with paleontologists. If there were the slightest overlapping, with the same fraction of the skull represented twice, then it would be clear that remains of two individuals were present. But, although there was found the better part of a whole skull and jaw, no point is duplicated, and there is no sign of the brain case of the supposed ape, nor of the jaw of a fully human man.

The position of the American conservatives was founded not so much on these facts as on the feeling of several wise and deeply experienced morphologists that Piltdown Man represented a greater illogicality than they had ever seen in their work; that it almost looked like a sort of immorality in nature. But the English liberals seem to have had slightly the best of it. What swung the argument to their side in the end was consideration of the 1915 finds. Remember that here, two miles from the pit, were found a molar tooth identical with those in the jaw, and a piece of the back of the head and the forehead unmistakably like the first skull; in other words, a second individual with precisely the same

ape-human mixture as the first one.[5] Elliot Smith summed up the meaning of this by remarking that Nature might have planted such a booby trap once, but surely not twice, and Professors Gregory and Osborn changed their opinions and reached the same conclusion. Since then, I should say, Eoanthropus has been accepted by a clear majority although Hrdlička, one of whose great contributions to the science was a fierce capacity for doubt, remained a doubter.[6]

But I should not say that Piltdown's passport is good everywhere, for the argument still goes on. In the last few years I have read a strong argument for removing the jaw from the skull,[7] and at least two of my friends are no friends of Eoanthropus, so that it remains an important question. It partly depends, of course, on what your own credulity will stand. Mine winces at the notion of ape and man incongruously mixed in a single animal, but it wilts entirely at the idea of their being mixed by chance, twice over, in the Piltdown gravel. I prefer to recall Hooton's remarks on the asymmetry of evolution.

The Size of the Brain

The other Piltdown controversy is an entirely different matter and took for its theme not the jaw but the skull, having to do with the size of the brain. I have said that there was never a question of the marked humanity of the shape of the forehead, the occiput, and the ear region. But at no point, except in one dubious instance, did any of the four fragments touch each other and fit, so that to determine their proper relations to one another and to make a restoration of the vault which would reveal its proper size was a ticklish job. Smith Woodward, on the discovery of most of the skull in 1912, made the first reconstruction and estimated from it a brain volume of 1,070 cubic centimeters which, as the reader will realize, is very low and is in the range of Sinanthropus. Nevertheless, this seemed suitable, because of the jaw. The next year,

[5]So entirely was the new molar like the first ones that Hrdlička suggested that there might have been a mistake in the records, and that it might have come from the gravel pit instead.

[6]A. Hrdlička, "The Skeletal Remains of Early Man," *Smithsonian Miscellaneous Collections*, vol. 83, 1930.

[7]A. T. Marston, "The Case for the Piltdown Jaw," *Discovery*, vol. 18, 1937.

however, Keith, examining Smith Woodward's effort, was struck by a lack of balance in some details of the rear portion, and set about a restoration of his own. Now when seen from above, the broken right and left portions of the skullcap follow each other's outlines down the middle, something like the maps of Africa and South America, but they do not fit, and so a gap between them must be left. Widening this gap, and so opening out the top of the skull, will change the apparent size of the latter considerably. Smith Woodward had so arranged the larger left-hand portion that it crossed over the middle line and invaded the right side of the vault. But Keith could find on this bone no sign of the mid-line, which is usually visible as a crest on the inside. Therefore, thought Keith, the whole left portion should be moved back again beyond the mid-line of the restored skull, and he found that when he did this the irregularities in the occiput, to which he had objected, disappeared. Therefore, he brought forth his version of the skull, with a brain size of 1,500 cubic centimeters. Now the consensus of opinion was that the Piltdown skull was female, and a figure of 1,500 is well above the average for European women today.

The anatomists were somewhat taken aback to find that two qualified experts could reach such different ends, and began to voice doubt as to whether any valid reconstruction could be made from four such ill-fitting fragments as the remains of the Piltdown brain case. As a friendly challenge, they cut four similar pieces from a modern skull whose brain size they had carefully measured, presented them to Keith, and asked him to try to restore them. He did so and came out with a triumphantly accurate result in almost every way, which gave a capacity differing from the true one by only twenty cubic centimeters, which we consider a negligible error. Naturally, Keith's stock soared out of sight; nevertheless, what he had learned by the experiment caused him to scale down his Piltdown estimate to about 1,400 cubic centimeters, which still is more than the present average female size.

Smith Woodward had revised his own estimate also, increasing it to about 1,300 cubic centimeters, and others followed him, so that there was much less of a gap than formerly. Finally, in 1939, twenty-five years later, Keith published a new study of the Piltdown skull, occasioned by the discovery of the Swanscombe skull,

of which more later.[8] This brought some refinements on his older restoration and a final judgment of brain volume, which he set at 1,358 cubic centimeters. This is just about at the mean for modern women, but in the interim Keith has come to think that the sex of the skull was male after all. Even so, a large proportion of living men have smaller brains. So the person from Piltdown, be it of either sex, had a brain of modern size to go with its modern skull.

The Antiquity of Piltdown Man

The age of the Piltdown remains is not clear, though it is considerable, without any doubt. The deposit in which they were found was shallow, being the lower of two layers of gravel and a little more than four feet below the surface. Of the few animals therein, some seem to be Pliocene (e.g., a mastodon tooth), but these fossils are waterworn, which the skull parts were not, and may have been washed in from some older deposit which was torn up by the water. Apparently from just below the skull there came a flat, pointed club, man-made from the bone of an ancient type of elephant (*meridionalis*). All through the gravels there were implements of an early Lower Paleolithic type, but students do not like to assign dates from these crudest tools. Apart from a few who thought that the date of the find was Pliocene, the general belief at the time was that it was early Pleistocene, and close to the beginning of the period. At the present, however, there is more of a tendency to put the time at early second interglacial (Middle Pleistocene). The gravels themselves are part of a plateau that seems to be connected with the 100-foot terrace of the Thames, and that is the date which is generally given to this terrace. It is not likely, at any rate, that the Piltdown skull is any younger.

More apparent to the reader will be the significance of the skull. Living in England at roughly the same time (if the dates are correct) as the Java and Pekin species was a man vastly unlike either of them. His jaw, far more primitive than the Pekin Man's, was also very different from the robust mandible of Pithecanthropus,

[8] Sir A. Keith, "A Resurvey of the Anatomical Features of the Piltdown Skull with Some Observations on the Recently Discovered Swanscombe Skull," *Journal of Anatomy*, vol. 63, 1938, 1939.

being slenderer and chimp-like, with a simian shelf. On the other hand, even at this early stage his brain had reached, or nearly reached, the modern level, while the easterners were struggling along with a much smaller supply housed in a much more primitive case. The place of Eoanthropus in the scheme of ancient man I will discuss later, but I can say that he has scotched more attempts to draw up a family tree for man than all the other fossils put together.

CHAPTER XIII

The Neanderthals

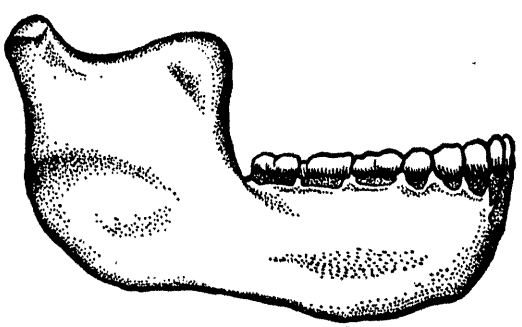
We come now to a fossil family line of great importance, that of Neanderthal Man. Excepting for our own species, his is the one most thoroughly known to us. It is also the only one which can be traced over a large territory and, according to the beliefs of many, through a great span of time. For if the Heidelberg jaw is correctly taken as its first appearance in the fossil archives, the Neanderthal succession of Europe left remains which run almost from one end of the Pleistocene to the other.

The Heidelberg Jaw

Heidelberg Man's discovery is yet another story of a relentless search and an implacable conviction. He was found because he lay in the sphere of interest of Dr. Otto Schoetensack of the University of Heidelberg. About seven miles away from Heidelberg, at the village of Mauer, a huge sand pit had been dug against the side of a valley, the banks of which had been built up by a long succession of Pleistocene deposits of clay, sand, and gravel. Cut vertically to a great height, this fine ladder of strata, with the fossil animals that came out of it, was more beautiful to the eye of a geologist than a garden of flowers, and Dr. Schoetensack was one of the professorial bees who buzzed around it. He felt certain that somewhere in the face of the vast exposure the remains of man would sooner or later come to light, and he infected the owner of the pit with the same feeling. It finally happened: a big human jaw, quite by itself, was found in the sand, well down at the base of the pit and nearly eighty feet below the surface of the ground. This was in 1907, after Schoetensack had been looking and waiting for twenty long years. But the Heidelberg Man himself could hardly have been impatient at the delay, because he had lain there for nearly a million.

There were no worked flints in the deposits to make it clear what sort of culture went with the type. Furthermore, the study of glacial geology is a most difficult science, and in spite of the labors of several generations of brilliant men there are still grounds on which to argue the correct placing of the gravel beds or terraces, considered by themselves, of any particular valley; and the bed containing the jaw has not been unequivocally fixed in this manner. It is the plentiful animals of the same level which become the important evidence. Containing bears, lions, cats, deer, elk, bison, a Pliocene and a modern horse, and a straight-tusked elephant, it is a group which elsewhere is known to follow directly after that which prevailed at the end of the Pliocene, and which must, therefore, belong to the first interglacial. This means that, as things stand now, the Heidelberg jaw is with one exception the oldest known fossil of man in point of time, whether or not it is the most primitive. None of the others is given a date earlier than second glacial or interglacial, aside from the Modjokerto child of Java.

This jaw is intact and well preserved, and has all of its teeth in a condition of only moderate wear. Its striking character comes from its huge size and its ape-like appearance. It is about as big



THE HEIDELBERG JAW

as that of a female orang, and enormously broad in the upright blade, which underlies the back part of your cheek, with a correspondingly heavy lower portion. In shape, however, it is deep and broad as in a gibbon, and not so long and projecting as in the other apes or as in Piltdown Man, to which it bears no likeness in its nature. It is sloping and has no chin in front; on the other hand, it has nothing of a simian shelf behind. In this same inner

region it has as another anthropoid feature a pit, in place of the "genial tubercles" which are the human form of attachment of the tongue muscles and which appear in rudimentary form in Pekin Man. It is altogether much more primitive than the Sinanthropus jaw, and only that of Pithecanthropus might be compared with it; and even though it lacks a simian shelf it might be taken for the jaw of an ape.

But the teeth are definitely human—another paradox which is one of the important features. Though not small, they are not in proportion with the jawbone. They are human in character as well, and it is not certain that, taken apart from the jaw, one could be sure that they did not belong to a robust specimen of living man. Their upper surfaces are worn flat. The canines are fully reduced in size and are ground level with the others. And the molars are of human proportions, with the hindmost being somewhat the smallest. Finally, the arch of the teeth is wide and broadened out behind; and if it has any primitive character at all, it is that the front of this arch is squarish rather than being rounded.

One peculiarity of the molars is that the innermost part of the tooth, the pulp cavity, is deep and extends down into the roots, which are fused into a sort of stump rather than being long and separate. This is a condition found neither in apes nor in modern man, and Keith has named it "taurodont" and given it considerable importance, though others are not so fully convinced of its singularity. At any rate, it is characteristic of the members of the Neanderthal clan and leads us into the other resemblances to the group which the Heidelberg mandible bears. These are mainly in the teeth which, while they would be exceptional in a modern man, are distinct in no way from those of the Neanderthals. The jaw itself is far more advanced among the latter, but there are some likenesses, and there are no features on either side which would disallow the idea of a distant relationship. It has always been considered likely that Heidelberg Man was a crude parental form of the Neanderthals, and Keith is convinced upon the point. As a working hypothesis it seems acceptable. It is, of course, not safe to conjecture what the rest of the Heidelberg skull might have been like. The scandalous mixture in Piltdown Man should be a warning for all time.

The Neanderthals in Time and Space

Away at the other end of the time span of the fossil men, in the fourth glacial advance, lie the Neanderthals themselves. We may call them the classic Neanderthals, or the cave Neanderthals, of Europe, and in spite of the large number of their remains there is about them a certain semblance of unity. And they meet the anthropologist halfway in his researches, because they buried their dead in the cave floors, bless them, and with an eye on the life everlasting they supplied the departed with tools of stone. There was thus religion among them, and not a matter of individual conceptions either, but an organized cult, for in one of the Neanderthal caves was found a row of cave bear skulls, plainly serving as a shrine, in a manner recalling practices of Menomini Indians or Ainus of Japan at the present day. Consider this and the excellence of their stoneworking, which was as good as anything which had yet been achieved, and let us grant them the power of speech at once, without waiting to look at their skulls.

This is our first experience of burial (all the other bones which we have encountered lay in the bed of a stream or a lake except those of Sinanthropus, whose cave was a sort of charnel house) and it gives us an unbreakable connection between the stone culture and the men who made it. Remember that the Choukoutien cave held no such assurance, leaving it possible to suggest that the Pekin men were not the true proprietors of either the cave or the culture. But the culture found with Neanderthal remains in caves has always been late Mousterian, and, vice versa, skeletons found with that culture have always been Neanderthal. This Mousterian industry was marked by skillful edging and retouching of short but well-made flakes, and in Europe[1] it constituted the last phase of the Lower Paleolithic, being found (as are the skeletons) directly below the earliest remains of an Upper Paleolithic type in those caves where there was later occupation. We are, in short, meeting for the first time a fossil type of man about whose date there is no question. The Neanderthals of the caves flourished at the very end of the Lower Paleolithic, living on the cold-weather animals of the time during which the fourth and last glacier was making its advance and reaching its peak.

[1]Elsewhere Mousterian work does not appear as a definite period, occurring more as an independent industry possibly contemporaneous with others.

The distribution of Mousterian culture makes it appear that western Europe, at least, was occupied by Neanderthal Man alone during this period. Finds of the bones themselves have been made in perhaps an even more generous territory, and they began to come to light, as we have seen, well back in the nineteenth century. Before that century ended, important specimens had been found on Gibraltar, in the gorge of Neander near Düsseldorf, in Belgium (the Spy cave), and at Krapina in Yugoslavia. From 1908 to 1912 several more or less complete skeletons were uncovered at various rock shelters in southern France, in the Dordogne. These were the richest and most satisfactory finds of all, at La Quina, La Ferrassie, La Chapelle-aux-Saints, and Le Moustier. Since then Neanderthal Man has been found further afield, in Malta and in Palestine, and in recent years in Russia, in Italy (Monte Circeo), and in North Africa. Although taurodont teeth have come from the island of Jersey, no skeletal parts have been found in the British Isles, in spite of the occurrence there of Mousterian cultural remains.

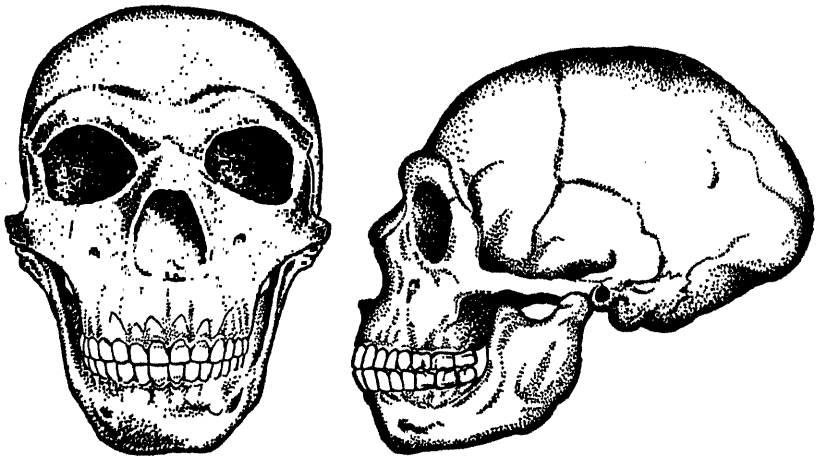
From this we see that, largely because they buried their dead and partly because they were living in Europe in relatively recent times (perhaps 100,000 B.C. to 50,000 B.C.), we have altogether a considerable number of skulls and skeletons of the Neanderthals (more than of every other species, except our own, combined), so that we know far more about this type than any other. We can even strike averages for brain or head size. And one thing of interest appears: the Gibraltar skull differs slightly in type from the French and Belgian specimens, as do also the Krapina (Yugoslavia) remains, which seems to mean that the cave Neanderthals, like ourselves, were divided into several races. The differences are not great, however, being less than this may sound, and the whole group was actually rather homogeneous. Says Morant: "Detailed anatomy and general conformation of the skulls suggest that the population was hardly more variable than a single race of modern man."[2]

The Type of the Neanderthal Men

The Neanderthal brain was most positively and definitely not smaller than our own; indeed, and this is rather a bitter pill, it

[2] G. M. Morant, "Studies of Paleolithic Man. II A Biometric Study of Neanderthaloid Skulls and of Their Relationships to Modern Racial Types," *Annals of Eugenics*, vol. 2, 1927. Hrdlička, however, strongly disagrees with this view that the Neanderthal material is homogeneous.

appears to have been perhaps a little larger. The middle-aged man of La Chapelle-aux-Saints had a brain whose volume was about 1,625 cubic centimeters, which is a figure that only a fraction of modern European men can match, and others of the ilk are over our average, though not all of them, the Gibraltar woman's skull being small. I repeat that the shape of a brain, as it is restored by



THE SKULL OF NEANDERTHAL MAN
(*La Chapelle-aux-Saints* specimen)

a cast of the inside of a skull, will not tell you with any precision what the quality of the brain was, and so we cannot use this kind of evidence in deciding, between us and the Neanderthals, who is the better man. We can, however, say that there was nothing retarded about Mousterian culture and technical ability, seen against its Lower Paleolithic setting. In sum, there are no signs whatever to indicate that the Neanderthals were our inferiors in intelligence, and at that this may be a statement which is more flattering to us than to them.

A skull of the Neanderthals has a characteristic and striking form. It is huge and thick. It considerably exceeds that of any modern type both in length and in breadth (although some of this is due to the thickness of the bone and the heavy brows), and it is particularly broad behind the ears; on the other hand, it falls short of ours in height. Beside it, our type of cranium looks high and

narrow. Its whole appearance is one of being flattened from above, with some compensation in being very broad, but more in being greatly pulled out and extended both in the back and in the front to give it a great length. The back of the head protrudes so much as to have almost a pointed look, and this is probably connected with the balance of the skull, for the long back seems to be a counterpoise to the long front and the face. Even so, it is clear that the Neanderthal head was not balanced like ours, but hung forward in a distinctly primitive fashion.

Our *foramen magnum,* as I have said before, faces directly down, or even slightly forward, while that of the Neanderthal faces a little to the back; and the muscles under the protruding occiput were large and strong to support the hanging head. (The mastoid processes, another indicator of head balance, are small.) The types of the modern and the Mousterian neck are those of a swan and a bull respectively. Nor is this something which we have to infer from the back of the skull alone (though I have shown that it could be done), for Neanderthal neck bones have been recovered. Not only do they show that this part of the spine tilted forward, instead of slightly back as in ourselves, but also the strength and straightness of the spinous processes, which stand out at the back of the neck vertebrae (and which are sloping and degenerate in modern man), give the key to the heavy development of the muscles leading up to the back of the head.

The face and the fore part of the head are as ponderous as this supporting equipment would imply. With all his brain, Neanderthal Man had little enough in the way of a forehead, and the front of it was embellished with a double-arched brow ridge, shaped rather like the upper rims and nose part of a pair of spectacles and of even thickness all the way across, though lighter in weight than that which overhung the eyes of the Pekin and Java men. It is a form which is especially characteristic. The face itself was very big, outdoing that of Homo sapiens to the same degree as the brain case, both in length and in width. The nose likewise appears to have been immense, with something of a bridge. But, although rather chinless and large in the mouth, this face did not project—was not "prognathous"—in the particular way which we think of as being primitive, which would be to slope forward from the root of the nose to the gum, as in an ape. The face projected, and markedly, but in another way: corresponding to the forward

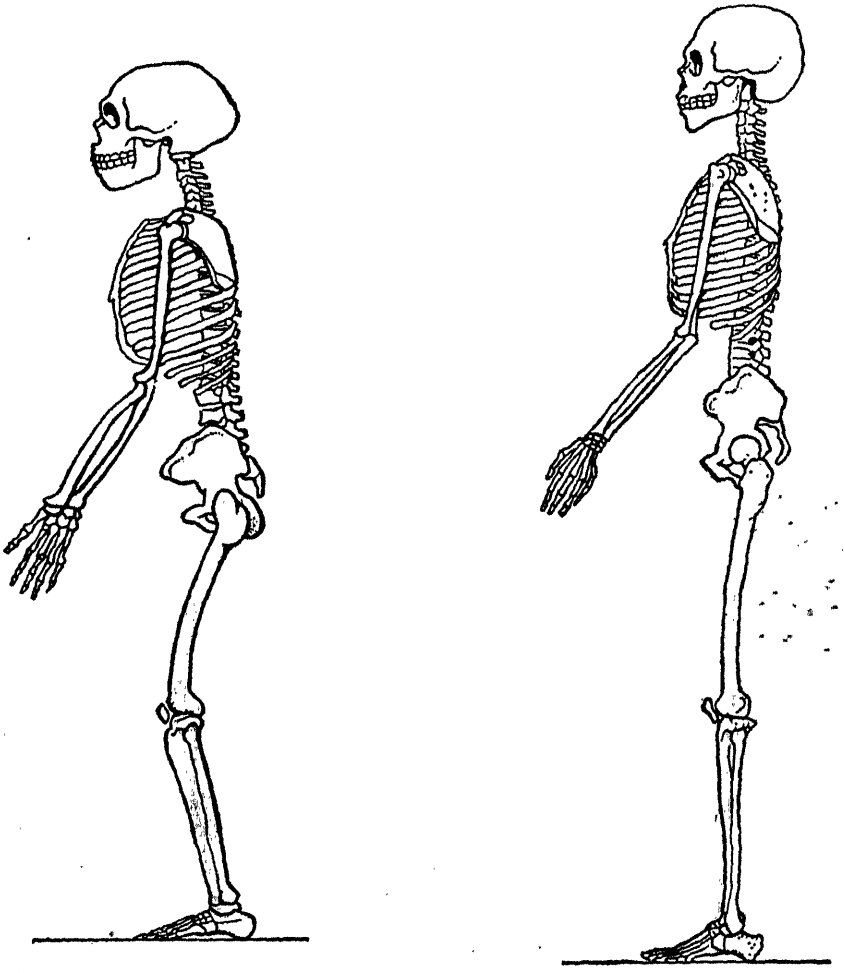
extension of the skull, the face as a whole was set far out on the skull rather than being pulled in underneath it, so much that the distance from the base of the skull to the root of the nose (just below the forehead) was a third again as long as in ourselves—a difference which in a man so much like us is impressive. Therefore, the Neanderthal face has a look of being puffed out around the nose, contrasting with our own flat cheeks, and the cheekbones slope back more sharply, and are not angular or "high" like ours. Thus it is altogether a face which looks quite different from that of the Java and Pekin men as well as from our own. This is bone structure, of course; were it dressed in flesh and put in the police line-up there is no telling what the effect might be. It is my guess, however, that it would appear far more brutish than that of any normal living man.

The mouth was one of generous size. The teeth were robust and somewhat larger than ours, but not more primitive. The molars were "taurodont." The palate or dental arch was broad, being smoothly rounded in the outline of the front, or top, of the arch and having straight and parallel sides in the region of the cheek teeth. This differs both from ours, in which the outline is slightly flatter in front and diverges toward the back like a V, and from the apes, who have a long, narrow U, instead of a short, broad one, with a flat front and with strongly marked angles at the canine teeth. The chin, finally, was receding, and was not built out into a point in front, but, on the other hand, it was not sloping and rounded as in a creature like the Piltdown Man.

The Mousterian people are almost the only fossil men who have left us any skeleton bones, and these create a vision of a squat, heavily built physique of great strength, but one in which the carriage of all parts of the body was in sympathy with that of the head. In other words, if a Neanderthal Man could be brought to life by some kind of a funny-paper magic ray, he would go to the foot of any posture class in the nation, but he would, notwithstanding, be a dangerous person to face in a wrestling match.

The Neanderthal men probably stood just over five feet, and the women just under. The bones were thick and heavy, and the joints were large. The shoulders were broad, but the chest was barrel-shaped. He had little of a lumbar curve in the spine and this, together with his bowed thighbones and the form of his knee joints, indicates that he stood and walked with a slumpy, round-

backed, bent-kneed stance and that he could not have stood at attention to the satisfaction of a drill sergeant if he had tried. As to his feet, they were less fully evolved than ours in various ways. They were human feet in form, and his big toe was not separated



SKELETONS OF NEANDERTHAL MAN AND HOMO SAPIENS

from the rest, according to Dr. Dudley Morton[8], but they were flatter, and he walked, from the nature of his heel bone, more on the outside of his foot. In all of this recital of his skeletal distinctions Neanderthal Man recalls the anthropoids and is certainly

[8]D. J. Morton, "Significant Characteristics of the Neanderthal Foot," *The Journal of the American Museum of Natural History*, vol. 26, 1926.

more primitive than we are. But there is one feature to which this does not apply: his lower leg and his forearm were relatively short, which is the opposite of ape-like, and which is a special character of his own. However, where the two bones of our lower arm (radius and ulna) are straight and slender, his were bowed outward from each other in their mid sections, which means, for one thing, that they accommodated powerful muscles. Other details of the muscle attachments indicate this also, but it is thought that these muscles were not so refined or differentiated as ours, leaving his fingers less adapted to delicate or skillful work.

It is not hard to catch a likeness of the general character of these European Mousterians. Offhand, they seem to be a type which had evolved along the direct line from ape to man without getting as far as Homo sapiens; one which is a little distance back along the track of refinement of the skeleton which came about through straightening of the leg and neck and lightening of the bone. Unlike the distorted Piltdown remains, it is the sort of early man who was expected by the evolutionists, being ape-like to an equal degree in all its features. Nevertheless, it had a brain which had progressed as far as ours. Seen another way, Neanderthal Man might look like an ancestor who could have begotten Homo sapiens, if you can swallow the very distinct difference between his low, spread-out skull, already full size, and our own high and narrow cranium. The difficulty with these simplified views is that he possesses features which are specialized and which are not primitive. Taurodont teeth are one such, though many people are not impressed by them. Since we do not have these teeth, then one would suppose that our ancestor did not have them, and that our ancestor, therefore, is not Neanderthal Man, who in this respect is specialized and possibly advanced. The same applies to the short forearm. This small problem becomes greater when other fossil men are remembered. One example will suffice: Pekin Man, so primitive in his skull, had leg bones already more advanced and like ours than were the Neanderthal Man's, according to Dr. Weidenreich.[4] This is an extraordinary fact.

Varieties and Problems

So far our Neanderthal Man has a well-defined character. We

[4] F. Weidenreich, "The Extremity Bones of Sinanthropus Pekinensis," *Paleontologica Sinica*, New Series D, no. 5, 1941.

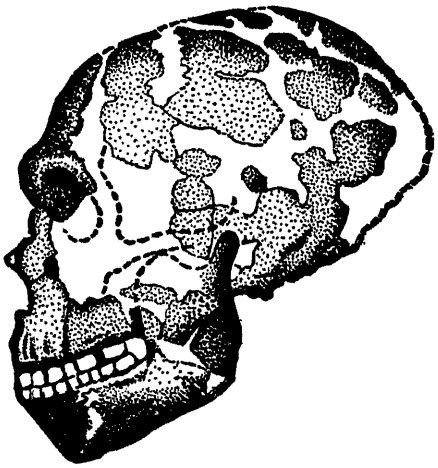
have seen how, if Mr. Dawson had stuck to the practice of law and left Pandora Piltdown where she lay, the picture of ancient man would seem clearer than it does. In the same way, if we had only those fossils of a Neanderthaloid nature which I have described, it would look as though we had isolated a clear-cut bit of history; as though we could imagine a type slowly evolving from that of Heidelberg in the first interglacial to that of the late Mousterian Neanderthals of Europe in the fourth glacial period. Unfortunately for this restful notion there have been found certain Neanderthaloid remains which are earlier than those of the caves but which refuse to be crowded into their expected places in such a line of development. They all appear to belong in the third interglacial, and the principal specimens are those of Ehringsdorf, Steinheim, and Tabun.

At Ehringsdorf, just outside of Weimar in Germany, there have been found a skull and two jaws. The skull, seemingly a young woman's, is Neanderthal in all its characteristics, except that its whole roof is higher, with more of a forehead, housing a brain with the large size of some 1,450 cubic centimeters. In spite of the thorough resemblance to the other Neanderthals, the higher, fuller vault is enough to make Dr. Weidenreich look on the skull as something transitional to our own type, and this, in view of its early date, is an odd thing. One of the jaws, a child's, might fit the skull if it were of adult size and development, but it has a very wide upright branch, in the manner of the Heidelberg mandible. The second jaw, on the contrary, from an adult woman, is long and narrow. This one disagrees with the type of the skull; it is more ape-like and primitive than the other Neanderthals, but instead of pointing back toward the Heidelberg mandible, it is rather more like that of the Piltdown skull.

The somewhat broken and distorted cranium of a young woman found at Steinheim, Germany, is also of a clear Neanderthal type without being entirely like the classic Neanderthals of later date. Yet while it was thus like the Ehringsdorf specimen, it differed from it in character. This girl had a small brain, of only 1,070 cubic centimeters, but in some ways she was actually rather advanced, and like us, in spite of being earlier in time than the other Neanderthals. She had more of a retracted face, a narrower head, and a more rounded back and neck region. The importance of the Steinheim skull is that it seems unquestionably to belong to the

Neanderthal family, but lacks at the same time some of the very things which do so much to give the cave Neanderthals their particular flavor.

The same is true of a skeleton from the cave named et-Tabun (The Oven) in Palestine. On the slopes of Mount Carmel in 1931 and 1932 a British-American expedition dug out this cave and its companion, Mugharet es-Skhul (Cave of the Kids). Both of them yielded implements which were of an early and middle Mousterian, and thus are probably of third interglacial date. They also yielded the most peculiarly heterogeneous lot of human beings who have ever been suspected of belonging to a single community. In the Skhul cave were several skeletons of tall, straight-limbed men who were faintly Neanderthaloid in some respects but otherwise almost like ourselves. These I must save until later. The skeleton of the woman of Tabun, on the other hand, was like the Steinheim girl



SKULL OF THE WOMAN OF ET TABUN
(After T. D. McCown, Bulletin of the American School of Prehistoric Research)

in that it was fundamentally Neanderthal, but had, at the same time, features more primitive and less specialized than the European Mousterians, together with some other features which were more like modern man. The natural supposition about the Neanderthals of the caves is that they rose from some more generalized and primitive form, which was possibly more like the Heidelberg Man, but these two young females, especially the Steinheim skull, do much to confound it.

The niceties of Neanderthal anatomy, with which we have been grappling, are hardly a subject for bathtub reading, though indeed I have barely scratched the surface. The Neanderthals are of incomparable importance to the question of our own past, even though anthropologists are to a great extent still up in the air over their significance. The problem of their origin remains obscure: it is hard to see how such different fossils as the Heidelberg and Ehringsdorf jaws, to say nothing of the Steinheim and Ehringsdorf skulls, can all be considered as ancestors of the well-known type of the caves. Still more important is the problem of their relation to our own species. In Neanderthal Man (Homo neanderthalensis) we see an advanced member of the Hominidae, whose brain and whose culture need not be pitied by Homo sapiens. Yet he was clearly different, and primitive in body structure. The great question is: how near should we gather him to ourselves, or how far away should we put him? Does he resemble us for the reason that the two of us are closely connected—that he represents a sort of last step in evolution before our own type grew out of his? If that is so, why is our head, which is no bigger than his, so different in form? Or does he resemble us because both species have responded to the same evolutionary tendencies to have large brains and shortened jaws, even though we and he have led separate developments for ages?

CHAPTER XIV

Other Members of the Genus Homo

LATE IN 1921 there arrived at the South Kensington Museum in London, as a present from a Rhodesian mining company, the remarkable skull from Broken Hill. Its story up to that point has been told several different ways, but Dr. Hrdlička, by paying a special visit to the mine where it was found, managed to clear up a good deal of the confusion.[1]

The original "Broken Hill," for which the town is named, stood on the borders of the Lake region in northern Rhodesia, being a hill or kopje about fifty feet high which was like a pyramid with the top half cut off. It was formed of limestone and it had caves and crevices in it. One of these caves, starting from either the side or the top, slanted steeply down beneath the center until it was ninety feet below the ground surface (one hundred and forty below the top of the hill), and here it was that the skull was found. This cave was filled up through most or all of its length (its opening was never actually observed) with animal bones and other debris, some of this material soft and some compacted, and all of it, like the limestone of the hill, was heavily impregnated with the salts of lead, zinc, and vanadium. Bones, hill, and all, therefore, were being tunneled and cut away from several directions and smelted down. There is now only a great crater where the hill once stood, and this is why one cannot go back and examine the place where the skull was discovered.

According to differing first press reports, various heroes happened to be on the scene in the nick of time to prevent the invaluable relic and some other bones, all of which had just been blasted loose from their resting places with dynamite, from making the trip to the smelter. Another story had it that the entire body of this ancient man was uncovered in place, beautifully preserved even to the skin because of the zinc salts percolating through the ground,

[1] A. Hrdlička, "The Rhodesian Man," *American Journal of Physical Anthropology*, vol. 9, 1926.

and that the workers considered it worth more as ore than as a curiosity, and so saved only the skull and a few bones, breaking up the rest of it for the furnace. Were it true, this would be a story to cause mass suicides in the exasperated ranks of anthropology. It probably grew from the fact that in the vicinity of the skull there was found a large piece of rich, laminated ore of natural formation, having roughly the form of a loosely rolled or bunched-up blanket. There was nothing inside it. What actually seems to have happened is that a Swiss miner and a Negro boy helper were cutting down a face of moderately soft ore with picks, and saw the skull while it was still in place. There was no jaw nor anything else immediately connected with it, though a few leg bones were found in the vicinity, one being near by and above. The miner took the skull out carefully and carried it to the mine office. That is all there is. What went to London was the skull, several leg bones from at least two individuals, and parts of a pelvis.

The Rhodesian Man plainly was not buried. It is also not likely that this lower part of the long cave was ever lived in. It is probable that the long incline was used to throw refuse down, however, and this might explain not only the large numbers of animal bones found in the fill of the cave but also the position of the skull. It is also conceivable that the latter was left by an animal, as there are marks on it which one student thought to be those of an animal's teeth. But whatever the case may be, there seems to be no way of reading the date of the find. There was no stratification within the cave, as far as is known, and the animals of the region were more or less constant and unchanging throughout the Pleistocene, so that the bones from the cave tell no secrets. But the filling of this long fissure, with the skull at the bottom, must have taken a respectable interval of time, and according to one geologist the fill material showed signs of successive damp and dry periods; still, however, this does not promise us that the skull derives from an early part of the Pleistocene. It is a pure stray, both in type and in time. But Hooton does it justice in saying that it would be important even if it had turned up in an ashcan.

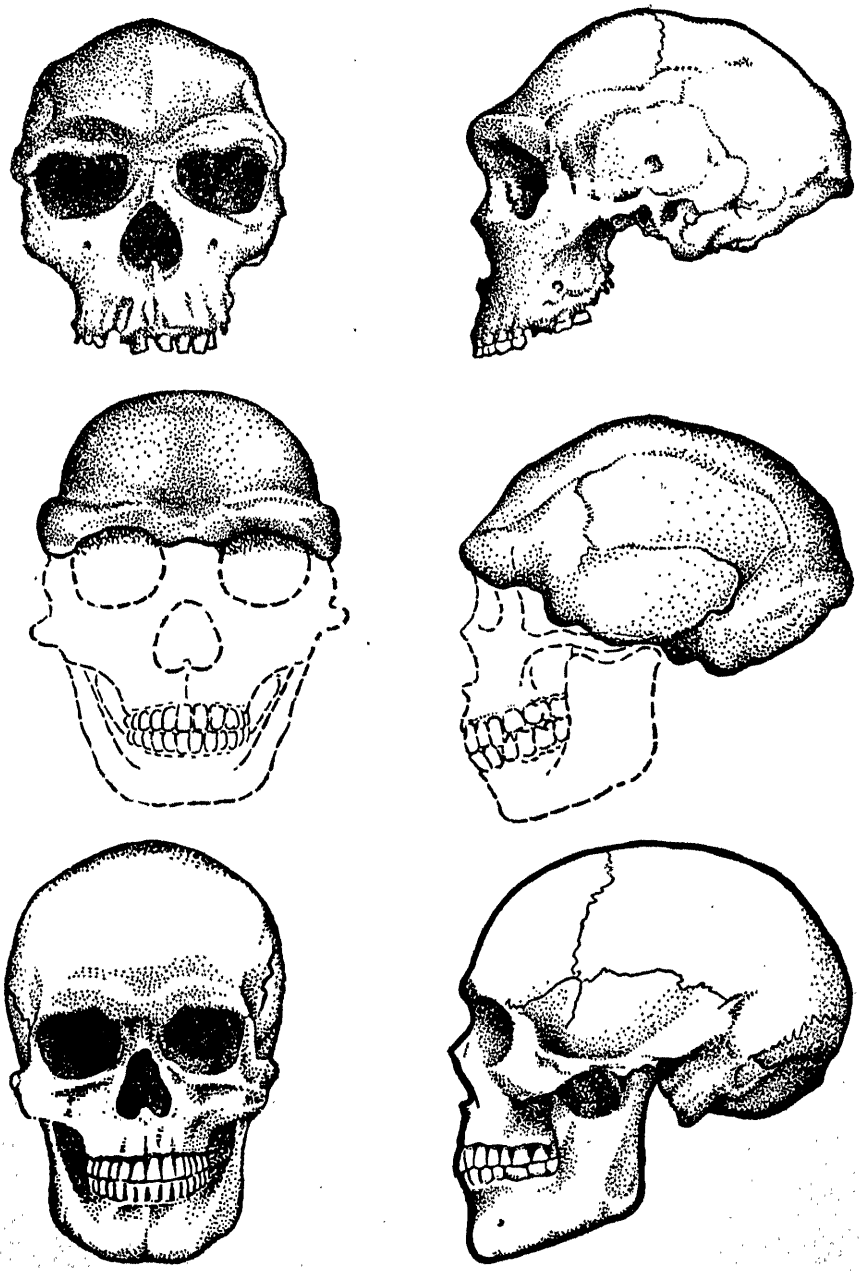
Type of the Rhodesian Skull

At first glance Rhodesian Man looks like a Neanderthal, and he was, at any rate, a man of about the same stage of development. He

had the same long, low skull of considerable thickness, the same heavy brows, the same big eyes and nose set in a face which is thrust well forward and really colossal in size (the upper part alone was nearly an inch longer than yours, which is considerable, in view of the fact that the probable figure for your upper face is under three inches). But in spite of this similar character, most people find that he differs too greatly in detail to be placed within the ranks of the Neanderthals. There is not much difference in the vault: if anything, Rhodesian Man had a lower forehead and crown. His brain was smaller (in this specimen, at least), measuring something like 1,300 to 1,350 cubic centimeters—about as far under our average as the La Chapelle man was over it. Seen from above, the outline of the head is different: the Neanderthals had a most characteristic shape, with the greatest breadth very far back, which is not true of Rhodesian Man, who also had a narrow forehead more like ours. Furthermore, while his brows were the biggest ever seen in a human skull, rivaling or exceeding a gorilla's, these also had a different form from that of Neanderthal Man, lacking the evenly swollen arches of the latter, and being particularly thick at the outer corners.

But it is in the mouth that Rhodesian Man had his principal special characters. His palate, like his face, was huge, being comparable only to that which the Heidelberg Man must have had, or Pithecanthropus. Yet the dental arch had a shape which, while broad, was like that of Homo sapiens, and not like Neanderthal, being horseshoe-shaped—parabolic, but with the ends drawn in. Here we have, then, a man with a human sort of mouth combined with a low cranium with immense brow ridges—a contrast with the Piltdown skull to which Hooton has drawn attention: "Asymmetry of evolution."

Little can be made out from his teeth. They were big, but they were broad, and in no wise like Neanderthal teeth; and the third molars were distinctly reduced in size—an advanced character. All are greatly worn and only five of them could be called healthy: one is lost and the other ten were all in various stages of decay. He really had a dangerous condition in his mouth, and he must have suffered horribly from toothache. This leads to one more accidental detail of interest about the skull: it has two small holes on the left side, one clean through the wall just above the ear, and another cutting along the back wall of the ear opening itself. From



THE SKULLS OF RHODESIAN MAN (*top*), SOLO MAN (*center*), AND HOMO SAPIENS (*bottom*)

certain markings taken to be pus tracks Keith and others believed that these were inflammatory injuries, possibly connected with abscessed teeth. Mollison, however, suggested that the holes were punctures wrought by the teeth of a beast of prey; but it is a little hard to see how an animal with two fangs so close together could bite the whole head, as would be necessary, or why the head was not more badly destroyed.

Students, and especially the English, have been inclined to accept the several bones of the skeleton as belonging with the skull. Hrdlička doubts that they do, however, and there is no clear indication: they were not found in association of a direct sort, and they represent at least two individuals. The best argument relating them to the skull is that one leg bone has rheumatic growths around the joint which might be connected with the septic condition of the teeth. And if the bones are not Rhodesian Man's, we are again called upon to imagine two different kinds of men in the same cave at the same time. Whoever they belong to, they give us a straight-limbed man, thoroughly erect and modern in body and standing about five feet ten inches. This could have been the Rhodesian Man, for the skull alone shows that it was poised erect. The markings of the neck muscles differ from the Neanderthal form and are lower on the head; the mastoid processes are large; and the *foramen magnum* is much further forward than in Neanderthal skulls, bespeaking a far higher degree of balance. It is one of the main distinctions between the two men. It is hardly possible to think of such an upright head combined with the bowed and muscle-bound posture of the Mousterian people, and so Rhodesian Man must have been possessed of a physique which was quite distinct and modern.

Solo Man

One final type, the Solo Man, brings us all the way back to Java again, and indeed to within a mere six miles of Trinil. Here, in 1931, in the banks of the same Solo River, at Ngandong, there were found the first of at least eleven skulls, all of them unfortunately lacking in faces, jaws, or teeth. The geological level in which they lay is the Ngandong "zone," which is the next one above the Trinil zone in which Pithecanthropus belongs, and its date is Upper Pleistocene, or, more specifically, third interglacial.

Apparently De Terra would carry it back through the third glacial (or "pluvial," in Java) as well. The authorities are none too definite on the point, but it will be safe to say from their estimates that the Solo men were roughly contemporaneous with the Neanderthals, being possibly as early as the earliest (like Steinheim), or as late as the latest. They had, furthermore, a culture, though little as yet is known about it.

These Solo skulls are also of about the same level of development as the Neanderthal and Rhodesian men. Like the Broken Hill skull, they are a little smaller than the Neanderthals in brain size (about 1,300 cubic centimeters), but, also like the Broken Hill skull, they are somewhat more advanced in some ways, as in having a large mastoid process and certain other progressive details of the ear region such as a deep glenoid fossa (or socket for the jaw joint). The brow ridges furnish still another resemblance to the Rhodesian specimen: they are rather straight across, and particularly thick at the outer corners, though by no means as large altogether. Certainly the skulls would never be mistaken for those of the classic Neanderthals, because they have a different outline from any point of view, and lack the exaggerated length. In details and to some degree in appearance, they are, as I have said, like the Broken Hill cranium, but it must be added that the brain case looks also like an expanded Pithecanthropus.

Only a shinbone has come to light along with the skulls. It is straight and slender, and not of the stumpy variety which characterized the Mousterians. And, as in the case of Rhodesian Man, the skulls themselves indicate a moderately upright posture of the neck and body, and the *foramen magnum* is further to the front than in the Neanderthals. Neanderthal Man is the only real slouch we have run across.

In this chapter we have reviewed two further kinds of man who were like the Neanderthals in general status and yet different in detail; and who were also practically modern in size of brain. The situation is well reflected in the scientific names which are generally given them. All of the above are put in the genus Homo, along with us. We are Homo sapiens, and they are Homo heidelbergensis, neanderthalensis, rhodesiensis, and soloensis[2] respectively. This

[2]Solo Man has also been called *Javanthropus*, which is unjustified, as it would put in a separate genus a type of man which is in many ways the closest one to us. Neanderthal Man has also been known as Homo mousteriensis.

recognizes their nearness to us, along with differences sufficient to put them in separate species, not only from ourselves but from each other. Many writers would draw these four species nearer together and make them all Neanderthal, in consonance with their common stage of development; but to others the distinctions between the Neanderthals proper and Rhodesian Man are far too pronounced to be slurred over in this manner. It would be stretching the idea of an animal species too far, even though there are a few aberrant Neanderthals. To my own mind the contrast that must have existed between the skeletons of the slumping Neanderthal and the upright Rhodesian is not to be lightly ignored.

Family Album of the Hominidae

I have laid before you the priceless relics of practically all those bygone kinds of men who were distinctly different from ourselves. Let us now take stock, by making an inventory of the family Hominidae as a whole. As matters stand, we might recognize the following genera and species (the first name, as in all Latin names for animals in the binomial system of Linnaeus, is the genus and the second is the species):

Pithecanthropus erectus	Trinil and Sangiran, Java
Pithecanthropus pekinensis (or Sinanthropus pekinensis)	Choukoutien, China
Africanthropus njaransensis	Lake Njara or Eyassi, East Africa
Eoanthropus dawsoni	Piltdown, Sussex, England
Homo heidelbergensis	Mauer, Germany
Homo neanderthalensis	All Europe, North Africa, Near East, Uzbekistan
Homo rhodesiensis	Broken Hill, northern Rhodesia
Homo soloensis	Ngandong, Java
Homo sapiens	

There are, really, three or perhaps four divisions.[3] The first is, of course, the primitive one, with the Java, Pekin and Eyassi men. Dr. Weidenreich calls them "prehominids"; Weinert calls them "ape-men" (Affenmensch), another apt term, and favors keeping the

[3] F. Weidenreich, "Some Problems Dealing with Ancient Man," *American Anthropologist*, new series, vol. 42, 1940.

root "anthropus" to use in the generic names of such lowly types. The second division is Piltdown, who gets a genus all by himself because of his jaw. Anyone who can think of something better to do with him will be doing science a service; we have just about given him up. The third is a somewhat more advanced and large-brained group, the genus Homo, of which one member species, the living one, might be set apart as having a thin skull, perhaps a better engineered skeleton, and a reduced and delicate face; all the others have much heavier, coarser heads, features, and jaws.[4]

Let us make an effort to forget Homo sapiens for the moment, and shut him from our minds. What, then, do we see? We see a few scattered fossils of a zoological family, varied among themselves like the anthropoid apes, though not so much. We have, as I intimated a while back, the parts of a jigsaw puzzle, but only a fraction of the parts, and not enough to tell us definitely what the picture is. Some parts are shapely enough: the Pekin, Java, or classic Neanderthal material makes a useful, clear-cut portion of foreground, but the Piltdown skull is one of those inscrutable pieces that might go in anywhere. For several of our fossils we have the remains of more than one individual, a fairly good date, and a culture which belongs to them (or might belong to them), so that, working with the relatively copious remnants of Pithecanthropus, Sinanthropus, Neanderthal, or Solo, a man might make a reasonable reconstruction of the human family. Then along comes a dateless and disreputable maverick like the Rhodesian skull to upset the apple cart, or an unconscionable animal-vegetable-or-mineral like the Piltdown specimen to wreck it altogether. What does that mean? If it means anything, it means that we are likely to make more such finds at any time—certainly the Piltdown and Rhodesian discoveries were sheer strokes of fortune—and that they will furnish new pieces of unexpected importance for the puzzle, showing objects in the picture that were not known to exist; in short, that the present number of different types of man is probably small compared with the number we shall someday find.

If I may squeeze a last drop of juice out of the picture-puzzle comparison, let me say that we can be sure of one thing as to the nature of the unseen picture: it will conform to usual biological and evolutionary laws. This is why we should forget momentarily

[4]Dr. Weidenreich would take the "Neanderthals," meaning Rhodesian and Solo as well, as a distinct group, or stage, of evolution; see p. 205.

about Homo sapiens and about our concern as to where he fits in. Taking only the others, we see simple types and then progressive types sprouting upward from some early, ape-like form. Three men as different as Neanderthal, Rhodesian, and Solo all developed to much the same stage of advancement and lived at much the same time, and I think that the reason for such diverging human types is the same tendency to radiation in the course of evolution which is found in any animal group. And I think that still other types of men which are as yet unknown, as further examples of this radiation, are sure to be discovered in the future.

CHAPTER XV

The Upper Paleolithic: Enter Homo Sapiens

HOMO SAPIENS has not yet trod our stage, for all the characters we have met so far belonged to other species. Who, then, do we mean by Homo sapiens? To begin with, all living men. All equally, moreover, and none more than any other. It should be borne in mind that it is no more typical of the species to be white of skin than to be black, for a white horse is not more of a horse than a black one, nor is a Great Dane more definitely a dog than a Pekingese.

What sets him off from the other species of man? In earlier chapters, when I was comparing man, as an animal, with the apes, I was using Homo sapiens for the comparison, and I described his general properties. But he is also distinct from the rest of his own family, the Hominidae, in a few ways which are minor in an anatomical sense. He is not, as we have seen, the only man with an erect skeleton or a straight neck, although his bones are probably somewhat lighter on the whole than those of his fossil fellows. But he is the only one known with so thin-walled a skull or so light-boned a face. His brain case is only half as thick as that of Java or Pekin Man, but, on the other hand, it probably makes up for this in strength to some extent by its rounded or vaulted form, which is a good design. This domed head and high forehead, therefore, are characteristic of Homo sapiens (although, of course, they do not serve to distinguish him from Piltdown Man). The same is true of his brow ridges, which are pure vestiges, being mere adornments of the forehead, and not something which stick out by themselves as a structure, as they do in lower types. They are a V-shaped swelling in the middle of the forehead, over the inner half of each eye socket only, and even when they are heavy they are still relatively small and uneven in size, being always largest near the middle. This is unlike all other forms (excepting Piltdown again).

Sapiens has a face which is extremely delicate in structure and pulled in below the forehead, throwing the nose into high relief.

This face projects, when it does so, mainly in the region of the teeth and gums. So sunken is the mid portion of it that there are hollows in the cheeks (over the sinuses) on either side of the nose, the "canine fossae," which are quite absent in the Neanderthal or Rhodesian species. As to our teeth, these are not notable unless it is for their small size and the degeneracy of the molars; there are no real distinctions. But the bony chin sitting on the front of the jaw is a clear badge of Homo sapiens although, as I said earlier, in evolutionary terms it is less a sign of determination than of a pushed-in face.

One thing, of course, we do not know, and that is how our vanished cousins, belonging to other species, might have looked in the flesh. We have not a single clue, since none of them seem to have drawn any pictures of themselves. The best that we can hope for is that during the last glacier one of them might have had an accident and fallen into a swamp in some still-frozen clime, like Siberia, someday to come to light in a condition of icy freshness like the famous preserved mammoths. Looking at the primitive remains of, say, Neanderthal Man, I should not be surprised if he had a regular pelt for hair, and a skin which would have made him look very much like an ape. But he might just as well have had an English complexion—certainly the climate of his day was of the English variety. The only restoration of him that I know of which hints at his tint gives him a white skin, like a European, but that is perhaps the least likely color; for white skin is a peculiarity among Primates, and even in Homo sapiens something of a deeper tone is typical.

Finds of the Upper Paleolithic

When do we first find fossils of our own kind? Now this is an important matter. All of the fossils I have so far described—all the non-sapiens men, that is—belong in the Lower Paleolithic. (This archaeological period takes in most of the Pleistocene, of course, running from its beginning up to the middle of the last glacier, bringing us up to something like fifty thousand years ago and therefore comprising nineteen twentieths of our million years.) None have come to light in more recent times. On the other hand, all the remains of Homo sapiens, of men completely like ourselves, even when fossilized, have come from the Upper Paleolithic or

from later periods. (There are apparent exceptions, so important that I shall deal with them separately, but in all of these cases there is something wrong with the evidence, either as to the date or something else, so that they are dubious and none of them has been accepted by everyone as genuine.) This does not, by any means, go to show that Homo sapiens did not exist in earlier time. But the fact remains that all the finds of our own kind come after the beginning of the Upper Paleolithic, in the climax and the gradual waning of the last glacier, and so this serves as a line of division in time. In Europe they follow after the Neanderthals, just as their stonework follows the Mousterian, and they have been found, in the same general culture stage, in Asia, in Africa, and perhaps in America. Their skeletons are far less rare than the poor remains of other fossil species, and we can treat with whole groups of men rather than single skulls.

The near-Arctic life of the Upper Paleolithic men must have been a good deal like that of the Neanderthals. They, too, lived in caves, and there they buried their dead. Their culture was really all in a single tradition, the Aurignacian, which, as I have said, was one of great skill in making blade-like flakes of flint as the fundamental tool from which other tools were fashioned. Changes took place, however: toward the middle of the Upper Paleolithic an intrusive, apparently foreign culture appeared in Europe, the Solutrean, whose makers were the best flintworkers of all, besides being lovers of horseflesh, by which I mean that they ate it, not that they bred it. This interlude was succeeded once more by the original tradition, now called the Magdalenian, in which stonework degenerated a little and the use of bone, especially as harpoon heads, became important. These hunters had artistic talents which they vented on the animals they chased. The Aurignacians made drawings on the cave walls which are extraordinary for their simple, self-assured draughtsmanship, while the Magdalenians also did excellent engraving and carving in ivory or bone. The animals themselves underwent changes: as the Upper Paleolithic wore on the cave bear, cave lion, bison, hairy mammoth, and woolly rhinoceros all gradually disappeared and the reindeer became the ruler of the European fauna, until he, too, as the ice withdrew, moved north into his latest home. Certainly the people of the caves were great hunters, for even the mammoth himself regularly fell prey to their weapons of stone and their skill.

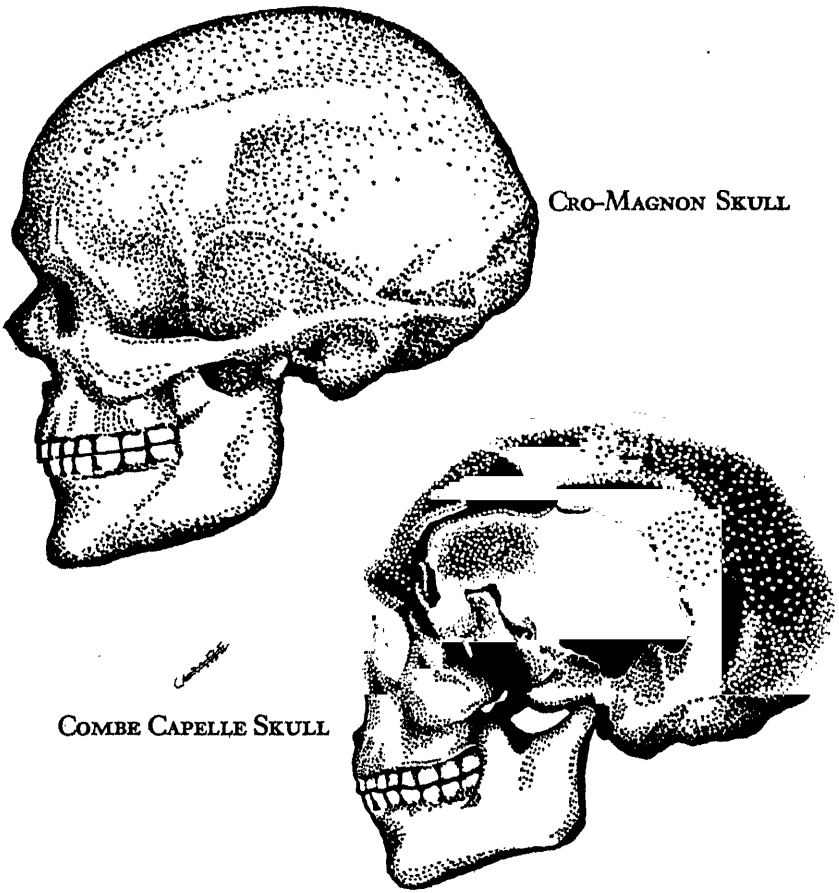
Cro-Magnons and Other Europeans

A name of great renown stemming from the period is that of the Cro-Magnons. These particular skeletons from southern France were the first Aurignacians to be found, and they attracted a great deal of attention; everybody has heard of their large brains and tall stature, and it is true that the skulls have rather a striking look, with their broad faces and wide, low eye sockets. Nevertheless, this prominence of the Cro-Magnons is out of proportion to their importance, and their name has been made to cover too much territory, until it has been applied to almost every skeleton of the Upper Paleolithic. They need deflating. They were not a different kind of man, but only a variation of the type of the period. You could not even call them a race by themselves. They are best looked on as a subrace, or only a local type, among the Whites.[1]

The truth is that all the Upper Paleolithic men were more or less alike, the Cro-Magnons being one group of them; enough alike to be considered as much of a unit as any given tribe, or any relatively homogeneous group of people, of the present day. They are fully Homo sapiens in nature, which means that I am left with little to say about them because I have already described the species so thoroughly. However, there is one thing which does distinguish them, and this is the large size and the rugged bony structure of their heads. They were a long-headed type as to shape anyway, and the average measured length of their skulls was greater than that which is known for any race of today, the nearest approach to them being found among such people as the Irish, the Scandinavians, or the Anglo-Saxon invaders of England. Their skulls were somewhat thick for Homo sapiens, and their brow ridges were heavy, but their brain capacity was also high and above present European averages. Their faces were of generous size, particularly as to breadth, and their jaws were deep and masculine.

[1]The degree of worshipfulness which the Cro-Magnons have inspired in the past is reflected in the fact that one writer after another has tried to identify modern survivors of the type, with the result that they have been spotted literally everywhere on the map of Europe as well as among the Egyptians and the American Indians. This far-too-great success of such efforts shows their futility, and I think they are based on a misconception. The characteristics of the Cro-Magnons are by no means so distinctive that they would stamp themselves indelibly on their descendants over many thousand years, allowing for even a slight amount of such mixture as must have taken place. Coon's assertion that their big size is reflected in the large heads of northern Europe in the present day is quite a different thing, and most likely (see C. S. Coon, *Races of Europe*, 1939).

While this description holds good for all, Coon and others believe that the Upper Paleolithic people can be divided into two types. One, represented in part by the Cro-Magnons, is very tall in stature, with especially wide faces, while the other, comprising the men of Combe Capelle in France, Brünn in Czechoslovakia,



CRO-MAGNON SKULL

COMBE CAPELLE SKULL

and others, is short and has a narrower head and face and rather more prominent brow ridges. At least one archaeologist[2] believes that the two groups had slightly different cultures and confirms the impression that the smaller Combe Capelle type was the first to come on the scene. But whether there was actually one type or two, and no matter how large in body they were, the important thing is that the Upper Paleolithic men were not something differ-

[2]G. Poisson, "Les hommes du paléolithique supérieur," *Revue Anthropologique*, vol. 48, 1938.

ent from ourselves, for their skulls had all the things which distinguish those of Homo sapiens from those of other men. They are even more familiar than that, since with their upright faces, their prominent chins, and their high-bridged noses they clearly belong with the European races. In other words, far from being some primitive kind of oddity, such as you might have expected an ancient Homo sapiens to be, the Cro-Magnons and the rest of them are so up to date and recognizable that we can be certain that their skins were "white," even in those days.

Then what does their ruggedness mean? Some writers believe that it betrays the presence of Neanderthal blood. But they do not agree beyond this. Dr. Louis Sullivan and Dr. Hrdlička thought that some of the Upper Paleolithic men were actually evolved straight out of the Neanderthals, and that the Combe Capelle type was a transitional form (because of its shortness and its well-developed brows), the Cro-Magnon being a later and more fully modern stage. Dr. Coon, on the other hand, has it the other way around: he thinks the Combe Capelle type was an old form of Homo sapiens, going back a long way into the past, which mixed, just at the end of the Mousterian and the beginning of the Aurignacian, with some of the Neanderthals, and in this way, because hybrids are commonly large in size, gave rise to the big Cro-Magnons. Those are not the only theories of this kind, but they are enough for the present. I am not much inclined to see Neanderthal blood in these perfectly good specimens of Homo sapiens, and when I see how other people arrive at that idea by totally different routes I am still less inclined than before.

Then there is another notion of proven popularity, which is that cold climates and a rigorous life breed big men, so that a really glacial homeland might well give birth to demigods like the Cro-Magnons. This is a particularly "Anglo-Saxon" supposition, apparently based on the Scots and the Scandinavians, and perhaps on Irish horses, and possibly on the immense Indians of frigid Patagonia. But its partisans forget the stumpy Eskimos, and also forget that the tallest people in the world bake on the shadeless plains along the borders of the White Nile, while possibly the next tallest fritter away an almost perfect leisure on the balmy beaches of Polynesia; and they are presumably not aware that medieval Danes and Norwegians who settled in Greenland suffered, in the course of several generations, a decline in size.

I do not know what we might select as the best reason for the Paleolithic physique. I think it may be in some part a racial characteristic—simply something which was the property of those particular groups—and therefore I agree with Dr. Coon that the explanation of the large size of the northernmost Europeans and the southernmost Indians (Patagonia and Tierra del Fuego) is not their cold climates but simply that they are the most ancient racial types in their parts of the world, being of Paleolithic origin, and have been pushed, like most such ancient types, right to the borders of the continent. But I think the best explanation is that it is a slight mark of primitiveness, since it seems likely that a greater lightening of the skull and skeleton is a progressive trait. This ruggedness constitutes only a slight difference, and nothing as large as that between Homo sapiens and other species. Nor does it make the Paleolithic people peculiar, for there are living races which are more primitive in other ways than they. It is simply that in spite of all the time that has passed, the only difference between these fossil Europeans and the ones of the present day is this slightly heavier build of skull and skeleton. And be it noted that the Whites to this day have rather heavier brows and muscle markings on the skeleton than most other races.

Other Races

I have been talking about the Upper Paleolithic in Europe in order to fix the situation in mind, because the great majority of the finds were made there, and the matter of time is best known. The rest of the world seems to say much the same thing, though it has as yet said very little. The same kind of man as the Aurignacians of Europe lived in North Africa at the same time, so that this, as it is today, was racially a province of Europe. East Africa probably shared a similar type. What about the Negroes? Let us go back to Europe, to one exceptional find about which I said nothing before.

In a cave at Grimaldi, next door to Monte Carlo on the Riviera, were uncovered two skeletons, of a woman and a teen-age boy, lying nestled together and obviously buried thus. And they were Negroes. Now you can look at almost any living man and spot his race without stopping to think, and can do it nearly as well from a

halftone in a newspaper, which shows no color and perhaps not even shade (the reader may have noticed that in fight movies Joe Louis seemed as light in color as any of the White Hopes he shattered). This is much harder to do with a skull,[8] in which there are no such clear marks of race. But anthropologists, besides knowing what racial characteristics there are, develop the same sort of "eye" for the cranium as the layman has for the living. And the Grimaldi pair look like Negroes. Aside from the look alone, they also have the upright, rather bulbous forehead of the Negro and the strong projection of the tooth-bearing bony gum, or "alveolar prognathism." I cannot say, nor can anyone else, what on earth Negroes might have been doing in the Aurignacian of Europe when there were none that we know of across the Mediterranean in North Africa. But it is impossible for most people to look at the Grimaldi skeletons and not feel sure that the skins which enveloped them were black. And at the same time the skulls have the large size of other skeletons of the time. These Negroes may have been mixed rather than pure, but that does not lessen the mystery of the matter. All we can say is that at the beginning of the Upper Paleolithic there was a white race in Europe, and representatives of a Negro race as well.

Were there also people of a Mongoloid nature? Apparently there were. Many have cited a Magdalenian skull from Chancelade, in France, as proof, because of its extraordinarily Eskimo-like look, with its broad jaw and flaring cheekbones. But its nose seems to have had a high bridge, like a European, and its skeleton was not like that of an Eskimo. The Chancelade Man may have had some dim Mongoloid connections, or he may simply have been a special example of the prevailing cranial robustness of the times, which Eskimos also share. Much the same thing can be said regarding another well-known skull from Obercassel. But the argument which has appealed so strongly to most people is that the Magdalenian culture, in which the men of Chancelade and Obercassel both lived, was something like that of the Eskimos. They did not paddle about southern France and Germany in kayaks, but they did live in a semi-frozen environment, using much bone for tools, and making use of

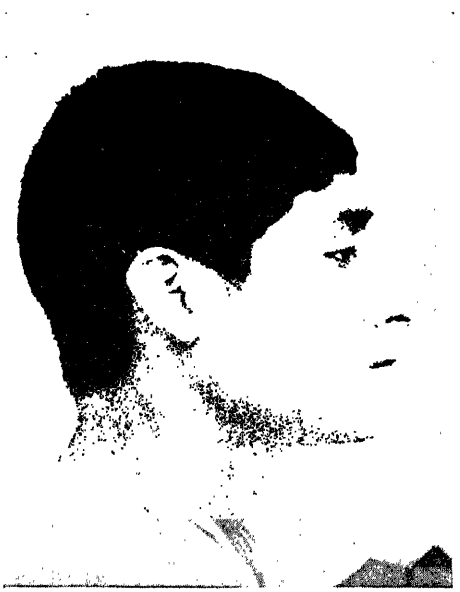
[8] I have rescued more than one friend from the notion that Negro bones are black and Indian bones red. They are all white to begin with, but they may be white, yellow, red, brown, black, or green if they have been dug up, because of the kind of earth in which they have lain.

American Museum of Natural History photo

ESKIMO GIRL

American Museum of Natural History photo

SIOUX INDIAN



Peabody Museum photo

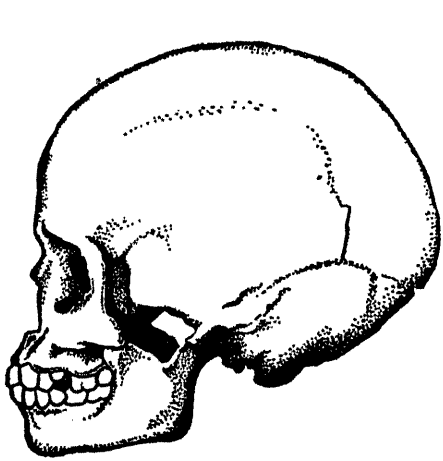
MAYA INDIAN

Peabody Museum photo

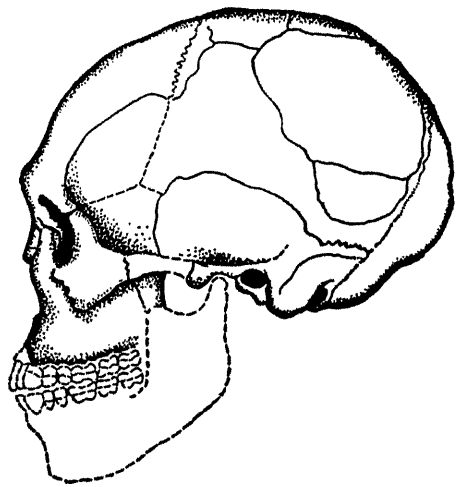
GUARANI INDIAN, BRAZIL

two pet weapons of the Eskimo, the harpoon and the spear thrower, and having as well a predilection for carving on bone. It is an enticing idea, but we really cannot call it proof of Mongoloids in Europe. However, we need only go to China, where one or two Upper Paleolithic skulls of a Mongoloid character have indeed turned up. These, perhaps, look more like American Indians than anything.

Having left the bountiful caves of Europe, we shall have to be content with very scanty remains from the rest of the world. There is, indeed, only one more general type on the list. For its first representative we turn still again to Java and to Dr. Dubois. When this remarkable man returned in the 1890s he had, along with Pithecanthropus, two other skulls which he kept entirely secret until 1920, for reasons which he never chose to explain. Perhaps, as Keith said, it was good judgment, for they were so



THE GRIMALDI BOY



SKULL OF THE WADJAK MAN

different that to hand them out along with the Java Man would have overtaxed the resilience of the anthropologists, like the chameleon who was put on a Scotch plaid. The skulls, male and female, were from Wadjak; they were large of size and large of brain, and entirely sapiens in their features;[4] and with little doubt their date corresponds with the Upper Paleolithic of Europe. In a word, the Wadjak skulls stand in the same relation to the living

[4]The skulls have often been called Homo wadjakensis, but this puts them in a species of their own and is entirely misleading as to their nature.

aborigines of Australia as the Upper Paleolithic Europeans do to Europeans of the present day. The Australian skull has heavy brows and a receding forehead, and is prognathous and chinless. The Wadjak skulls are the same in form, but have that heavy construction and large brain (1,650 cubic centimeters in the male) which is the great feature of Ice Age Homo sapiens in the West.

A few skulls of much the same sort (and date) have come to light in South Africa, the important ones being the Florisbad, Fish Hoek, Boskop, and Springbok Flats crania. They are all old and big. The predominant character of these as well is like the native Australian, though some of them also bring to mind the little South African Bushman, large though they are in size. This is especially true of the enormous Boskop skull (with a capacity of perhaps 1,800 cubic centimeters), which again presents us with this queer relation, in the same place, between a large and heavy Upper Paleolithic type and a smaller one—in this case very much smaller—of the present day.

There are a great many problems attached to the men of the Upper Paleolithic period, but they do seem to tell us a few fairly simple and definite things. They all, of course, belong to Homo sapiens, so that our species appears to have had the world to itself already. We cannot be sure elsewhere, but in Europe it seems clear that the sapiens men, with their Aurignacian culture, invaded the continent and in a short time swept the Mousterian-using Neanderthals from the face of the earth. These incomers, furthermore, were racially "white"; that is quite clear. And there is evidence that is hardly more than a hint that Negroes and Mongoloids were also present, as well as the type of the native Australian. The races we know, then, had appeared by the beginning of the Upper Paleolithic, in the middle of the last glaciation. They even foreshadowed their present distribution in part, but they differed from the peoples of the present day in one special respect: the ruggedness and large size of their crania.

This vague description is all we can supply for the people who lived from about 50,000 B.C. to 12,000 B.C. Even during the Mesolithic, a time by which the ice had retreated far to the north and men were living on the shores of the Baltic, the same types prevailed in Europe. The only addition to the European scene was a few people whose heads were round rather than long. Where they

came from nobody knows, and the rest of the Old World is, in fact, too little known to help us at all. It is not until the Neolithic, some ten thousand years before Christ, that we see the establishment of peoples with a lighter and smaller brand of skull, and with them come the beginnings of the modern world.

CHAPTER XVI

Ancient Moderns: The Lower Paleolithic

WE HAVE SEEN Homo sapiens making his entrance in the last fraction of time, following earlier men of the Lower Paleolithic, who stretch out before him over a much longer period. What we have not considered is how he is related to those others. What are they to him? Somewhere in this question lies the key to the origin and antiquity of our own species.

From what we have seen so far we might go on to suppose, as some do, that Homo sapiens is descended from any one or all of the others, since he is the latest kind of man. But there are certain reasons for looking askance at this simple idea, and it would lose some of its simplicity if we were to find a fossil of Homo sapiens which actually came, not from the Upper Paleolithic, but from the Lower, showing that the species is older than it seems. Have such things indeed already been found? Apparently they have, but their hands are unclean. As I said before, we cannot be certain of their dates. Now, to see the importance of the Piltdown or Rhodesian finds we do not have to know their precise places in time. But if it is a question of early Homo sapiens the date is the whole significance of the matter, and dates are difficult to fix.

The problem is as old as that of man's antiquity. The recognition of the fact that crude stone implements lying in gravels with the bones of extinct animals meant that man was older than Genesis was due to the insistence of a great amateur: the French customs collector, Boucher de Perthes. He was winning this recognition at the middle of the last century, still before Darwin or the acceptance of Neanderthal Man. And it was Boucher de Perthes himself who found, in 1863, the Moulin Quignon jaw in the 100-foot terrace of the Somme (second interglacial) at Abbeville. This jawbone is perfectly modern in form, as are its teeth. After the first sensation, people began to doubt its authenticity; it seemed to be in too good a condition, and not completely, though heavily, miner-

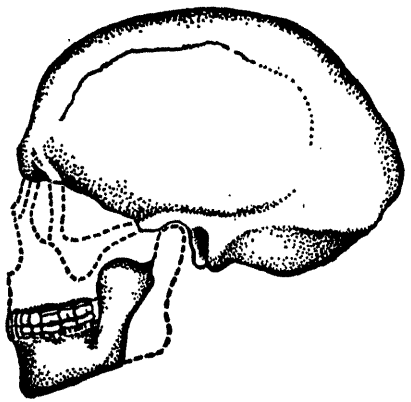
alized; and Boucher de Perthes' workmen had played tricks on him in one or two instances before. As Keith says, it was a growing acquaintance with Neanderthal Man and the realization that he, a more primitive form, belonged to a later date, which did most to discredit the jaw. But the fact is that, although archaeology was then only an infant science, Boucher de Perthes took the mandible from the gravel with his own hand and had no doubts about it himself; and students today are by no means sure that the find was illegitimate. Another such bone, the Foxhall jaw, was found, or appeared, the same year in England, said to come from an even older deposit. A drawing of it shows that it also was fully modern, and, like the Moulin Quignon specimen, could not have belonged to anything but Homo sapiens. But the Foxhall jaw itself disappeared in some strange way and has never been seen again. It has a much shadier character than the other.

Galley Hill Man

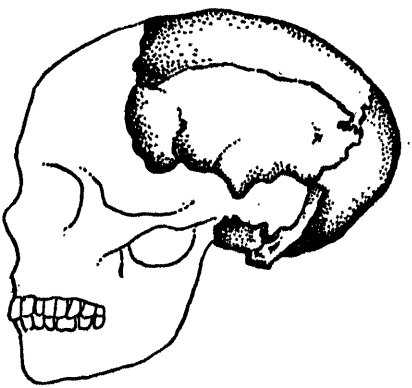
Next comes a famous and long-disputed case, the skeleton of Galley Hill. It was found in 1888, still before the vital character of such evidence was fully understood. Along the Thames below London the terraces of glacial gravel are copious and deep, mainly at levels of 20, 50, and 100 feet above the present river, and the oldest and highest of these formed in the second interglacial when the land sank until the Thames flowed several miles wide. Going up through the 100-foot gravels one encounters a crude stone industry using flakes, the Clacton, followed by the Acheulean fist-ax culture, the whole representing a section out of the middle of the Lower Paleolithic. It is a splendid region for study, and collectors and archaeologists have always infested it. In a pit at Galley Hill a workman taking out the gravel came on human bones at a depth of some eight feet in a ten-foot gravel deposit of this terrace. Two interested men, a printer named Elliott and a schoolmaster named Heys, each saw the bones in place, nor were they the only ones. But these two were unaware of each other, and while Heys was trying to get a photographer to record the bones *in situ*, Elliott appeared and took them off. Heys was so heartbroken at this that he took no further interest in the matter, until Sir Arthur Keith wrote to him twenty-two years later to ask him what he knew about it.

Both men were intelligent and practiced observers, and they agree as to the gravel in which the skeleton lay. Of the pit side Mr. Elliott said: "It presented an unbroken face of gravel, stratified horizontally in bands of sand, small shingle, gravel, and, lower down, beds of clay and clayey loam, with occasional stones in it—and it was in and below this that the remains were found. We carefully looked for any signs of the section being disturbed, but failed; the stratification being unbroken. . . ." Mr. Heys long after wrote: "No doubt could possibly arise to the observation of an ordinary intelligent person of their deposition contemporaneously with that of the gravel, for there was a bed of loam, in the base of which these human relics were embedded. The underneath part of the skull, as far as I could see, was resting on the sandy gravel. The stratum of loam was undisturbed. This undisturbed state of the stratum was so palpable to the workman that he said, 'The man or animal was not buried by anybody.' "

Unfortunately, however, this does not settle it. In spite of the workman's impression, one is always obliged to suspect that so



THE GALLEY HILL SKULL



SWANSCOMBE SKULL, WITH FACE SUGGESTED

complete a skeleton may have been a case of intentional burial, especially since the deposit itself was laid by running water and so would not have been likely to preserve in perfect articulation a skeleton which had got there in any natural fashion. And that is the charge that has always been made against Galley Hill Man: that he might have lived in any age, and simply happened to be buried in a grave eight feet deep which happened to be dug in the 100-foot terrace of the Thames. Aside from this, of course, most

anthropologists have not been able to believe that Homo sapiens existed when Pithecanthropus, Sinanthropus, and possibly Eoanthropus also trod the earth, even before the Neanderthals had come to Europe. Furthermore, the observations made at the time of the Galley Hill find leave something to be desired, and it was unfortunate that the skeleton was dug out before more people could see it. Notwithstanding all this, the remarks of Messrs. Elliott and Heys have a ring of accuracy to them, and the two men appear to have seen clearly unbroken beds and strata directly over the bones. Now if a grave had actually been dug from the surface, all the earth above the skeleton would have contrasted with the rest of the deposit by lacking clear levels and giving an impression of having been stirred up, and one might even expect to see the outline of the grave itself. Therefore, if there was a grave, it was a shallow one, and not made from the present surface of the land. So we may still suppose that it was dug while the Thames was at the 100-foot level and still rising, covering the grave with fresh layers of gravel from seasonal broad floods; in other words, during Acheulean times.[1]

The skeleton itself was fairly complete, though not perfect. It was that of a man about 5 feet 3 inches tall, and of the modern type, and indeed, although face of the skull is missing except for the jaw, of the European type of today. There is no possible doubt as to its Homo sapiens nature. Yet there are certain primitive features: a thickness of skull, large brows, and rather small mastoid processes; and various similar things. Keith says that "a combination of such characters would be very difficult to find in any European of modern or of Neolithic date." These words are not so strong as they sound, for there are living non-European races which are equally primitive, perhaps in different ways, to say nothing of the Wadjak or Florisbad skulls; and we can expect to go far lower in the scale of primitiveness before finding something which would strike us as a really early form of Homo sapiens. Galley Hill Man actually corresponds fairly well with the Combe Capelle type of the Upper Paleolithic, and the very fact that the skull is European or "white" in racial character is enough to give anyone pause before accepting its antiquity as genuine. For

[1]For the possibility that the Galley Hill Man was not buried at all, but drowned and became covered with silt unusually quickly, compare the case of Minnesota Man, on p. 266.

it goes against the grain to suppose that anything so up to date as the European racial type could be so old. Galley Hill has had few friends since rising from the grave, but among them was Keith, who would be friend enough for the most forlorn of fossils, and he has lately found one or two more. The disposition to receive him is probably greater at present than it has ever been before.

Further Candidates

Part of the reason for this is an accumulation of other such finds, none conclusive in themselves, but all lending force, through weight of numbers, to the idea of an ancient strain of Homo sapiens of the European type. A remarkably similar find was made much earlier, in 1868, in the Avenue de Clichy in Paris. Here a skeleton was discovered, apparently in gravels of the same age as Galley Hill, and of very much the type of the Galley Hill skeleton, but it encountered the same cold shoulder as did the Moulin Quignon jaw.

In England two further cranial fragments have received particular attention. At Bury St. Edmunds, in Suffolk, the upper forehead and crown of a skull appeared in a pit which had been washed full of earth and sand, at a level which contained tools of a late Acheulean type, though of not too clear a date. In 1925, in the excavation for a new building for Lloyd's of London, a similar piece, with the forehead and part of the side of the head, was recovered forty-two feet down in the ground. No implements were found, and the date of this fragment is likewise obscure. Most people believe the deposit belongs to the 50-foot terrace, younger than the 100-foot and probably corresponding to the third interglacial. Keith thinks it earlier; a few think it later. But both at London and Bury St. Edmunds the evidence is unsatisfactory, and the most that can be said is that the skulls are possibly but not certainly older than the Upper Paleolithic. The pieces themselves are much alike, being thin and giving, as far as they go, every indication of belonging to Homo sapiens, with at least very distinct foreheads. Both probably belonged to women with an estimated brain capacity of from 1,300 to 1,340 cubic centimeters—a modern figure. The skulls appear to have had, in fact, a low, longish vault of a special type which has been characteristic of England in recent times, and this seems almost like too much of a good thing.

The most tantalizing evidence comes from East Africa. Here, on the south shore of Lake Victoria in Kenya Colony, Dr. L. S. B. Leakey made two finds. One, at Kanam, was a piece of a lower jaw with a good chin and small canines, and the other, at Kanjera, was the parts of several skulls, all indisputably of the sapiens type, and in both cases in beds of somewhat different age but of Middle Pleistocene date, according to the indications of the animal fossils. There is not much doubt in general as to Dr. Leakey's discoveries, but the evidence he brought home did not completely satisfy his colleagues, because of some omissions and contradictions in the data which did not exclude the possibility that the human remains might have been washed down into apparent association with the older deposit from a later one. And, most unfortunately of all, it has not been possible among the wastes of Kenya Colony to locate the exact spots of the excavations for a second examination.

There are a few other such skulls as those I have described. They all make up a group which is without doubt Homo sapiens. Their apparent dates, as we have seen, are mostly second interglacial, and they are in some cases associated with Acheulean remains. If any one of them could be proved absolutely genuine it would be possible to accept them all, and we would have the spectacle of men older than the Neanderthals in Europe who did not have any of the Neanderthal characteristics. Actually the precise date is not the vital thing. Any Homo sapiens who was older than the Upper Paleolithic, and thus at least contemporaneous with the Neanderthals, would settle a lot of questions. There are two further finds, made in recent years, which bear on this question, but which are different from the others; the Swanscombe skull and the Mount Carmel men. Their early dates are verified. The only question is: are they Homo sapiens?

The Swanscombe Skull

Swanscombe is the town in which Galley Hill is located, on the south side of the Thames between Dartford and Gravesend. I have mentioned the geological appeal of the district and hinted at the perils of any navvy who works there: the back of his neck is hot from the breath of archaeologists, and he can hardly throw a shovelful of gravel in any direction without hitting some tweedy individual from a learned society. The Galley Hill gravel pit was only a minor one compared with another, the Barnfield pit, sev-

eral hundred yards away and long a renowned center of attention. Here, the terrace which reaches up to 100 feet is especially deep and well stratified, having three major sets of beds which, as I have been saying, are generally thought to have formed in the long second interglacial. The Barnfield pit has been worked back in a high vertical face, and in June 1935 a human occipital bone[2] was found in a particular stratum of the Upper Middle gravels, twenty-four feet below the top of the terrace. There was no doubt about the bone; it belonged with absolute certainty in this bed, and with implements which have been classed, because of their clear stratification here, as early middle Acheulean. It is as perfect a geological association as a human bone has ever been found in, but as if that were not enough, the left parietal bone of the same skull, which fits the occipital neatly along the joint, was found in March of 1936, when the pit face had been carried eight yards further in, at the very same level. If Luck had been paying the archaeologists off with gold bricks up to now, she made up for a lot of this bad coin at Swanscombe. The find was called by its discoverers an "indigenous fossil of the 100-foot terrace of the Thames." This is a citation for absolute integrity: it means that the two bones, from a skull which had just disintegrated, are truly and unmistakably contemporaneous with the particular layer of gravel in which they were discovered.

There are only these two bones, but they tell one what the back and crown of the head were like, and give one an impression of its general form. The skull was that of a woman in her early twenties, who had a brain filling about 1,325 or 1,350 cubic centimeters. The bones are rather thick—too thick, or at least exceptionally so, for a modern woman—but at the same time the skull definitely has the look which one would expect in a really primitive member of the sapiens line. Was the Swanscombe girl Homo sapiens? We have no face or jaw for her, and only the back of the head to judge by. Nevertheless, the same two bones are sufficiently different in the classic Neanderthal, the Rhodesian, the Java, or the Pekin types so that it can be shown that the Swanscombe remains could not have been an individual of any of them.[3] This is not so when the

[2] The back and base of the skull.

[3] G. M. Morant, "Report on the Swanscombe Skull," *Journal of the Royal Anthropological Institute*, vol. 68, 1938.

Swanscombe skull is compared with Homo sapiens: though peculiar, the occipital and parietal could not be proved fully distinct from those in our own heads. But (and here's the rub) if you follow the same reasoning, the Swanscombe parts also cannot be distinguished from the Steinheim skull, and probably not from the Piltdown skull either.

If you remember, the Steinheim skull (p. 171) was an early (third interglacial) Neanderthal-like woman who differed from the later Neanderthals in having a higher, more modern type of head, especially in the back. This is the disappointment in the Swanscombe skull. We cannot put it out of Homo sapiens, but we cannot put it in. It certainly has a pronounced Homo sapiens look. But it might have had a face like the Steinheim specimen, or even one which approached that of Eoanthropus. This last is Keith's theory in particular.[4] He finds some resemblances between the two in details, and he thinks that the Swanscombe skull was an advanced descendant of the Piltdown Man, and much closer to Homo sapiens—how close cannot be told. Contrary to most, he believes that the Piltdown skull is very early (first interglacial) and that Piltdown and Swanscombe are a family line quite distinct from those most primitive men, Java and Pekin. But, at all events, the Swanscombe find fails to be conclusive about Homo sapiens. One thing, however, it does show, and show more definitely than the Piltdown skull: that a relatively high and narrow brain case (as distinguished from the low, broad form of the Neanderthals) had appeared in some kind of man before the middle of the Pleistocene.

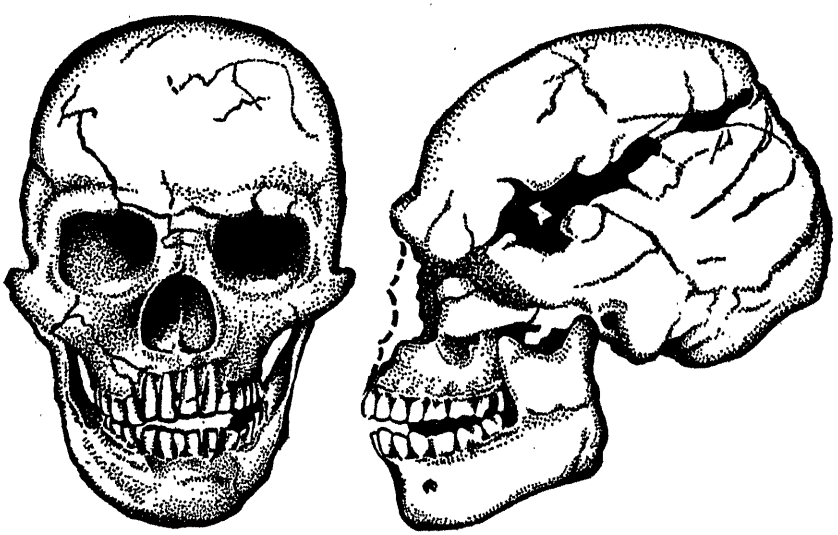
People of Mount Carmel

I have referred before (p. 172) to the caves on Mount Carmel in Palestine. The two caves, Mugharet es-Skhul and et-Tabun, are thought to have been lived in at about the same time, in the third interglacial, by people with an early "Levalloiso-Mousterian" culture. This was before the day of the European cave Neanderthals, and of course earlier than the Upper Paleolithic. In the Tabun cave was the skeleton of a Neanderthaloid woman who, like the Stein-

[4] Sir A. Keith, "A Resurvey of the Anatomical Features of the Piltdown Skull with Some Observations on the Recently Discovered Swanscombe Skull." *Journal of Anatomy*, vol. 73, 1938–39.

heim girl, had certain sapiens features. In the Skhul cave were a number of skeletons of the opposite end of the scale: they were practically modern, or rather like the Upper Paeolithic men of Europe, being tall and straight-limbed; and yet they had some primitive and Neanderthal-like features.[5] It is an extraordinary variation. There seems to have been a single tribe ranging in type from almost-Neanderthal to almost-sapiens.

It is the Skhul people who engage us here. Their Neanderthal-like features are not easy to put a finger on. There is a certain heaviness of the skeleton and a shortness of the neck, but the long, straight bones of their forearms and the muscle markings of the thigh bones do not recall the Neanderthals so much as a heavily built specimen of sapiens. Their tall stature, furthermore, will bear another mention. The teeth are not "taurodont," like the Neander-



MEN OF THE SKHUL CAVE, MOUNT CARMEL
(*Two specimens*)

(After T. D. McCown, Bulletin of the American School of Prehistoric Research)

thals, for whatever significance this may carry. The head also recalls the more primitive types of Homo sapiens rather than the Mousterians: the skull is high and poised erect, with large mastoid processes, and although the face has heavy brows and is project-

[5] T. D. McCown and A. Keith, *The Stone Age of Mount Carmel*, vol. II, 1939.

ing, the projection is, as in some sapiens races, more in the region of the mouth than in the middle face. There are "canine fossae" (see p. 184), absent in Neanderthals. And the Skhul jaws sport respectable chins. All this leads me to feel that perhaps the Neanderthal element in the Skhul people is more shadow than substance. If you believed in prenatal influence, you might say that the mother of the Skhul children had looked at a Neanderthal Man before they were born. But my colleagues, who do not believe in prenatal influence, mostly think that this would be stating it decorously—that the strange mélange existed because at Mount Carmel the two species, Homo sapiens and Homo neanderthalensis, had come into peaceful contact and had interbred, begetting hybrids of varying degrees of likeness to one or the other (something like mulattoes), with the Tabun woman being the most Neanderthaloid of the lot.

McCown and Keith, who studied and published the remains, first propounded this hypothesis.[6] In their final report,[7] a marvel of completeness, they offered a different interpretation. In essence, this was that the two species originally were one (as they must have been at some time) and that the community at Mount Carmel actually represents the stage at which they were for the first time diverging and becoming separate, leading subsequently to the later, specialized Neanderthals on one hand and to a more progressive Homo sapiens on the other. This would explain, they believe, the great variation in the Mount Carmel people, as well as the peculiarities of the Steinheim skull. The objection to this idea is that it is somewhat unnatural. Animal types do split apart and become two species. However, they do not do this within a single group, but only when two groups have been separated physically and do not breed together (p. 10). It is difficult indeed to understand the Mount Carmel skeletons, and they are likely to remain a puzzle for some time. As I have said, I think that much of the primitiveness of the Skhul men is not due to Neanderthal ancestry, but rather to their being a primitive form of Homo sapiens in themselves. In the light of some of their features, however, it would be hard to deny the Neanderthal element entirely.

But the important thing is that Homo sapiens is beyond a doubt

[6] "Mount Carmel Man, His Bearing on the Ancestry of Modern Races," Bulletin 13, American School of Prehistoric Research, 1937.

[7] Op. cit., 1939.

involved. If the explanation now given by McCown and Keith[8] is correct, then we would have evidence that our own species was appearing at approximately this time, in the third interglacial. If, however, the majority are right, and the Mount Carmel people are a mixture, then a full-fledged Homo sapiens must have existed already, and might have been in being for an unlimited length of time, so that apologies to the Galley Hill Man are in order. We have in the Skhul men, at any rate, the most reliable evidence yet of Homo sapiens in the Lower Paleolithic.

[8]Keith for many years was foremost in the belief that Homo sapiens was an ancient type, and not new in the Upper Paleolithic. This latest hypothesis seems to be a modification of his former views.

CHAPTER XVII

The Origin of Homo Sapiens

WHERE, at last, did Homo sapiens come from? It has not yet been fully proved that he goes back to the middle or early part of the Pleistocene, but many writers, notwithstanding, now believe that he does. If he is indeed old, then we are not bound to look directly at some other species like Neanderthal Man for an ancestor. On the other hand, it would not mean that we were not descended from the Neanderthals, or some other species, because such forebears might easily have lingered on in their ancestral crudity long after some of their descendants had assumed another form. Evolution will always be quicker in some lines than in others.

Two points of view exist. One is that to which I am prejudiced, and which I have fitted into the spruce-tree simile. All men started as one type (of ape) well back in the Tertiary, but this type split up into several lines, or twigs, which became more and more different as time went on. Because these lines separated does not mean that they ceased to progress in a forward direction, which is to say that Neanderthal, Rhodesian, and modern man may all have evolved in parallel to some extent. But the real gist of this view is that the human family had an evolutionary radiation, that Homo sapiens is very old, and that his own primitive stages are not necessarily represented by Neanderthal[1] or Rhodesian Man.

The other philosophy relies even more strongly on the belief that separate lines may evolve in parallel, or along similar paths. It holds that Homo sapiens is a mere youth, and that he is not so much a species as a stage reached by other species; that his several races are descended from different kinds of fossil men who, having once become different in form, then evolved upward in the direction of Homo sapiens until they were all much alike again. According to the suggestions of different authors, Rhodesian Man became

[1]Alleged "throwbacks" to the Neanderthals among living men are usually victims of glandular disorder, and so cannot be cited.

the Negroes, Solo Man the Australians, Pekin Man the Mongoloids, and Neanderthal Man the Europeans. Dr. Weidenreich[2] suggests that the "prehominids" (Java, Pekin) gave rise to Neanderthal, Rhodesian, and Solo, who in turn became Homo sapiens, so that any of the known fossils might have living descendants. For example, Pithecanthropus, a man of the lowest stage, evolved into Solo Man, who evolved into the Wadjak people and finally into the native Australians. These writers are not so naïve as to be upset by finding an advanced skull like the Swanscombe to be earlier than a primitive one like the Neanderthal; for, as I said, ancestors may live on along with their descendants, and representatives of several different "stages" might have been present together in, for example, the second interglacial. But their choice of this kind of explanation is based on the feeling that Homo sapiens is not extremely old, the feeling that he is too varied racially to have come from one single type, and, I suspect, the feeling that there is nothing much else to do with the fossil men we know except to make ancestors out of them.

Homo sapiens today is pretty clearly a single species. His races differ, but their skulls are really all much alike in detail. There are far wider differences between the other species of man (such as Neanderthal and Rhodesian), and therefore the natural thing would be to try to trace Homo sapiens back to not more than one of them, if any. If you look for the ancestors of an individual man, you find more and more of them as you go back, but if you look for the ancestors of a race of men you find fewer and fewer—there are more apples than twigs, more twigs than boughs, and all the boughs go on a single trunk. It may be, as is often suggested, that Neanderthal Man or some other kind mixed with our ancestors (Skhul? Cro-Magnon?), but one cannot explain the very existence of Homo sapiens by such an applesauce as this. That would be as if you expected to find a given branch growing on two trees at the same time.

But if you look for the branch or trunk from which Homo sapiens did grow, matters are not much happier. Some, like Dr. Hrdlička, cleave to the Neanderthals. This has its difficulties. Dr. Hrdlička argued that they were not so different from ourselves as they seem, and that by a rapid evolution they might have

[2] F. Weidenreich, "Some Problems Dealing with Ancient Man," *American Anthropologist*, new series, vol. 42, 1940.

changed into the Cro-Magnons. But they are unquestionably different, and we are faced with the principle that an animal should be traced back to a parent no more specialized than itself. As for their having evolved into the Upper Paleolithic men, the replacement of Mousterian culture by Aurignacian seems far too sudden to allow any idea of transition. And a comparison of the lumbering skeleton of the Neanderthals with that of their successors is almost laughable. Rhodesian Man would be a better bet as an ancestor. But the very fact that there is more than one species of the genus Homo which might be so considered seems to indicate that none of them will really satisfy.

You might, however, take a simpler form, such as Sinanthropus or Pithecanthropus. Pekin Man at least had a straight leg, which was more than the Mousterians could say, and he is probably generalized enough to be our ancestor. But here the Piltdown skull asserts itself, as a conflicting candidate. His jaw puts him behind Sinanthropus in appeal, but his brain and the shape of his cranium put him ahead. You can hardly accept both the Piltdown and Pekin men in your genealogy, and anything with a brain like the former is not to be ignored. The natural tendency is to arrange the other English skulls, the Swanscombe, Galley Hill, and Bury St. Edmunds in a lineage from Piltdown which thus leads up to modern man. But the Piltdown jaw now becomes more of a stumbling block than ever, for it must have taken a long time to modify this into the ultra-human, well-chinned jaw of even an early Homo sapiens. If you are going to accept the Piltdown Man as the progenitor of modern men, then you will either have to give the jaw back to the chimpanzees, as some have recently done, or follow Keith in believing that the Piltdown deposit is early first interglacial, which would relieve the pressure of time somewhat, but at the expense of parting company with most of the geologists. One is tempted to doubt that the true ancestor of Homo sapiens has been found up to the present at all.

Let us assume, as we have before, that man began, long ago, as a particular kind of ground-ape. As this animal spread over a larger territory it must, probably while it was still very primitive, have broken up into several species, but at the same time there is good reason to suppose that these species would have continued to advance in generally similar ways, though too divergently to wind up as the modern races. One type, developing like others a large

brain and a straight posture, also went further in a thinning of the skull and reduction of the face, and this was Homo sapiens, in all likelihood the best endowed of any. Now, if the others are not to be included in his ancestry, and if they did not mix to any great extent with his forebears, what happened to them?

Stonework had added considerably to man's powers during the Pleistocene. If any species had natural physical advantages over another, these would be increased by stone weapons, as the human population grew and different species came into conflict, and the more so the better the stonework. But I do not mean that they fought or killed and ate one another. Rather, the one with the best hunting implements and the greatest physical ability would kill the most game in any given countryside. And of course the game was limited in quantity by natural laws, as it is today. When a pinch came, the critical amount necessary to live on would go to those best able to hunt it. It would then be beyond the means of the rest, who would perish rapidly, or as suddenly as the Neanderthals. Even supposing the latter were as intelligent as the Cro-Magnons, and made tools as good as theirs, I think that the more cumbersome physique of the Mousterians might have been the telling handicap. Between the two groups, hunting was an athletic contest with survival as the prize.

Dr. Hrdlička, who was opposed to the idea that the Upper Paleolithic people were invaders who caused the disappearance of the Neanderthals,[8] asked, "And where are there any other examples of a sudden complete extinction of a whole group of humanity? . . ." I should say that the American Indians would answer the case. They are not extinct, of course, but for the archaeologist of the future they might as well be. They never have affected and never will noticeably affect the general physical type of the United States of today; a digger would find Indian bones with Indian cultural remains succeeded by European bones with European culture; and the three hundred years of the Indians' passing is almost instantaneous, being to the length of the Pleistocene as half a minute out of a day.

There seems to be no denying that the Upper Paleolithic men of our species appeared in Europe relatively suddenly. More than that, they appeared, as we have seen, in the guise of the white race.

[8]A. Hrdlička, "The Neanderthal Phase of Man," *Smithsonian Institution Annual Report for 1928*, 1929.

And, as we have also seen, other races were in existence elsewhere. This fact is further evidence that Homo sapiens was not new at the time,[4] even if you say that Galley Hill and Swanscombe are incompetent, irrelevant, and immaterial. The question is: Where had he been keeping himself? Conceivably in Africa. But if the chances are that man as an animal evolved in Asia, they are equally good that the species of Homo sapiens appeared there also. And if many of the finds of ancient man have been made in Europe, this is because Europe is generously endowed with glacial deposits and has been thoroughly explored. Actually, it is in Palestine that we find the most dependable signs of ancient Homo sapiens yet seen.

But this raises another problem. If we are going to be receptive, and believe all the evidence which says that ours is no new species, then we have this species in Europe (or at least England) in the second interglacial, replaced in the third interglacial by the Neanderthals, and returning after this usurpation to the ancestral demesne again during the fourth glacial. This is a little hard on the imagination. A possible explanation is that the advance of the third glacier would have had the effect of driving mankind largely out of Europe, and that on the reopening of the continent the Neanderthals got there first, Homo sapiens not returning until later and probably as a second incursion from the same source as the older one. This is a rather lame and purely speculative answer, however. The background of Homo sapiens remains a great problem, though a single skull might solve it.

But problems are almost all that fossil humanity has given us. Look back at some of them. What, really, is the Piltdown skull? Why has Neanderthal Man alone such a peculiar skeleton? What are the Skhul people? What about the Steinheim skull and the faceless phantom of Swanscombe? If experts do not agree, it is not their fault. We will have to find more fossils than we have now, and that is what we look forward to. There is plenty of excitement in the hunt for ancient man.

[4]Keith pointed out its importance in his *Antiquity of Man*, 1929.

PART III

Homo Sapiens and the Coming of Races

CHAPTER XVIII

The Nature and Origin of Races

HAVING ARRIVED at Homo sapiens, it only remains for us to bring him up to date; to make the contact between that shadowy ancestor, made up of guesses and half glimpses, and the swarming humanity of the modern world. But this is nothing easy, and even beginning is difficult. I have described the skeleton of the present type of man in no little detail,[1] but how would you describe the living animal? Every specimen belongs to some race or other, so that there is no such thing as a plain Homo sapiens. To see how this might manacle your imagination, put it another way, and ask yourself how you have always thought of Adam and Eve. In your mind's eye, tutored by Michelangelo or Dürer, they were doubtless white. But if you seriously try to picture for yourself how the actual parents of all living men might have looked, you will see what we are up against.

The races and their development are the closing chapter of the story of man. You must comprehend the nature of race in order to understand its history, but you also must understand its history to understand its nature. Actually, the whole of this book has been a preliminary course in understanding both.

All this being so, it would be asking for trouble to start with a definition. Fortunately everyone knows, more or less, what races are, and he becomes aware of them long before he hears of Pithecanthropus, or learns to tell a monkey from an ape. As soon as a white person realizes that the children of black persons inherit their parents' dermal darkness, curl of hair, breadth of nose and form of lip, so different from his own, he has the general idea; and the black child has made the same discovery on seeing that the pale, uneven skin, the pinched nose and sharp face and emaciated lips, and the hair that does not make a neat mop but blows about and has to be cared for all the time, each inevitably crops out in

[1] See Chapter V.

every generation of the white families of his acquaintance. That is all. The anthropological classification of races is merely a rigidly scientific extension of the same kind of observation, substituting method for impression, together with an equally rigid rejection of any superstitious assumption which is not germane to the problem.

Racial Features

Let us look at these ways in which races differ in their outward appearance. If you were writing a zoological description of the present human species, you would probably begin this section by saying that the species was characterized by great variation in general pigment. The skin in particular shows this, you would note: the concentration of the brown pigment granules (which are always present) may be so small that the blood shows through and the skin appears pink, or so great that in some specimens the skin appears black. There is a good deal of variation in color among the individuals of any racial division, but each has its characteristic range of brownness. Apart from skin the species is more uniform in color, typically having dark brown or black hair and eyes, but even in these features, certain sections of the depigmented European branch have lighter shades. The hair may be so lacking in brown pigment (which has the same nature as that in the skin) as to be blond, and since hair also carries a reddish color, the combinations of different amounts of this and the brown may give rise to an infinite variety of tints. The color of the eye is a still more complicated affair, and is not properly understood, but in the lightest eyes the brown pigment may be entirely absent, leaving only a blue color which results from the reflection of light from the purple protective layer at the back of the iris.

Hair varies also in its shape. Among Mongoloid peoples in general it is perfectly straight. Among the Europeans it may be straight also, but the hairs are more apt to twist in unison at intervals along their length, giving rise to waves or curls. In Negroes there is a continuous curl to the hair, and the twists are irregular, so that instead of lying together the hairs intertwine vigorously and give a woolly mat.

Races are otherwise told apart by differences of shape, almost entirely in the skull and face. Some of these are mementoes of evo-

lutionary journeying, like the size of the brow ridges, or the prognathism of the face. The height to which the nose stands out is to some degree a reflection instead of how much the face has shrunk in, but the narrowness or breadth of the nose is by no means fully dependent on this. The size of the chin differs from race to race, and this, too, is smallest in people with the most projecting faces. Of the soft parts taken alone, the lip is variable in the amount to which it is rolled out, showing the membranous lining; and the most everted lips are also generally the thickest. It goes without saying that everted lips are a Negro characteristic, but the other racial groups also differ somewhat in the same feature.

Finally, the Mongoloid eye is often distinguished by an "epicanthic fold" of skin, whence the clichés about slant-eyed or almond-eyed Celestials. When this fold is present (and European children sometimes have it), the skin in the hollow of the eye above the upper lid is attached to the side of the nose so low down that it makes a screen over the whole inner corner of the eye, and even over the eyelid. There are a good many other ways in which races diverge, but they are less obvious and important. However, there is a whole class of useful information which you get by measuring rather than observing.

Measurements

An anthropologist never seems so impressive as when he is measuring somebody's skull, dressed, for preference, in a white smock; and by this cabalistic conduct he is supposed to read the secrets of race. I do not think I shall be a traitor to the trade if I strip a little of the mystery from the procedure. Your anthropologist is simply trying to get more ways of telling races or racial groups apart, and breadth of head or length of arm can be as useful in this respect as darkness of skin or flatness of face; you simply get them with a pair of calipers instead of making a visual estimate. Especially worthy in this way is an index, which gives you not size but proportion. Let me take the well-known cephalic index to illustrate. You have taken the length and breadth of a head. You then express the breadth as a percentage of the length, which you do simply by dividing the length into the breadth, and, naturally, the higher the index the greater the relative breadth of the head—the rounder it is, in other words. An index of 75 means a head whose

breadth is three quarters of its length, which is a longer-shaped head than one whose breadth is 80 per cent of its length. These are the terms used:

Dolichocephalic (long-headed), anything up to 75.
Mesocephalic (middle-headed), 75 to 80.
Brachycephalic (short-headed), anything over 80.

This same principle, of describing shape by a number, can be and is applied to the nose, the face, the ear, and so on.

Measurements have one definite advantage: you can treat them mathematically, which allows you to take a single average for a group, and also to study its homogeneity. This is practically impossible to do with something like the color of hair, or the texture of it. But measurements have the disadvantage that they are of no great significance in themselves and do little actually to identify the race of a single person or even a group in the way skin color might. It does not mean anything in particular to be long-headed or round-headed. It is simply a bodily characteristic which helps to describe, but not to diagnose. "Measure my head and tell me what I am!" cries some science-loving acquaintance of yours. You measure with pleasure, but you actually tell simply by looking at him that he is a specimen of, shall we say, the White races; you learn nothing about him, as an individual, by the measuring. It would, perhaps, be clearest to say that anthropologists use the obvious, observable features to identify individuals or races, and use measurements rather to tell closely related groups apart, with the help of statistics. Thus measurements are useful in studying the people of a whole area, or a continent, but not in studying individuals.[2]

The Nature of a Race

What, next, is a race, in terms of these things? A race is always a group of individuals, and not some ideal form of which you could take a picture. And the variation of the individuals, a great principle of biology, is an important thing to bear in mind. Shots at a target scatter, and so it is with the members of a racial group. What you are trying to describe is the bull's-eye, the center of the mass; but at the same time an individual who represents a shot in the edge

[2] A lot of anthropological measuring is for other purposes than studying race. It is used for observing the growth of children, the changes from generation to generation, and so forth.

of the target is just as much a member of the racial type as one nearer the middle. Or, when you give an average figure for height or for the cephalic index, this is not a figure you expect to find in every member of the group, but rather the figure most commonly found. You expect a few individual shots to be far from the center, or a few measurements a certain distance from the mean; a long-headed type is bound to have certain extremely long heads and certain moderately round ones, and a round-headed group will similarly contain some long heads; and these odd heads, only expressing the variation of the group, are no less "pure," racially, than their fellows. A largely false notion of purity of racial types has grown up through failure to recognize the fact of variation: a notion of races being cast originally from very definite molds. Nordics tend to be blond (which is different from saying Nordics *are* blond), but the most strikingly fair of them are not necessarily more pure of breed than others with darker hair; not all Chinese have eye folds; and the most puffy-lipped African is not automatically more of a Negro than one whose lips are less thick.

There is a further thing about racial features. By and large, they are not adaptations, of the sort illustrated by the greatly differing kinds of mammal. Black skin and the tropics, white skin and the chilly, sunless forests of the north of Europe would seem to go together. But this is a layman's assumption. It has not been proved, and one can confound it by pointing to the unvarying color of the American Indians from Baffin Land to Tierra del Fuego. This is not to deny completely that environment has influenced skin color through natural selection—it is not improbable at all. But if it has done so, it must have taken a very long time (considering the Indians again), during which climate has altered radically enough to break up the argument altogether. And with skin color goes what would seem to be the best case for the environmental determination of racial qualities.

Another kind of racial difference comes from the fact that a given feature may be more thoroughly "evolved" among some peoples than among others. The aboriginal Australian, for example, has larger, and consequently less "evolved," brow ridges than most men, as have also the Europeans; while, on the other hand, the Europeans have straighter faces and more chin, and are more evolved in the human direction in this way than the main body of mankind. Races, therefore, have been in the process of separation,

while Homo sapiens was still evolving, long enough to get out of harmony in these slight ways. Nonetheless, all the features which are distinctive enough to seem of any practical biological value, to express a real stage of evolution in man, or to be considered adaptive modifications (erect head, large brain, thinning of skull, straight, light skeleton, et cetera)—all these are found in every race of the species. As far as we can truthfully say, then, racial features are "non-adaptive"—not a product of natural selection.

This is equally clear in matters of physiology. Between the skin and the skeleton all men are almost indistinguishably alike, no reliable differences having been discovered in the bodily processes of different races. Slight variations have been found in metabolism, or in certain kinds of performance, but in all such cases one cannot be sure that the differences are not due to the adjustments of the individuals to their habits, to their diet, or to climate, so that in other surroundings the same groups might become readjusted and give a different result. The blood of all men is precisely the same substance, and if you, a white American, were filled to bursting with transfusions of the blood of other races there would still be no chance that your skin would darken (or that of your children), or that you would start to speak Choctaw.

Much has been said, of course, about the differences in blood groups between races, but from the point of view of telling races apart this is simply misleading, because the same blood groups occur in all races, varying only, and very irregularly, in proportions. It will be surprising if in the long run internal differences between races are not clearly established. There is a general conviction, for example, that each has its characteristic odor, though this is hard to analyze and prove. And Negroes are found to be definitely more resistant to skin diseases than are Whites. But the point is that, with all the existing refinements of medical testing, detectable differences are slight, and the basic unity of mankind in all of these things by which he lives and adapts himself to nature is impressive.

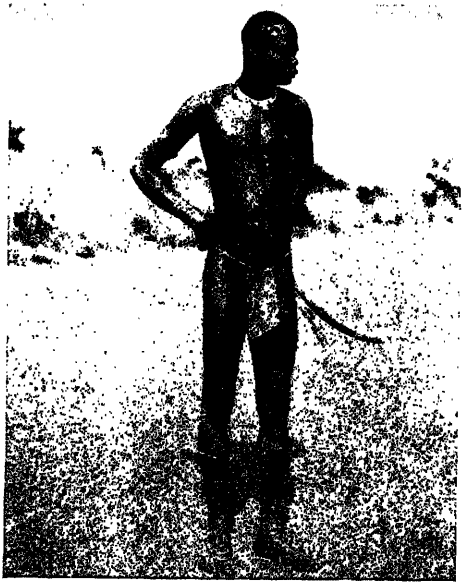
It is the same with the senses. We cut our teeth on tales of the great acuteness of Indian sight and hearing, some of them well founded. But this acuteness turns out to be due to training and experience, and not to superior eyes and ears; in other words, not to seeing more, but to knowing and recognizing what it is that one is seeing. Actually, if tests are used which get around this, and test

American Museum of Natural History photo

FOREST NEGRO WOMAN, CONGO

American Museum of Natural History photo

PYGMY WOMAN FROM THE CONGO



Peabody Museum photo

NILOTIC NEGRO, ANGLO-EGYPTIAN SUDAN

Peabody Museum photo

BUSHMAN OF SOUTH AFRICA

the senses as senses, savage peoples often seem even a little inferior to civilized whites. But again this is not a racial difference, being traceable instead to diseased eyes and dirty ears.

However this may be, differences of a very tangible kind certainly exist on the surface. It is, in fact, just because these external markings are so pronounced that it is easy to jump to conclusions and assume that differences in mentality or behavior are on the same seemingly wide scale. Now we have seen that natural selection has probably had little to do with either internal differences (which hardly exist) or external differences (which are non-adaptive). How, then, are these striking if superficial divergences to be explained? What is the origin of race?

The Cause of Races

Most people, I believe, have only certain vague ideas at the back of their minds about this, and much of the misunderstanding about race probably comes from the rather extraordinary history of past theories. Races were recognized in antiquity, but roused no great interest, and were shrugged off with some fabulous explanation; any foreign land was thought to be peopled with ogres or cannibals (the Anthropophagi), and a man who differed from yourself merely in having a black skin and fuzzy hair was by comparison nothing to look at twice. Little of the world was known. Race was really discovered in the fifteenth and sixteenth centuries, in the great age of exploration. This was, of course, before anything like an evolution for man was envisaged, and the stunned travelers from Europe ascribed the many new kinds and colors of men to a series of separate creations, in other Edens which the Scriptures had failed to mention. With Darwin, however, it became apparent that the fabric would not wash. Another idea, that all these races were descendants of the several sons of Noah, perhaps hung on longer before collapsing. Nevertheless, Darwin was so new, and so little was actually known about the past, that people were not possessed, to help them think, of any logical notion as to how races might actually have appeared and grown up.

There seems to have prevailed simply a hazy understanding that somewhere in the past there had been ancient races which once were pure, which would imply nothing as to how they came into being in the first place, unless one fell back on Shem, Ham, and

Japheth after all. This mythical atmosphere made it possible for the Germans to develop their groundless philosophy (long before the Nazis) of ancient Aryan purity as the secret of civilization. With what we now know of the pattern of animal evolution there is no excuse for such an idea, and it should be buried forever in the past. Let us, instead, consider race in the light of known principles.

Races seem very different externally. But if we are to put these differences on a scale along with the fossil men, of whose exteriors we are ignorant, we must look at skeletons only. And here racial distinctions become far less. Beyond making a judicious guess, it is not always possible to tell the race of a skull, and the rest of the skeleton gives almost no indications. The trained eye can generally spot the narrow, poorly filled skull of the native Australian, with its large brows and small chin, or the wide face and peculiar, high-pitched cranium of the Eskimo, or the long, straight face of a European. Negroes, American Indians, and Mongoloids generally are harder to discriminate. But all the skulls have the features of Homo sapiens that I have previously described. How would you explain a collection of men, differing from group to group in minor details of the skull, but all at the same time fundamentally alike, and never differing among themselves as much as do Homo sapiens, Neanderthal, and Rhodesian?

The answer to this, and to race, would seem to lie in the "origin of species," which I have already described. Evolution is a matter of constant change. The arrival of Homo sapiens himself was evolution in the sense of progressing, but evolution can also mean simply becoming different, and this would seem to apply to his races. Perhaps the essential thing is whether animals or men breed as a single group. If they do, they will share their bodily features, and all their changes, and remain the same race. If they do not, they will not undergo the same changes, and they will become different. This is how two or more new species are formed out of one old one. At an advanced stage in the process there will be different adaptations, but the earliest differences to appear are mostly random and of little biological significance, and these are the kind of differences which distinguish the races of man.

The races, therefore, correspond to the very latest branching out of the spruce-tree twigs, the last stage and expression of human evolution. Their likeness in fundamental structure and the random, non-adaptive nature of the things in which they differ show that

they have not moved far apart, and have only just begun the process which might have led afresh to several species of man.

The Major Races

The great, familiar racial stocks, the White, Yellow, and Black, obviously represent an ancient separation. Evolution does not proceed by neat steps, and the separation probably took place almost as soon as Homo sapiens could be called a species, or at least when this species began to spread out into different territories. These divisions then evolved to some degree in isolation from one another. But in spite of the considerable differences in their appearance, it is difficult to call any of them definitely more advanced than the others, or think of any of them as older. The Whites[8] are rather generalized: they are the most advanced (or the least ape-like) in having the straightest face, but they have the thinnest, most ape-like lips and the hairiest of bodies. Both the Negroes and the Mongoloids are more specialized, the Mongoloids with their flat faces and eye folds, and the Negroes with their fuzzy hair (not found in other primates) and their thick lips; the Negroes have the most projecting faces, and are most primitive in that respect. A fourth racial stock, however, that of the native Australians, does indeed deserve to be looked on as primitive, and as the most archaic of races. The others each have a few primitive features, but the Australians have all of them: hairiness, small brain, big brows, protruding mouth, and sloping forehead and chin, and many others. They are, so to speak, generalized, and one can imagine that the other races might have all developed from such a type. They give us an excellent idea of what a primitive Homo sapiens was very probably like.

It may be that certain other peoples, like the Bushmen of South Africa, are ancient, major stocks. But this is not the greatest complication we must meet. The main one is the business of subdividing the major stocks. Now, nobody is simply a White, a Negro, or a Mongoloid, because these stocks are in turn divided further into Nordics, Pygmies, American Indians, and so on. The process of divergence, as I have been insisting, is continuous—only a "breeding unit" can be expected to remain a racial unit—and the major

[8]They might better be called the Pinks. The traditional name, Caucasian, has nothing wrong with it, though it is meaningless.

races have each given off variations of themselves. Added to this, many existing types of men arise from mixtures of the others. For all these reasons the racial panorama around the world is complex and varied. No two people would classify races in the same way, and I shall certainly not try it at all. But if we are to learn about the recent history of Homo sapiens we can do it only by studying the distribution of racial types, by a sort of giant Cook's tour on paper, on which we shall now embark. One admonition only: the year is 1492, or at least a time when the Europeans had not colonized every quarter of the world, to kill off its older inhabitants with sermons, spirits, and smallpox.

TABLE OF RACIAL STOCKS AND THEIR CHARACTERISTICS

	White	Mongoloid	Negro	Australian Aborigines
Skin	white	yellow, brown	dark brown	dark brown
Eyes, hair	varied	dark brown, black	dark brown, black	dark brown, black
Hair	straight, curly	straight	woolly	straight, curly
Body hair	medium	none, slight	none, slight	medium
Prognathism	none	slight	marked	marked
Brows	medium	small	small	marked
Forehead	sloping	upright	upright	very sloping
Chin	projecting	medium	slight	receding
Nose	high	low	flat	large, broad
Lips	thin	medium	thick	medium

CHAPTER XIX

Europe and the White Races

EVERYBODY has heard of Nordics, Alpines, and Mediterraneans, a division which has been sinking into the public consciousness for fifty years and more. The Nordics are (or tend to be) blond of hair and blue of eye, tall, with long heads of fairly good size, and long faces with deep chins. Their blondness called notice to them in antiquity, and the same thing caused them to be the first racial type to be picked out for attention by students of the nineteenth century, when the infant science of man was developing. The tow-headed and rather blameless Scandinavians were seized upon long ago as the original Aryans by the founders of this old German racial legend, and there was a general tendency to look on them as perhaps the one race truly indigenous to Europe.

But this was before the Rome–Berlin Axis, and it irked the great Italian anthropologist, Sergi. He pointed out that in the south of Europe there was an equally definite type, shorter in stature, with a more delicate skull and face, but also long-headed and long-faced, and with a brunet complexion: a swarthier skin, dark eyes, and dark, often curly hair. He named this type the Mediterranean and introduced the view that, since it stretched from Gibraltar to India, it had a far better right to be looked on as the fundamental White race, wherever it may have arisen. This view seems to be correct, as we shall see. But Dr. Carleton Coon, on whose excellent book, *Races of Europe*,[1] I shall lean heavily, indicates that it is not the Nordics or the Mediterraneans but the Alpines who might claim actually to have first come into being on the soil of Europe itself. The Alpines are intermediate and rather indefinite in complexion, but in build they are of middle height, thickset, and round-headed, with a broad forehead and a fairly broad nose.

These are the classic European races. At least one other equally

[1]Nineteen thirty-nine. This is a completely new analysis, and not a modernization of the well-known book of the same name by W. Z. Ripley, which was published in 1899 and was the first general study of Europe.

valid type has been defined: the Dinaric, or, which is about the same thing, the Armenoid. This, like the Alpine, is brachycephalic, but instead of having a globular head it has one with a slanting, narrower forehead and a very flat back, so that it rises to a high, short crown. The face is big, and the nose, a very characteristic feature, is narrow but high. Several other races or racial types would be accepted by many writers, but they are less important, and once the business of listing possibly distinct races is begun it is hard to know when to stop.

Nevertheless, this older scheme is an oversimplification. It is true that you can say that the Nordics predominate generally along the north of Europe and the Mediterraneans throughout the basin of that sea, while the Alpines form a great wedge from the east with its tip at Brittany, with the Dinarics cropping out here and there from the Adriatic to the Near East. But actually, in almost any given part of Europe, there is a great variety of apparent racial type. This fact is usually greeted with the observation that there has been prolonged and widespread mixture. However, this is not enough of a corrective to the simplicity of dividing man in Europe into three or four racial parts. For to suppose that all is mixture, or, on the other hand, ever to have said: "My brother is a Mediterranean, my sister is an Alpine, but I think I am a Nordic," is to be content with classification and to fall into the fallacy of assuming that, once upon a time, three or more races appeared somewhere in a vacuum, in a state of original purity. This is forgetting both biology and history. The white races must obviously have a common origin somewhere in antiquity. The likely view is that Europe is indeed a cauldron of mixture, but also one of long-time local divergence and recombination, marked by a tendency for the principal divergences to take place in the directions of what we know as Nordic, Alpine, and Mediterranean. It is not necessary to suppose that these have ever been particularly purer than they are now.

In other words, Nordics, Alpines, and Mediterraneans surely do not float around in a mere scheme, and must be rooted to something in the past. One of the virtues of Dr. Coon's book is the transfer of interest from classification to the historical and archaeological background which has been accumulating.

Paleolithic Beginnings and the Mesolithic

The present peoples of Europe did not evolve there. Europe, of course, is not really a continent at all, but only a large peninsula, a western cul-de-sac of Asia, and truthfully speaking one of the ends of the world. Therefore, we cannot really be surprised if it appears that most of its inhabitants are immigrants from somewhere else. The story of modern Europe begins, as we have seen, when the people of the Upper Paleolithic arrived, anywhere from 35,000 to 50,000 years ago, at the height of the last glacier, crowding the Neanderthals over the brink of oblivion. The same people were present also in North Africa, and they could conceivably have entered Europe from there, but the chances are that it was not their original home. More probably they arrived both in Europe and Africa from somewhere in southwestern Asia.

They were hunters, of course, depending essentially for sustenance on the flesh of game animals, though they doubtless filled out their diet to an important extent with wild vegetables and fruits. And they were skillful hunters—more than a match for any beast. But their manner of living was one almost as old as man himself. For doubtless over a million years, ever since man had got command of fire and committed himself to a meat diet, life had been hunting and hunting had been life. He had known no other way of existence, nor any real change in it.

These people were a kind of generalized white type, long-headed but marked above anything else by the large size and rugged structure of their skulls. One or two round heads have been found, but only as many as one would expect as the extreme variants in a long-headed people. No visible change really took place among the Europeans during all the rest of the Paleolithic. Conventionally, this came to an end as the glacier left the mainland of Europe; its retreat can be accurately timed, and this took place just under 14,000 years ago (11,800 B.C.).[2] But the succeeding Mesolithic period, often referred to as transitional, was simply one of greater local variety in stone cultures, and thus a continuation of the Paleolithic. New devices of great usefulness probably appeared for the first time: canoes, netting and basketry, and methods

[2]Dates for the retreat of the glacier in North Europe can be told with great exactness by counting the layers or bands of clay, known as "varves," which were laid down by the water melted from the ice by successive summers.

of fishing; and dogs were now domesticated and used for hunting, as they had been from the end of the Paleolithic. It was also perhaps a time of movement of peoples. The shores of the Baltic were newly open, and the hunters were drawn northward as the cold-loving reindeer followed the ice; and settlement along all the shore lines of Europe was encouraged by the existence of shellfish. The people themselves were to a considerable extent the descendants of the Upper Paleolithic population, especially in the north and the west. However, among these are to be found some broadheads, apparently the first real introduction of them. The best known of these were found in the Ofnet cave in Bavaria. Here were discovered thirty-three skulls all huddled together in a circle. Their owners had each been killed by a stone ax, and all the heads had been cut off and buried together in this fashion. I wish I knew what had happened to them. Some were of the old Upper Paleolithic type, but the greater number were round-headed and broad-faced, having a different look.

Quite aside from these, there were some groups of people in Egypt and the Near East who were long-headed but had the lighter-boned, smaller skulls of men of today. During the Mesolithic, then, Europe was still in the hands of the big Paleolithic people, but their center of gravity seems to have been shifting northward, and heralds of other kinds of Whites were putting in an appearance to the east.

The Neolithic Era

Culturally also, the Mesolithic was only the somewhat refined extension of the ancient way of life, bringing dependence on hunting, in Europe, down to three or four thousand years before Christ. The turning point came with the Neolithic, the most important thing to happen to man between the time when he left the trees and this present moment, barring nothing. "Neolithic" means New Stone Age, conventionally, and indeed some stone tools were polished, which allowed the making of an efficient ax for woodworking; and the important arts of pottery and weaving were discovered. But these are inconsequential doodads beside the domestication of animals and plants, which is the foundation of modern life and of all recorded history. Because of agriculture we can live together in large numbers and therefore accomplish a civilization

resting on writing, mathematics, science, and trade.[3] Without it we might still be bending every thought upon the next meal; still living a Paleolithic life such as was led by our own forefathers ten thousand years ago or less and such as would be beneath the contempt of the New England Indians or the natives of the Congo. To return today to hunting would call for the extinction of all but a handful out of every thousand living persons. And in such a state as that, what use could we make of writing, or of the formula for sulfanilamide?[4]

The difficult process of learning to breed animals and to seed vegetables, and so to overturn those laws of nature which had always limited the supply of possible food, must have been a gradual one, taking several thousand years.[5] For the people who did it could hardly have fully realized what it was that they were doing, and different animals and plants were probably brought under control in different places. Only when these had become hardy and prolific in a domestic state, and only when borrowings had put any given people in possession of several different kinds of this food, would such a group find itself comfortably independent of hunting and able to give up wandering in search of fresh game.

Cattle and grains appear to have been domesticated on the Persian plateau, or north of it, though the actual place and date are not yet known. From somewhere in that region, however, came an outpouring of farmers to be the new population of Europe. Control of the food must have brought a tremendous increase of numbers in this homeland, leading to overpopulation, and it is also suggested that the area, just at this time, had finally become as dry as it is today. The two factors would be the proper combination to make many of the inhabitants migrate to better lands, somewhat as the potato famine started a great stream of movement from Ireland to the United States at the middle of the last century.

Eons from now this trek will seem to have been an almost instantaneous transfer, like the impression we have of the arrival of the Cro-Magnons. But the Neolithic invasions lasted about 2,000

[3]These benefits actually appeared later, in the Bronze Age, but are impossible without agriculture.

[4]The leading writer on the emergence of civilization in the Neolithic and Bronze Age is V. Gordon Childe: *The Dawn of European Civilization*, 1939, and *Man Makes Himself*, 1936.

[5]See R. H. Lowie, "American Culture History," *American Anthropologist*, new series, vol. 42, 1940.

years, and at that they skirted around a few patches of people living a Mesolithic life without dislodging them. Even after the discovery of agriculture, in other words, about half the time between that moment and this was to elapse before some of our northern ancestors were lured out of the woods by the newfangled practices. The Neolithic as a period, therefore, begins far later in the west of Europe than in the east: by this time culture was progressing faster than it could spread out, so that the Bronze Age was in full swing in the east before the Neolithic had really completed its course through the west.

The Neolithic people who left their home in southwestern Asia took various trails, but many of them led to Europe. They can be followed, because they made pottery of definite forms differing from group to group, and because large communities leave more remains. Some came into the northern lands through southern Russia and the Ukraine. Others came through Turkey and followed the valley of the Danube up into the heart of Europe. Still others arrived in the same place, but came through Egypt, following the narrow shore of North Africa and crossing the Strait of Gibraltar. And others yet went largely by sea through the Mediterranean itself, out through the strait to the Atlantic coast, to the British Isles, and to Scandinavia, these being the Megalithic people who built the dolmens and the other large stone structures of western Europe.

Neolithic "Mediterraneans"

These were the main migrations. Their points of departure are not known, but they were not from a single source alone; details of their cultures or their pottery styles are far too individual. Physically they were all of one generalized, basic European or "White" type, medium-sized, with long heads. Coon calls them all Mediterranean in the skeletal sense, not meaning that they were all as slight of build and as brunet as the living type to which the name is given, but meaning that they were homogeneous in fundamental character[6] and might constitute a lighter-skulled version of

[6]Coon gives names to the several variant types and describes them in detail, and traces their hypothetical later histories—a matter of great difficulty and complication. What I am trying to do here, and with the peoples to come, is to give an outline of the utmost simplicity. Those who would like a fuller treatment are urged to read Dr. Coon's replete and well-written study.

the Upper Paleolithic people, or the Galley Hill Man. But the Neolithic people varied within this description, the principal distinction being that some approximated the living Mediterraneans in build while others were larger, with heavier faces and even longer heads (one such type is often called Atlanto-Mediterranean). This is not difficult to understand. As the Neolithic way of life developed in southwest Asia, it probably did so not at a single focus but over a wide region, with different communities participating in it and contributing to it. Given a fundamental White race of the kind described, under these circumstances, the perennial tendency toward divergence might be expected to have exerted itself somewhat, producing varieties running from the slender Mediterranean of today perhaps all the way to something like the Cro-Magnons. At any rate, the same region, southwest Asia, still contains both small and large types, or groups, of the same fundamentally Mediterranean stock.

In Europe, the smaller types among these new arrivals mainly occupied the shores of the Mediterranean itself and the central and southeastern parts of the continent. The essentially Mediterranean racial character of parts of southern Europe and other Mediterranean lands thus was founded at that time, not to be altered radically since. Egypt, for example, seems to have racially the same population now as it had then. It was the larger-headed types who went, both by the west and by the east, more toward northern Europe. Here they came up against the remaining stronghold of the very large-headed Paleolithic and Mesolithic hunters. The latter would have been poorly equipped to contest the country with settled farming people and would tend to be driven still further north. However, the two peoples doubtless began to mix at once all through this zone of contact, and in central France it appears that the Mesolithic people were actually left temporarily undisturbed.

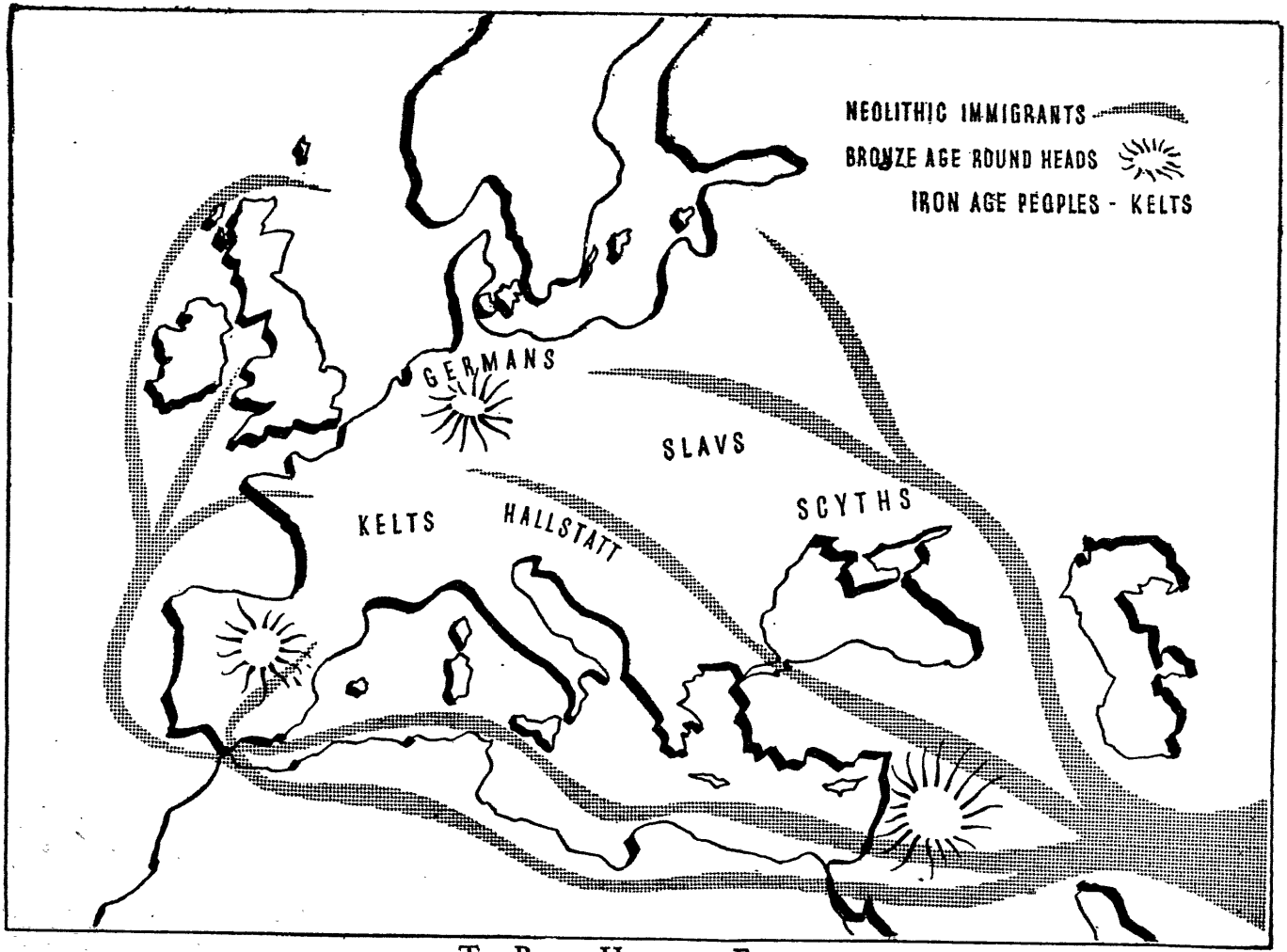
Now, as we have seen, all the people who were on the move in the Neolithic were long-headed. In other words, no brachycephals were coming into Europe, as everything indicates. And yet round heads were present there during the Neolithic, notably among the peoples of the Swiss Lake Dwellings. They must, therefore, have carried over from some of those round-headed people who had been there earlier, in the Mesolithic, and had survived in some strength in Scandinavia during the Neolithic (called the Borreby

type). And if the Bronze Age, which comes next, can be given a general theme to distinguish it, it is that during that time round heads manifested themselves far more widely.

The Bronze Age and Round Heads

The Bronze Age, as a culture, spread gradually over Europe in the pattern of the Neolithic. Various people were moving west through the Mediterranean, though not in the relative force of the Neolithic farmers. The Bronze Age was not a fundamentally new tradition, and the term "Bronze" does not convey its character any more precisely than "New Stone Age" implies the domestication of food. It is marked by the appearance of the metal, but that is minor. In the east, the Bronze Age saw the founding of European civilization. Among the farmers, cities appeared in the most favorable places, and these indeed introduced a new kind of life in a few localities. There was a new division of labor, so that some lived as artisans entirely; new kinds of work appeared, and these called for trade in materials; and in the centers of work and trade, the cities, people lived close together in blocks of houses. Over such a large population rose rulers of yet unheard-of power, able to construct temples and palaces. And through all this ran knowledge, writing, and mathematics. That was the Bronze Age. Before 3,000 B.C. there arose the Indian cities, Mohenjodaro, Harappa, and others in the Indus Valley, and Kish and the Sumerian Ur in Mesopotamia; and before the Bronze Age ended Egypt had had her day, the Minoan civilization of Crete had taken the scepter from her and had passed it on again to infant Greece. But this was the east. In the west life remained rude, although the knowledge of alloying and casting bronze, with certain other improvements in culture, had by 1,800 to 1,600 B.C. penetrated all but the furthest reaches of the north, and the trade in tin and copper from which to make bronze caused a considerable amount of travel and contact all over the continent, including the British Isles.

The racial history of the period is rather confused. Its beginning, of course, was the Neolithic's end, and in the east the civilizations of Mesopotamia, Egypt, and Crete grew up among peoples of the Mediterranean type. Later on in the age (in the east) there appeared in Asia Minor the first visible people of Dinaric form, with short heads and somewhat higher noses. They do not seem



THE RACIAL HISTORY OF EUROPE

to have come from anywhere—still further east in the Neolithic homeland the people were dolichocephalic Mediterraneans then as now—and the only remaining deduction is that they developed in that very region.[7]

In the west there seems to have been, continuing from the Neolithic, a similar spontaneous blossoming of the other kind of round-head, the Alpine, growing from the same ancient Mesolithic roots; nowhere becoming the ruling racial type as yet, but cropping up as a minority in many parts.

The signal event of the Bronze Age, however, the principal movement, was that of one major group of round-headed people along the western coast, generally referred to as the Bell Beaker people. Dr. Coon, in his thoroughgoing analysis, believes that they can be traced all the way to the Dinaric source at the eastern end of the Mediterranean. This type did move westward through the sea, making itself felt along the shores and in the islands, affecting somewhat the basically Mediterranean population in many places. The Bell Beaker people themselves (and some close relatives) had two centers, connected in an unknown way, in Spain and northern Germany, and their movements are revealed by the presence of the sort of earthenware tumbler known as a bell beaker. They were round-heads, who were large and heavily built, and therefore probably were descended in part from peoples of Upper Paleolithic physical type still present in northern Europe, although Coon traces the original round-headed influence in them all the way back to the Dinaric source just mentioned. This Bell Beaker type was important in Central Europe, and up to the mouth of the Rhine, and particularly in the British Isles, to which it might have come both from Germany and from Spain. They were, at any rate, the people who brought bronze to Britain and who mixed with the older large long-heads to give a general intermediate type of good size which has carried down to the present in many parts.

The Bronze Age, then, was marked by the appearance of round-heads in important numbers, both in the east and in the west. The Dinarics, appearing in the east, were active, affecting the Mediterranean fringe somewhat but being more important in the zone to the north of this, extending to northern Germany and Britain. The more globular-headed Alpines, who had already been seen in

[7]Coon (op. cit.) discusses a hypothetical manner in which the Dinarics might have arisen from a certain blending of existing strains, including the Alpine.

the Neolithic, did not travel in this manner, but had a slight increase in strength which only presaged their later importance. In Scandinavia and on the mainland opposite the old Borreby type of large round-head still persisted from the Mesolithic, and Coon thinks that, while no explanation is satisfactory, the Alpines must be derived from this Borreby type mainly by a process of reduction. The Borreby type was not the only one which was affecting the increasing number of racial forms coming up from the south, as it retreated before them, for there were long-heads of large size and of obviously ancient establishment in the north as well. To summarize the west of Europe, therefore, the old Mediterranean type still occupied the south from Neolithic times, while to the north of them, as the Bronze Age ended, there were Dinarics, Alpines, and long-heads from the Neolithic, moving and mixing with one another and with the large-headed types carrying over from the Old Stone Age, who had lingered on in Scandinavia and probably to a slight extent in the British Isles. In the east, on the other hand, from Germany through Russia, some of the long-headed peoples who came in during the Neolithic lived through the Bronze Age in greater tranquillity, and these are the ones who became the principal progenitors of the Iron Age Nordics.

The Iron Age and the Nordics

The Iron Age was even less of an "age" than was the Bronze Age.[8] Conventionally it is commonly taken to have run from 1,000 B.C. to the beginning of the Christian Era, and to be marked by the introduction of iron into Europe and the spread of its use. The time and place where ironworking was discovered remain an utter mystery. Iron is a far better and harder metal for tools than is bronze, but the majority of metal objects continued to be made of the latter. And as far as the history of our civilization goes, the Iron Age was not a stepping out of the old into the new, but only an iron-embellished continuation of the Bronze Age. Greece picked up where Crete left off. Her Golden Age technically falls into the "Iron Age," and during the same span Rome replaced Greece as the forefront of the westward progress of civilization, to reveal it in some degree in turn, before the Dark Ages, to the rest of

[8]Outside of Europe the idea of a Bronze Age and an Iron Age can hardly be applied at all.

Europe, where life had been changed only by the growth of a larger number of towns and villages. If you must speak in terms of time, it would be better perhaps to say that, as a period, the Iron Age began with the appearance of iron and ended in different parts when peoples gave up a tribal life and became cosmopolitans of Europe, which often meant succumbing to Roman rule or, later on, accepting Christianity. This is, of course, a generalization.

But the Iron Age has a real character in one way: it was the time of the establishment of the Indo-European languages, sometimes called Aryan, spoken today by almost the entire continent. The Greek, the Latin, the Keltic, the Germanic, the Slavic, and many other branches found their present places during it and have hardly changed since.[9] Before this time, Europeans spoke languages which are now, with the exception of Basque, lost and unknown. The great Indo-European language family is relatively young and had its beginnings some time before 2,000 B.C. somewhere in the east, probably in southern Russia beyond the Volga and north of Persia. Little has yet been made out about its early days, but its original proprietors were probably a people not too advanced in culture and partly nomadic. Its first definite manifestation was not in Europe, but in India, where it arrived in the northwest on the tongues of the Aryas,[10] about 1,400 B.C.

The family had become divided into distinct branches when it made its bow in Europe, roughly coincident with the new metal, iron. It did not come in, as has been fondly imagined, arm in arm with civilization. Far from it. Indo-European was actually carried about by those very people who were living a tribal life beyond the pale of the existing civilization, and it was brought to the civilized centers by them. The Iron Age might also be called the Age of the Barbarians. Iron brought better swords to a people only too glad to turn them against their neighbors and, in brief, the Iron Age in the west of Europe saw a series of upheavals in which a tribe or group of tribes erupted suddenly and swarmed over some major portion of the continent, and of which the Germans by

[9]Even the retreat of Keltic before a Latin language in France and Spain and before a Germanic language in England only marked the end of the Iron Age.

[10]Whence the term "Aryan," which is rather meaningless and is at best a disreputable synonym for Indo-European. It is hardly worth repeating the fact that it is only dealing in confusion to apply it to races, except to show how the Nazis have plumbed the depths of asininity in this respect. They call a Jew a non-Aryan. But their only practical conception of an Aryan is a non-Jew. This is simply defining a Jew as a non-non-Jew. Q.E.D.

Photo courtesy Carleton Coon

NORDIC FROM SWEDEN

Photo courtesy Carleton Coon

ALPINE, SPANISH BASQUE

Photo courtesy Carleton Coon

MEDITERRANEAN, FROM THE RIF, NORTH AFRICA

American Museum of Natural History photo

DINARIC, TURKISH ARMENIAN

whom Rome was cut down were only one of a list. This was the process by which the languages of today were spread. It does not mean that there was any great migration of Indo-European speakers into Europe from the east—this, in fact, does not seem to have been the case. Nor does it mean that these truculent hordes made a racial sweep of the regions they successively overran. The fact is that languages may replace one another with comparative ease: witness the manner in which Ireland, never in any sense an Anglo-Saxon country, has come to speak the Anglo-Saxon language in place of Keltic. The barbarians actually have left surprisingly little of their physical stamp in most of their onetime territory. Our immediate interest in them is that they were, by and large, peoples of the Nordic type.

There certainly were, as I have said, peoples of this type over a broad territory from Scandinavia to South Russia toward the end of the Bronze Age. One great difficulty largely prevents us from knowing what exactly happened at the beginning of the Iron Age: during late Bronze and early Iron times the wretched Europeans burned their dead and buried only the ashes. So we know little about their skulls. However, an iron culture, the Hallstatt, appeared in Austria with a Nordic physical type about 1,000 B.C. The culture, marking the beginning of the Iron Age in western Europe, expanded. It went slowly to the north, and hardly to the west at all; its main direction of motion was down into Yugoslavia. It is thought that these people spoke an extinct, little-known branch of Indo-European (Illyrian). At the same time, other tongues of the family were making their appearance in Italy, from the north, and in Greece, though the manner of this is not clear and the bringers may have been folk still living in a Bronze culture.

In the east, a few hundred years later, we have some semi-historical knowledge of another people of Nordic type, as far as can be told: the Scythians and their neighbors. They were nomadic horsemen, centered north of the Black Sea from the Danube to the Don, but widespread. They tell us little except to show that this large region was apparently predominantly Nordic.

In western Europe the Iron Age from 500 B.C. on is known as the La Tène period, after the culture of the Kelts, or Gauls, with its rich art and now-flourishing town life. It had its roots along the upper Rhine, but the Kelts, like the others, had an explosive expansion, although the aftereffects have not been very profound

in most places. They went to the southeast, into Italy and also into Greece, and one colony was even planted in Asia Minor, the Galatians, who were favored by Saint Paul with an epistle. But it was in the west, in France, where they found their great domain, before the Romans put an end to it, and they went also into Spain and England.

Coon makes of the Kelts a sub-type of Nordic, but they were certainly a borderline case, having somewhat rounder and lower heads than would be expected. Above all, they typically had brown or reddish, rather than light, hair—it was not the Gauls but the Germans whom the Romans displayed for blondness in their triumphs. The Kelts probably represented something of a crystallization of the older, mixed Bronze Age population to a great extent, rather than an efflorescence of the typical blonder Nordics present to the east and north. In other words, while this latter element may have been present, the older dolichocephalic Neolithic and brachycephalic Bell Beaker strains were probably of great importance. Now the earlier people of the British Isles were also composed in a somewhat similar way, which may explain why it is difficult to tell what the real extent of Keltic influence, racially, in Great Britain was. The Kelts were important in southern England, where they are probably distinguished by slightly smaller skulls, the other Britons retaining more of the ancient Paleolithic big-headed strain. At any rate, the entrance of the Kelts there appears to be the last significant contribution to the racial nature of Britain. On the continent, in spite of its onetime prevalence, the type of the Kelts has largely disappeared.

The Italians of today are thickset and somewhat mixed Mediterraneans in the south, changing to something mainly Alpine toward the north. The Romans of the Empire were also by no means typical Mediterraneans but seem to have been, in the north at least, something like the Kelts, and were probably a mixture of former strains influenced to a degree in a Nordic direction, apparently by the bringers of iron from the north at the beginning of the Iron Age. The Romans do not seem to have modified any of the other peoples of Europe in any case, for all their conquests. When Rome had passed its peak, after the beginning of the Christian Era, two other groups of Nordics spread far and wide and fixed their respective language families over big areas: the Germans and the Slavs.

What the Germanic Goths and Vandals did and where they went hardly need recounting. They streamed away from the Baltic shores; they broke up the Roman Empire, and they went nearly everywhere. Who they were is the important matter. They seem to have been Nordics from the old Hallstatt center who had gravitated northward into North Germany and Scandinavia and held these lands against the Kelts. Here they had mixed with those older, big-headed people of Paleolithic ancestry (almost certainly both were blond) and so had become a larger-skulled variety of the same general type, and in fact what would be thought of by most people as the classic Nordic. Their volcanic departure from the Baltic doubtless has done much to create the historical impression of this area as the "home" of the Nordics. In the lands they overran they have actually left little trace of their racial type, though they were probably responsible for a good part of what blondness is seen today in the south of Europe. The Vandals who finally wound up in North Africa have left no signs of themselves. It is likely that their spectacular doings have caused their actual numbers to be exaggerated.

The Anglo-Saxons, from the Rhine's mouth, were another branch of the same type, known from English cemeteries. They settled in England, of course, in considerable numbers, but if this invasion, or the succeeding Norman Conquest, had any great effect in a racial way, it cannot be detected, for the present population seems, on the whole, to go back to the Kelts and even more importantly to the older people, and Britain is not a fair-haired nation to a really "Nordic" degree. The Franks, finally, were probably a mixture of Kelts and of Germanic Nordics.

The Slavs were the last people to go on the march, in the sixth and later centuries. They had lived originally, perhaps for a long time, in the marshes of Poland, in wooden palisaded villages like the Irish crannogs. In type they were unquestionably Nordics, being long-headed and blond, and certainly not at all round-headed like their descendants, the modern Slavic-speakers. On their outward migrations they ran up against the Germanic stronghold to the west, but one great movement took them south into Bohemia and Yugoslavia, and a greater still took them eastward, far into Russia. The weight of these thrusts is revealed in the fact that the Russian migration drove the Finns, who were in Russia, speaking their non-Indo-European language, into the north and split them

apart from their kindred in speech who live today, as they did then, beyond the Volga.

Here came to an end two thousand years of Nordic wanderings. What do they tell us about the old puzzle of Nordic origins? The traditional belief, and the one on which the writers on Nordic or "Aryan" supremacy banked, was that the Nordics arose in a particular place as a unified, unmixed race, endowed by Providence with yellow hair and a knowledge of what is good for other people, and that all of European blondness can be traced back to them. There seems to be little back of the idea in actuality. The evidence is good that typical Nordics (as a large and blond version of the fundamental, long-headed Mediterranean type) did form over a wide area in southern Russia before the beginning of the Iron Age, and that the same kind of people further to the west began harrying their less war-like neighbors with long iron swords and Indo-European languages. But these basic long-heads go back in that area all the way to the Neolithic. Are the Nordics to be looked on as an extraordinary development, or a pure race? The crux of the matter seems to be blondness.

Now blondness is clearly not the property of these later Nordics alone, but seems to have been incipient in the Neolithic long-heads (particularly the larger-headed type) and even in the Paleolithic people. It is found where Nordics (meaning the Iron Age travelers) cannot have been responsible. The Vandals can hardly explain its presence in the Rif, in North Africa, because they did not go into the Rif. In Denmark the skeleton of a Bronze Age woman, apparently of Paleolithic ancestry, was found with her blond hair accidentally preserved. And in the British Isles (and especially Ireland), where brown hair is typical and where Nordic influence (in the Kelts and Anglo-Saxons) hardly seems to have been overwhelming, the prevalence of blue eyes, which is as great as anywhere in the world, must be rooted in older, pre-Nordic strains. Blondness today is spread in a great circle centering on the Baltic States and reaching west into Scandinavia and far to the east into Russia, so that one is at the Ural Mountains or halfway down the Volga before coming to an area where the average pigment is as dark as in the middle of France. All in all, it appears that the ancient tendency toward blondness became intensified, perhaps as early as the Neolithic (by an evolutionary process which is not understood) in this great area, which was peopled by the

somewhat varied Neolithic long-heads and, further north, by larger-headed Paleolithic and Mesolithic people. (There were no new people here in the Bronze Age.) This is the Nordic race: a general but not complete coincidence of blondness and large long-heads in an extensive area; and not a band of heroes who came from a single place. This would also explain the so-called East Baltic race, found largely among the Finns, which is a rather square-headed derivation of Neolithic and older strains, but also blond. The Nordics are not so mysterious after all.

The Middle Ages and the Alpines

As the clangor of the Iron Age died away the settlement of western Europe was complete, but its racial contours were still forming. They had been more or less fixed by the end of the Bronze Age in the lands of the south, with the intrusion of round-heads (mainly Dinaric) into the older Mediterraneans, and this was partly true of the British Isles as well, where Paleolithic remnants were added to the mixture, and of France. Ancient strains also frequented the Baltic lands. It was here that the Nordics, during the Iron Age, took root and spread out, affecting the south slightly, Britain moderately, and eastern Europe and Russia very heavily, so that all the north, center, and east of the continent was long-headed. The one remaining change, during the Middle Ages, was the rise to great importance of the Alpine type of round-head.

Unlike past events, this was not because of new arrivals on the scene. On the contrary, the last thousand years of history in Europe have been a time during which people remained where they were. (National wars have had no racial effect.) And yet, in some way, the whole core of Europe, excepting only the north shore, Spain, and the Mediterranean tips of land, was becoming brachycephalic, and approaching the Alpine type. That is what I meant by saying, early in the chapter, that this was the only type which actually came into being in Europe, or at least in the west.

According to Coon, the foundation for this round-headedness lies in some of the old Mesolithic people, who became reduced in body size, and there is nothing to show him wrong. France, for example, had an early start in this direction, and from appearing as a mere suggestion in the Bronze Age the Alpine type has there become overwhelming. But this old stock could not be more than

a probable source. It did not actually spread, or extinguish other peoples. And yet in formerly long-headed, and especially Slavic, territory, and in Switzerland, the skulls of different centuries show that the people changed, right where they were, from long-heads to round-heads of an Alpine type. This is extraordinary. Now, if no new people had arrived, something must have been happening to those who were there.

This turn to brachycephaly is also apparent among some of the other races of the world. Without going into the matter, I suggest that it may, perhaps, be the latest step in human evolution to the present, the last of those refinements and adjustments which make Homo sapiens seem like so much more of a finished product than his cruder relatives. There is, at any rate, evidence that in mixtures round-headedness gradually comes to dominate in the offspring. Therefore, the recent settled period for the well-shuffled peoples of Europe may have provided a situation in which these several factors and processes might have worked themselves out. At any rate, the Alpines, though varying somewhat, now make a great stock stretching from France far into the center of Asia.[11]

Huns and Turks

Something of the same sort seems to have been going on in little-known Asia, and from here the east of Europe received a partially Alpine reinforcement in the invasions of a series of Turkic-speaking peoples, running from the Huns through the Turks themselves. I have not mentioned these, although they took place at the same time as the eastward movements of the Slavs, during the first thousand years of the Christian Era and later, and this movement recalls those of the various Iron Age Nordics. It is difficult to be either concise or definite about their racial effects.

The story of the Huns seems to be as follows. For a good many centuries before Christ the Chinese had suffered on their north-western frontier from the forays of the barbarian Hiungnu. These became intolerable when the Hiungnu acquired horses, from the nomad Whites of Central Asia. After long wars the Han emperors of China at last subdued the Hiungnu and drove them off, before

[11]Dr. Coon believes that the Alpines represent a wholesale "re-emergence" in great force of the ancient round-heads, and he and a few others also think that the Alpines are basically responsible for the Dinarics, who result when Mediterraneans and Alpines mix in just the right proportion.

200 A.D., after which they disappeared from Chinese annals. Two centuries later the Huns, a people corresponding to Chinese descriptions of the Hiungnu, turned up in Europe, to make of Rome another subject for their depredations before they settled at last in Hungary. The Huns, as shown by their remains, were a purely Mongoloid people, who, however, left no traces visible among Europeans living today. But they led the way for Avars, Bulgars, and then Turks and more Turks, until Turkish invasions from Central Asia were almost constant. In the earliest of these many of the leaders, if not a majority of individuals, were Mongoloid, although the others were a familiar type of old white Mediterranean, and probably to some degree Nordic. The later Turks, however, came without Mongoloid traces, and showed more and more of a type of big round-head. Altogether, the Turks proper seem to go back to the large-headed and large-faced varieties of Mediterranean, but to be now partly Alpine; and Dinarics are common among them as well. It is hard to say how much they originally differed from the people among whom they settled in the Near East, or to distinguish them from most other Balkan peoples. Dinaric and Alpine elements have been getting stronger in the whole of southeastern Europe.

The Jews

A final people of particular interest are the Jews. It is not easy to say anything anthropologically sound about them. Many writers justly point out that there is no such thing as a Jewish race, but they are apt thereby to lose the confidence of every reader who knows perfectly well that he can pick out a fair percentage of people of Jewish descent by their looks, and who may have been told a few pages before by the same writer that this is the general process by which one does discern a race. The situation rests on the peculiarities of Jewish history. From what I have said already it should be plain that they cannot be of any extraordinary origin, and can only be descended from Mediterraneans of the various Neolithic types. They are no more "oriental" than anyone else, although they were relatively late in coming to Europe. What happened was that the Jews developed, with their religion, both a strong nationalism and an exclusive social system which, biologically, expressed themselves in inbreeding and a refusal to mix with other peoples. This is like the geographical isolation which I

have said fosters the formation of separate and distinct racial or physical types. Their destruction as an actual nation 600 years before Christ intensified their social exclusiveness into an ideal from which they have never departed, so that they have maintained this extraordinary isolation ever since. They have never simply mixed freely with other segments of the European population, or they would otherwise long since have disappeared, as Jews. And their long inbreeding has preserved that almost indefinable conformation of the nose (seemingly related to the Dinaric) and lips which was probably only a slight local variation to begin with and of which the individuality may be exaggerated by habits of facial expression which are more social than physical in their nature.

They have preserved their original eastern Mediterranean type to a very considerable extent. The historical distinction between the Spanish Jews (Sephardim) and the Central European (Ashkenazim) reappears anthropologically. The former are close to the classic Mediterranean type. The latter are round-headed, like other Central Europeans. This is doubtless due to a certain amount of mixture with round-heads in the centuries of their residence there, helped along by the apparent dominance of brachycephaly in mixture. But they, too, maintain their Mediterranean character, being to a slight degree blond but mainly darker than the people among whom they live, and they have been found to be on the whole surprisingly homogeneous in measurements and physical form in this part of the world. They have probably not mixed as much as is generally supposed, if this is so, and their surviving character, therefore, is not due to any imaginary special potency of Jewish blood in a mixture, which would be a most remarkable phenomenon if it existed.

It would be pleasant to discuss in more detail people like the Basques, or the Phoenicians, or the Sumerians, or even those of legend, like the shadowy ancient inhabitants of Ireland. But as for legend, it is a poor basis for racial history, and in any case there is no room. The subject of the book is Homo sapiens and not individual mysteries.

I have been able to give only a broad scheme of the peopling of Europe, but I hope it has been inclusive enough to show one thing above all: that no European group, whether Nordics, Jews, Basques, Picts, Kelts, Scyths, Etruscans, Romans, Greeks, or yet

Cro-Magnons, need be supposed to have any origin which has a pattern peculiar to itself, less humdrum and more romantic than that of others, even if its hair was blond, if it spoke a funny language, or if it lay down to its meals. That is the real point of this chapter, prosaic if it be: that all the Europeans come from an ancient "Mediterranean" long-head, varying somewhat in size and pigment, whose varieties both through local evolution and through mixture became still more diverse, making, after the early wanderings and the more recent settled period, a crazy quilt of types in which confusion seems to reign and in which no races are any longer "pure."[12] Actually the confusion is partly in the mind of the beholder, who in the past has usually tried to detect a few great "races," once pure, instead of expecting the constant variation and reshuffling of racial types which seem to have filled all our history, early or late.

[12]This is Coon's general thesis, but he believes also that Neanderthal Man should be included among our ancestors. He suggests that the original Mediterranean type was that of the Galley Hill Man (and of the Combe Capelle skeleton from the beginning of the Upper Paleolithic) and that this short-statured type mixed somewhat in Europe (but not in the east where the Neolithic developed), with the Neanderthals, the result being the larger Upper Paleolithic men of the type of the Cro-Magnons. The likelihood of this rests on the matters discussed in Chapters XVI and XVII.

CHAPTER XX

Asia

In leaving Europe we are not leaving the White racial stock, for Asia has many millions of its members. It is true that Europe is purely White territory while in Asia the Whites merge almost imperceptibly, through mixture, into other races. But we have seen that, as far as we know, the southwest of Asia is probably their true home, and their occupation of Europe has been simply the extension of their *Lebensraum* first at the expense of the Neanderthals and then, ever since, at the expense of one another.[1] In reviewing the history of Europe we have been constantly looking toward Asia. But to consider the Whites as a whole it might have been even better to imagine ourselves standing somewhere near the Caspian Sea and looking outward in every possible direction.

Hither Asia

Here in southwest Asia is what might well be looked on as the core of the white races, or at least the source of the Neolithic migrants. It is true that in Turkey, Syria, and the Trans-Caucasus, as we have seen, Alpines and Dinarics, and especially the latter, are common or typical. The whole region is, however, mainly one of Mediterraneans. The people of Arabia are generally small and of the classic type. North of the fertile crescent, in Iran and in Afghanistan, they are taller and larger-headed, and, in Persia particularly, noses are characteristically high and beak-like.[2] This last makes for a British kind of face, and Persia contains many people who except for their greater brunetness could pass for Englishmen of a familiar type. The whole region is what the past of Europe bids us look for. The several Mediterranean racial types of the

[1]It is true that according to some theories the most ancient Whites, or part of them, developed on European soil, but there is no doubt that the Neolithic Mediterraneans were immigrants.

[2]Henry Field, "Contributions to the Anthropology of Iran," *Field Museum of Natural History*, Anthropological Series, vol. 29, nos. 1–2, 1939.

south and east of Asia Minor seem logically to be a surviving segment of a larger reservoir from which, in the Neolithic, peoples representing variations on a Mediterranean theme went westward to Africa and Europe. What little we know of ancient times here also leads to the same conclusion: that southwestern Asia is the home of the recent, or Neolithic, Whites.

Those that departed set forth in all directions, and not only to the west. But any of them going to the east would be confronted by the great block of the Tibetan highland, walled along the south by the Himalayas, to split them and force them either north into the Asiatic plains or southward into India.

India

If the reader finds that he has confused ideas about India he need not be abashed, because there seems to be nobody living who has clear ones. The ignorance regarding the nature of her peoples is profound and that regarding her ancient past is almost complete. The anthropologist at present can only look at the surface and attempt the obvious, which would be to say that the extremes in her racial nature are poles apart, and then to try to identify the poles. India's population is a mixture between Whites and one or more dark-skinned races—so much seems unmistakable. This, in fact, is the basis of caste, with the uppermost castes being in most places perfectly European in appearance, if swarthy in complexion, and with the other castes being progressively darker in skin color as the scale descends. At the same time there is a grading by geography, from the northwest, where all the people (for example, the big, bearded Sikhs) are thoroughly like European Whites in nature, down into the south and east, where the whole caste ladder becomes gradually darker throughout. Finally there are the wild tribes, primitive natives who are entirely outside Indian castes or culture, who speak Dravidian or Munda languages rather than Indo-European ones, and who are the darkest people of all. It is these people and the Whites who make the opposite poles in India's people.

There is nothing difficult in tracing the Whites. They are clearly the invaders, and from that same home in Asia Minor whence the Neolithic Europeans came; and to look at the people of India it would seem that both large and small Mediterraneans found their

way there, as into Europe. (Indian peoples are mainly dolichocephalic and Mediterranean in nature.) It is certain that these invaders brought in Indo-European speech, for its oldest known form (Sanskrit) was introduced by the Aryans some thirty-five hundred years ago. Yet it is most unlikely that the Aryans were the original source of India's White blood. For, long before the appearance of Indo-European, a similar people had built in the Indus Valley the oldest "civilized" cities in the world: Mohenjodaro, Chanhudaro, and Harappa, older than the cities of Babylonia and Egypt. It is probable that Whites came out of the northwest into India in very early times, largely submerging the primitive hunters whom they found, but absorbing, at the same time, enough of them to cause a perceptible darkening of the skin. Except for this last, the story may have been like the peopling of the United States. It is as if the European colonists of America (our own forebears), on arriving on the East coast with our Anglo-Saxon culture and language, had also mixed with the American Indians as we displaced them, more and more as we came to California, until there was some American Indian blood in all of us; yet leaving, as we have actually done, islands of aborigines with their original culture and language in the least desirable places, like the mountains of California, the desert of Arizona, or the Everglades of Florida. I do not mean that, in India, Whites brought in modern Indian civilization already formed, but only that this civilization, the property of the mixed Whites who are India's population, is a single culture, and that in going among the wild tribes one leaves this and steps into an aboriginal world.

The wild tribes, including the Vedda of Ceylon, hunt in the hills and jungles of the south and east, while some of the Dravidian-speakers have adopted a farming or dairying life, though remaining pagan and primitive. What, now, do they tell of the secret of India's older races? What is the dark-skinned element to which they point? This is a very difficult thing to answer, because they do not fit easily into the main classification of races, and it looks as though White blood had affected even them, without changing their culture, just as some living American Indian nations, like the Menomini, could not now produce a real full-blood. Yet three things these tribes do seem to say. The first is negative: there are no signs of a Negro race, as we would know it, among them, nor do the people of India resemble American mulattoes. The second in

view of the first is surprising: there do exist signs of Negritoes, the pygmy Negro race which we shall meet again. Certain of the wild tribes are very short and have broad noses, and with extremest rarity a man with woolly hair is seen among them. The third point is perhaps the most important: many of India's people faintly resemble the aborigines of Australia, and occasional individuals come fairly close to this type. The Australians, it will be remembered, have dark-brown skin and wavy hair, and are heavily bearded, like many of the darkest peoples of India, and they also have a primitive short, broad, and rather chinless face, projecting under heavy brows. The Vedda of Ceylon and certain other groups recall this type without being so extreme. Many anthropologists think that the Vedda and others are a separate race, distinct from the Australians, if possibly related. But it is likely that it is simply the Australian type which is hidden at the base of India's races, and that in the Vedda it has been mitigated by mixture, mainly with Whites. At any rate, if the darkest people of India can be allied with non-white races known elsewhere in the world, these races are the Australians and the Negritoes.

The probable existence of this Australian element in Asia is an important point, and it becomes more definite with the fact that the same element is to be found not only in India but also westward, both in Baluchistan and on the south shore of Arabia.[3]

Central Asia

Central Asia is one more place which attracted the footsteps of wandering Whites from the southwest. It is possible that there were Whites in the Far East during the Upper Paleolithic, but we know nothing definite of this as yet. With the Neolithic, however, a story parallel with that of India and the west unfolded. Long-headed Whites of a Mediterranean type, with a nomadic herding life well suited to the open, easily traveled plains of Central Asia, moved north and east into Siberia and along the border of China and Mongolia, coming in contact with Mongol peoples whose language they seem somehow to have shared. They were followed later by others, who had horses and who spoke Indo-European languages, some of which survived in Chinese Turkestan up to a thousand years ago. There were blonds among these later comers

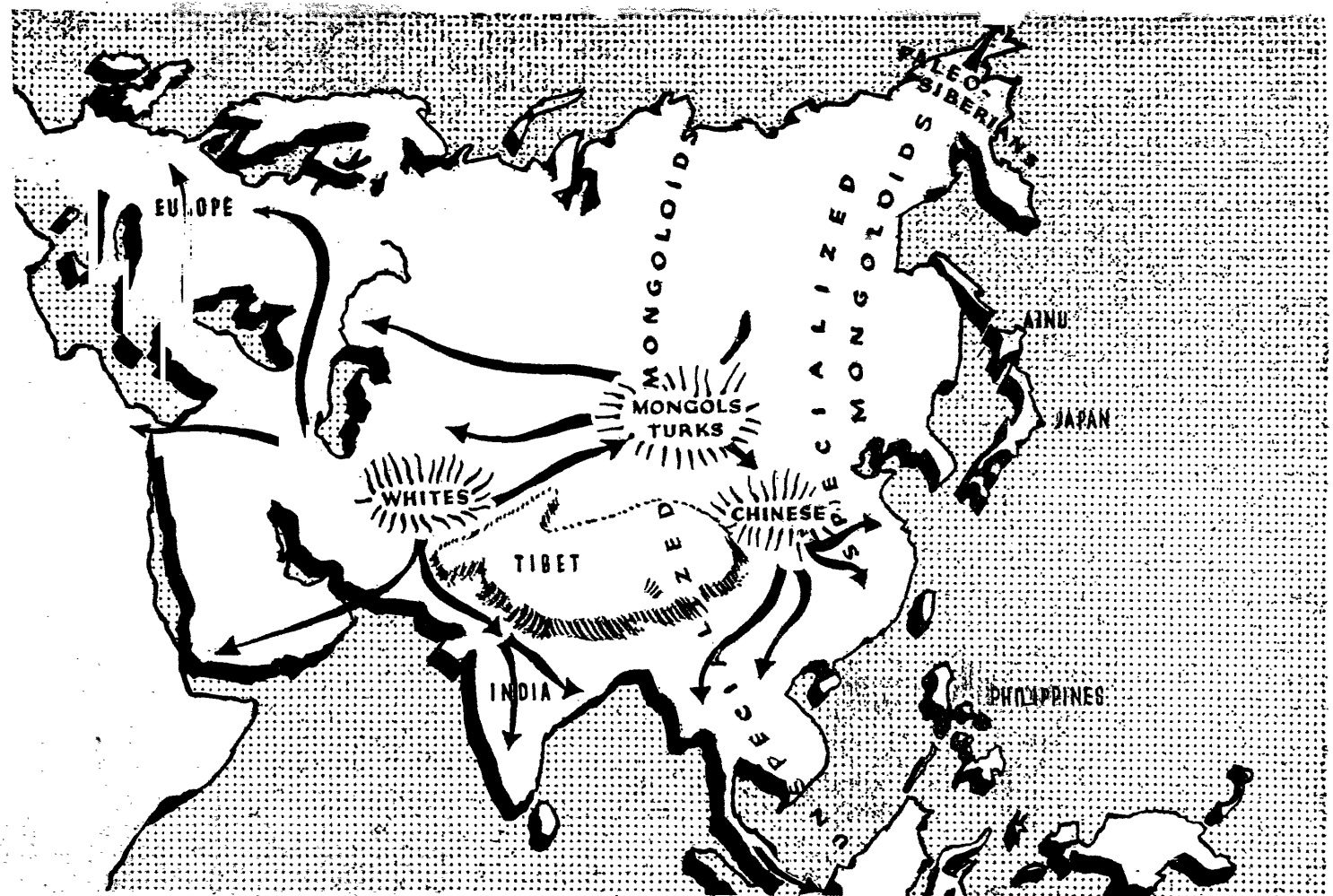
[3] C. S. Coon, *Races of Europe.*

at least, for Chinese records speak of them, and there is other good evidence of their existence. The use of horses was adopted by the whole region, the Mongol peoples included, until there was a common, nomadic culture from Mongolia to the Black Sea. Two subsequent things have brought about the racial distribution of the present day. In the first place, the Whites (Turkish, on the whole) have somehow taken on an Alpine type, apparently by the same spontaneous change to round-headedness as took place in much of Europe, so that the Whites of the center of Asia are today hardly distinguishable from the Alpines of Central Europe. Secondly, the Mongol Hiungnu, as we have seen, started a stream of movement to the west, toward southeastern Europe, to which the open country and the nomadic culture lent themselves. These movements generally contained Mongols and Turks together, but the momentum finally carried large bodies of pure Mongoloid peoples all the way to the lower Volga and the Caucasus, where they are settled today, in European Russia. Central Asia, which once was largely White, is today, therefore, a hodgepodge of Mongoloid and Turkish peoples, with the Mongoloids becoming predominant as one goes east. An opposite movement has, of course, been under way since the Russian expansion into Siberia.

The Ainus of Japan

We have now pursued the White racial stock right out to its Asiatic fringes and seen it melt gradually into other races. But after this seeming disappearance it crops out once again in a group, far to the east, which is an unalloyed mystery: the Ainus of Japan. They live a primitive life in the bleak northern islands, Hokkaido and Sakhalin, and they are incontestably white. The majority betray signs of mixture with Mongoloids, but plenty of them show no trace of it and could pass for Europeans without a question. Their principal character is, in fact, their great hairiness—a primitive feature of the White stock which the Ainus carry to almost indecent extremes. Indeed they actually admire their own bushiness. Wearing a long coiffure and beard, most of the older men manage to look a good deal like Tolstoy, and the women, who cannot grow real mustaches, tattoo themselves with false ones in a tasty shade of blue.

What are these people doing here? They have no connections



RACES OF ASIA

with the Neolithic Whites emanating from the southwest of Asia (nor might they be expected to), either in culture or in type. They are stocky brunets, medium-headed, and somewhat Alpine-like; on the whole generalized though not particularly primitive. Some people ally them with the native Australians, because the latter are hairy and because they consider the Australians to be a sort of very primitive black "White," but this is possibly the counsel of despair. We might surmise, for want of a better idea, that the Ainus are descendants of Paleolithic Whites in the Far East, connected thus with the Western Whites only in an antiquity which has still to come to light. It has not been decided whether their cultural connections, if any, are more with the north of Asia or with the south, but the former is more likely.

The Mongoloids

We have come to the home of the great Mongoloid family, which varies within itself like the Whites. Perhaps the first thing to consider about this stock is the rough distinction which can be made between the most "typical" or extreme groups within it and the remainder. The whole stock is yellow or brownish of skin, straight or very rarely slightly wavy of hair, broad and flat in the face, with "high" cheekbones; and a varying proportion of its members have the Mongoloid eye fold, itself developed in a varying degree. The nose is apt to be rather small. If the body form differs consistently from that of Europeans, it is in being short-legged and having a trunk without much of a waist. But in northeastern Siberia, north of Manchuria, and also to a great extent in China, the Mongoloid facial features are exaggerated. The Mongoloid fold is most common and very pronounced. And the face is especially moon-like, being not only broad but having a low nose and a flat forehead, giving the whole countenance a flat character which is added to by a filling out of the eye socket with fatty tissue until it is flush with the rest of the face, which also augments the slit-like look of the eye itself.

This distinction is probably of some importance in the history of all the Mongoloids. It might seem that the extreme type could be looked on as the original or "typical" Mongoloid, especially if you were given to the notion that the main races of man were each pure and of a very distinct form to begin with. But this is to fall

Peabody Museum photo

NATIVE OF INDIA. SINHALESE, CEYLON

American Museum of Natural History photo

AINU OF JAPAN

American Museum of Natural History photo

YUKAGIR WOMAN, NORTH-EASTERN SIBERIA. A SPECIALIZED MONGOLOID TYPE

Peabody Museum photo

JAPANESE MAN

into the fallacy which would make of the Nordics the purest, the oldest, or the most typical Whites. It is to imagine an impossible set of circumstances for the beginning of races, in place of what we have seen to be the more logical process, of races gradually diverging and becoming steadily more unlike. The Nordics are a specialization in blondness. Likewise, these central Mongoloids seem to have specialized (within a given area) in this exaggerated Mongoloid face, and I believe that instead of being the most ancient they are the most recent of their whole racial stock. The distinction exists, therefore, simply between specialized and various unspecialized Mongoloid racial types, without the faintest implication that either of them is an ideal, undefiled archetype.

Siberia

We know nothing about Mongoloid beginnings, excepting for one or two skulls of Upper Paleolithic date which have a somewhat Mongoloid character, and we shall have to look mainly at the distribution of the Mongoloids at present. In northern Siberia peoples all live in a crude state of culture. Northeast, out toward Bering Strait and the brink of the New World, there are the Paleo-Siberians: Chuckchi, Koryak, Gilyak, Kamchadals, and others, hunters and fishers, and it is they who make up the northern part of that focus of the specialized Mongoloid type which I have described. To the west of these is a great area peopled by more or less unspecialized Mongoloids, including the Mongols proper, who are nomads of two general kinds: the reindeer nomads like the Yakut, who live northward along the Arctic coast of Siberia far to the west, until in the Samoyeds they actually penetrate Europe; and the horse nomads, the Mongols, who have also swarmed west through south Central Asia, to settle as far as the Caspian and the Black seas. The people of Tibet, between Central Asia and China, are apparently a continuation of the same physical types, though they differ in culture. They vary in their measurable features, but they mostly belong to a generalized Mongoloid type, lacking the extreme nature of the Paleo-Siberians of the northeast. Some of the Mongol peoples have heads which are among the world's largest, and they are typically round-headed, almost merging with Alpines.

China

China was certainly in contact with southwest Asia in Neolithic times, and Chinese civilization, therefore, had the same foundation in this Neolithic agriculture as did Europe, although by the Bronze Age it was pursuing its own way. The Chinese as a nation have ancient and semi-mythical beginnings, of an Old Testament-like character, but they appear definitely as a people calling themselves the Descendants of the Yellow Emperor in the great bend of the Yellow River, moving down and expanding to the sea and to the south. In the two thousand years before Christ they spread their empire and their language, incorporating some peoples and pushing others outward.[4] All too little is known of the tribes they encountered, though the annals make tantalizing mentions. On the coast they were long in conflict with a piratical shore people, who were finally driven away, and southward various others are mentioned, including some black dwarfs, who may have been actual Negritoes. But even as they expanded steadily southward the Chinese were subjected to unceasing inroads of barbarians from the northwest, from the same direction in which they themselves had come. There was, in fact, a repeated historical pattern, in which the ruling dynasty of China was overthrown by uncivilized and warlike Mongolian invaders, who thereupon supplied the succeeding dynasty and became absorbed by Chinese culture; and China has indeed had only one really native Chinese dynasty in her history, the Ming.[5]

Physically the modern Chinese vary greatly, from tall to short or from long-headed to round-headed. It is not likely that the original Chinese people constituted any very singular physical type, though they may have been homogeneous; nor is it likely that they uprooted and displaced most of the people to the south as their influence expanded, even though they doubtless exerted some pressure. It is more probable that the area of China contained Mongoloid people who differed locally as they do today, and that it formed the southern part of that region in which the specialized type of Mongoloid countenance tends to appear, perhaps less

[4] ChiLi, *Formation of the Chinese People*, 1928.

[5] It would be a laughable fate for Japan if she fulfilled some of the predictions by being added to the list of absorbees, but this is not really likely because of her own large population and the insulated nature of her culture.

forcibly than in the north. A large proportion of Chinese, however, are much more "generalized" in their appearance. Now this may seem to be dismissing half a billion people with a wave of the hand, but unfortunately what we know of the racial types of China is not very instructive. They do not, at any rate, appear to contain any element which is not purely Mongoloid.

Southeast Asia

In Burma, Siam, Indo-China, and the Malay Peninsula there is another great body of Mongoloids who have felt the force of China's growth, without being engulfed by her. The Mongoloids have never penetrated India, which seems to be well protected in this quarter, and the only overlapping occurs in the people of Assam in the very northeast corner, the Brahmaputra. From the border of Burma eastward, however, mountain ranges and river valleys run north and south, and it is down these that people have moved, some of them in historic times. Partly "civilized" and partly not, there is considerable divergence in the culture and languages of the whole region. At the same time this region has a certain unity, and probably an old one, for it is the home and center of a "Neolithic" kind of agriculture of its own, different from the one which is common to southwest Asia, Europe, and China, and related to it only in unknown ways, if at all. This agriculture is suited to the forests, which the other is not: its food plants were mainly roots, like yams, rather than grains, and its animals were pigs and chickens, not cattle, sheep, or goats.

Racially, it is difficult to say much except to utter the generalization that southeast Asia contains an agglomeration of varied but unspecialized Mongoloids, among whom the specialized type is suggested in a moderate proportion, in such people as the Siamese or Cambodians. They differ on the whole from the Chinese or from the people of Tibet and Siberia, being usually of smaller size and brown-skinned. But besides the Mongoloid mass there are one or two significant remnants of non-Mongoloid peoples. Foremost are the Semang, blowgun hunters of the dense forests of the Malay Peninsula, who are pure Negritoes—pygmy Negroes with woolly hair, black skin, and Negro features. Aside from their probable presence as an original element in the wild tribes of southern India and possibly formerly in South China, this is the only place where

they are found in all of Asia. In the same territory, and in a similar manner, live the Sakai, who are larger and have wavy or curly hair. They are considered to be allied to the Vedda of Ceylon by many, but I think it probable that they are simply a mixture of Negritoes with some or other of the Mongoloids. One further people of dubious significance are the Moi, the pagan[6] peoples of the mountains of Annam in Indo-China. They are small of stature and some of them have wavy hair. They might be the faint expression of Negrito blood in a Mongoloid group, or they might be simply remnants themselves of a primitive and unspecialized type of Mongoloid, devoid of mixture with other peoples.

Japan

Finally, there are the Japanese proper, as much of a mystery as are the hapless Ainus. The Ainus once occupied most or all of Japan, far to the south of where they are at present, in a simple sort of Neolithic culture which persisted until not long before the Christian Era. Then the basic Japanese people arrived, from Korea, in an Iron Age state of culture with horses, although this invasion was not the only constituent in the Japanese or their culture. With the founding of the nation and the imperial dynasty they began to war against the Ainus, driving them ever further into the north, in fighting which was so constant that it led to the formation of the Samurai, or warrior caste, and which ended only with the subduing of the Ainus in the tenth century.

The meager history of early times leaves much about the Japanese unexplained. There seem to be two extremes among the Japanese, physically. On the one hand, they resemble the Chinese or others of the northern, specialized Mongoloids, so that a large proportion of Japanese could not be distinguished as such; and many Japanese soldiers or geisha girls represent this type. Undoubtedly it is traceable to those settlements from the mainland which gave rise to the actual Japanese nation. At the other extreme there is some kind of an apparently White, or European-like, element, expressed in beards, in wavy hair, and in a more marked chiseling of facial features which contrasts with the bland flatness of the

[6]Anthropologically, "pagan" means having some nature-religion, rather than belonging to any of the great sects, and implies that the people in question have not had someone else's culture imposed upon them wholesale, whether it be European, Chinese, or Indian.

Mongoloid face. This is to be seen sometimes in photographs of cabinet members or businessmen, as well as in paintings or presentations on masks. Finally, and this is most indefinite, there would appear to be a third ingredient, Mongoloid in nature but different from the Chinese or other mainland types and more suggestive of the small-sized, less "specialized" Malays, or Indonesians, of the East Indies, still to be described.

It is the presence of these elements which not only serves to distinguish the Japanese from the Chinese somewhat, and to give them a special look, but also adds a tone of mystery to Japanese origins. Nothing would seem more obvious than that the Ainu must be responsible for any "White" strain, and yet the facts are largely against it: Japanese history would have you think that there was no absorption of Ainu blood, least of all by the Samurai, among whose descendants this type of countenance seems to be commonest now. It may be, of course, that history has here twisted facts to suit ideals, and there are occasional hints that some lines do harbor Ainu forebears.

There is another possibility for both of these supposed non-mainland strains. It has been suggested that the wavy hair and the hairiness are derived from a Malay source. But this is difficult to credit, because these features are not characteristic of Malays, occurring among them only rarely. However, the people of the islands immediately to the south and in Formosa manifest them, and also here and in the East Indies a possible faint White strain is suggested, which might have been the one entering the Japanese population. Accordingly, both a "White" and a "Malay" element might have arrived from the south, perhaps together. The culture of Japan certainly has a large increment which is neither Ainu nor from the mainland, but bespeaks in a general way that found both in the East Indies and in Polynesia. It is seen in such things as their type of house and their light, untailored dress, together with the mulberry tree, and a taste for raw food; while the mythology and the idea of a divine king are strongly Polynesian. There is no one clear and obvious source for this contribution, however. The Japanese are plainly a people of mixture, both racially and culturally, but the expansion of the Chinese and the southern Mongoloids in the last three thousand years has obliterated exact evidence of their original homelands. No confidence can be given as yet to any detailed analysis or reconstruction of Japanese racial history.

CHAPTER XXI

The American Indian

WHO are the American Indians? For one thing, they are the subjects of a long series of misapprehensions. Their very name stems from the first blunder, and after it was realized that they were not the people of the Indies, the guesses as to their origin became more and more imaginative and less and less realistic. I am not going to fish up the lost continent of Atlantis, having no space for sheer invention. Apart from this idea, the most popular belief of recent times was that the Indians were the descendants of the ten lost tribes of Israel, who are supposed to have become separated from Judah and Benjamin at the time of the Babylonian captivity and to have fled into parts unknown. Even this itself is fable, but many good people accepted the explanation. General Custer was one of them, which seems to mean that he went to his death fighting on the side of the Philistines.

Let us forget the guesses and scrutinize the Indians as themselves. The obvious question would be to ask whom they look like, and the answer is that they look like various of the Asiatic members of the Mongoloid family group—not the Chinese, but the less specialized people of Central Asia, Tibet, or the East Indies. The Indians (like the Cro-Magnons) are not as singular as they have been made out to be, and they are not "redskins."

Dr. Hooton makes a useful distinction.[1] He points out that in certain ways all the Indians are much alike: they have dark hair and eyes, and a skin which is a medium brown, variable though it may be in individuals. There is little or no hair on body or face, and that on the head is straight, or in some of them slightly wavy. And all tribes have large, broad faces, with "high" cheekbones. Notice that all of these things ally them with the Mongoloid stock. In other characteristics, however, the Indians differ tremendously: some groups are very tall and some are short; some have long heads

[1] E. A. Hooton, *Apes, Men, and Morons*, 1937.

but more have round; some have high, narrow noses and some have short broad ones; and some have a Mongoloid fold more commonly than others, though it is a minor feature in them all.

The traits in which they are homogeneous are the most obvious and visible ones, which give them an exaggerated appearance of being all alike. Apart from hair, skin, and eyes, however, they vary among themselves at least as much as do the Whites, in whom differences in coloration create an air of diversity. To put it another way, if you consider the skull and skeleton alone, the Indians of the Americas exhibit quite as great a variety of type as do the Whites of Europe.

Indian Racial Types

At the same time it is just as difficult as in the case of the Europeans to make any kind of a neat classification of such types, or to find regions where the Indians are distinct as to "race." A person of any acquaintance with them can readily tell a Navajo from a Pueblo Indian, or make other such tribal distinctions in some cases, but the differences are too subtle to be caught by anthropological terms or methods. About all that can be done by way of analyzing the Indians as to racial type is to draw attention to certain groups which have enough distinctiveness to make them stand out from the others. This again is something like the situation in Europe.

The Indians of New England seem to have been the least Mongoloid and most European-looking of any in appearance, and are fairly well represented by the head on the buffalo nickel. Another type, that of the Sioux and other war-bonnet Indians of the Plains, has an extremely broad face across the cheekbones, with a nose which is, however, high and narrow, making altogether a characteristic and striking facial type. Both this and the eastern type are tall of stature and long of head. All up and down the west of North America and into Mexico the Indians were relatively nondescript, being on the whole short, round-headed, and variable as to nose form, though this nose lacked a high nasal bridge.

The Mayas of Central America portrayed themselves accurately on their stone monuments, for their peculiar physiognomy is the same today. Their faces are large and long, their noses high and convex, and their upper lips are prominent; the eyes are large and heavy-lidded; but the whole face, in spite of its size, has a certain

softness—almost a femininity—about it. (This is a most unanthropological characterization, but I am forced to use it in giving an impression.)

In South America, the Indians of the west coast, who were largely included in the Inca Empire at one time, are again rather nondescript. But in the Amazon Basin, to the east, there is a greater variety of tribal types. Here there are short people with a Mongoloid flatness of countenance and fold of eyelid, whose faces might almost be found again in Borneo or the Philippines, as well as others who have unusually wavy hair and features something like those of a dark European.

But if some of the Indians of North and South America recall Europeans in their racial nature, this does not mean that they have become mixed with Whites. There is no good evidence that that is the case, at any rate. It seems to mean instead simply that the Indians vary widely around a common theme, a sort of unspecialized, big-faced Mongoloid; and that while some of them have more of the standard Mongoloid features, others have them in so slight a degree that they are extremely unspecialized racially, and therefore have an accidental resemblance to Whites.

There is one clear exception to all of this, which I have not mentioned. This is the Eskimos, who stand out strikingly from the other peoples of the New World. Although they are strung along thousands of miles of the Arctic rim of North America, they speak languages of a single group and partake of a basically similar fishing and sealing culture, highly developed to overcome the difficulties of their life; and they have been only slightly in contact with the Indians, because of the barrier made by the bleak, inhospitable lands back from the Arctic coast. Physically speaking also the Eskimos are exceptional, principally in that they are a good deal more like the highly specialized Mongoloid type of China and northeastern Siberia than any of the Indians: they have very broad, flat faces, wide at the jaw as well as higher up, noses which are long and narrow without being high, and eyes which have narrow openings and are adorned with the Mongoloid fold more commonly than in Indians, by far. Not all Eskimos have this markedly Mongoloid character by any means, nor are they entirely homogeneous in all parts of the Arctic, but it is justifiable to say that they are on the whole more like their neighbors across Bering Strait than their neighbors here and there in America.

Indian Origins

Where did the Indians come from? Even those people who were not so naïve as to think they might be dislocated Hebrews have professed to be puzzled on this score, and *Time* magazine commented a year or so ago on some archaeological finding by saying that it lent added weight to the "theory" that the Indians had come from Asia. Of course they came from Asia, where their racial cousins are, and they came over the Bering Strait. They could have come from nowhere else. They did not originate in the New World. They did not come from Europe, nor from Africa. And they assuredly did not cross the Pacific Ocean itself; the Indians, nowhere good boatmen, cannot be imagined, in a long-ago era before seaworthy boats had been invented, as having made a series of voyages which were too much for the mighty Polynesians. Lastly, I have just remarked upon Atlantis, that hoary hoax which boasts not a single particle of tangible evidence to lend it credibility. Therefore, the Indians came from Asia.

When they came is not so plain. But the New World differs from the Old in this: that all the bones ever found in it are those of Homo sapiens, and no group of scientists believes that man was present here during the greater part of the Ice Age. These conclusions have been getting more definite as time goes on. Yet it is only fifteen years since we began to get any real grip on the question of time. In 1927 archaeology on our continent was already showing its heels to the rest of the world in technical proficiency, and was beginning to understand recent Indian cultures fairly thoroughly, yet it had not been able to pin down the problem of Indian antiquity at all. At that time it could be seen that in several places the remains of the known Indians, or of their forebears, could be traced down through the shell heaps or back into the earliest Basket Maker caves, getting simpler all the time—roughly about as far as the time of Christ, when they dwindled away entirely and left the record blank. Even the more highly developed cultures of Central and South America could not be followed beyond such a point. Evidence ran into a dead end only some two thousand years back, and nobody knew what to make of it.

While it was allowed that it must have taken the Indians another thousand years, or several, to arrive from Asia, to settle down, and to find the basis for the tropical civilizations, nevertheless there

was a general disposition among archaeologists to be somewhat close-fisted with the centuries. The only deductions which could be drawn were rather negative. Obviously, if the present distribution of Indian cultures went back two thousand years, there could have been no arrivals within that period from Asia, especially since the Eskimos seem to have been in their present home for the same length of time, plugging up the route in Alaska. On the other hand, the general nature of even the simplest Indian remains then known was so well developed, being of a "Neolithic" character, that nobody felt that the Indians could have been migrating when a more ancient, Paleolithic form of culture prevailed in the Old World. In short, students were morally certain that the Indians had come more than two thousand years ago, but at the same time were afraid, lacking clear evidence, to make any grandiose estimates.

On the whole the archaeologists were maintaining a stern show-me attitude toward themselves. This ultra-conservatism has now relaxed, under two influences. One of them was simply a shift of opinion about the known facts. Although living Indian cultures may in most cases seem simple, they were, nevertheless, well attuned to the particular region in which they were found, and they had made an extraordinarily full use of the native food plants. Not only had they domesticated corn, beans, and other plants, and found the best ways of cultivating them; they had also managed to make valuable foods out of the poison manioc and the acorn, and had discovered the uses of such special foods and drugs as chocolate, cocoa, tobacco, cascara, quinine, and even chewing gum. This list covers only a part of the food supply that made the Aztecs or the Incas possible, and it was not the achievement of a single century or so, but must have come from the long habituation of the Indians to all the original homes of the several plants.[2]

But the great change of heart came about when archaeology began at last to find the keys to really ancient remains of man and culture. Spear points have now been found imbedded among the bones of animals extinct in recent times, such as the American horse,[2a] the camel, the mammoth, the ground sloth, and Bison taylori, which was not our familiar buffalo but a larger one with widespread horns like a Texas longhorn steer. Some of them suggest

[2]R. H. Lowie, "American Culture History," *American Anthropologist*, new series, vol. 42, 1940.

[2a]The horses of the Plains Indians were brought by the Spanish.

colder conditions, and all of them were thought to have vanished along with the ice in North America. More important than the animals, the oracle of geological evidence has begun to speak. Like the Delphic oracle, it speaks in garbled tones, but at least it speaks. Previously no finds had been made in conditions which commanded the serious respect of an ice-age geologist.

Ancient Cultures: Folsom and Sandia

I took 1927 as the turning point, because that is when the now-renowned Folsom culture was recognized. The Colorado Museum of Natural History had been digging out Pleistocene mammals at a place near Folsom, New Mexico, in 1926 when an arrow or dart point was found in place, near the ribs of a fossil bison. Announcement of the startling find was greeted with the then-habitual scorn and disbelief of the archaeologists. But the same group turned up more points in the same place the following year, one of them actually between two bison ribs, and this time they sent for Dr. Frank Roberts of the Smithsonian Institution and Dr. Alfred Kidder of the Carnegie Institution, who came and were at once convinced. In 1928 Dr. Barnum Brown, paleontologist of the American Museum of Natural History, went to the site at Folsom and found more points, together with the skeletons of twenty-three bison, complete except for the tail bones—strong evidence that the animals had been skinned by hunters, the tails having been removed with the hide. That year there was a regular parade of experts across the site, and conversion was wholesale. One important aspect of the discovery was that these "Folsom points" were of a very particular and skillfully made kind, and not something which might accidentally occur in different cultures at different times. Now these points had previously been picked up here and there in several parts of the country at random, without clues as to their age, and the evidence at Folsom all at once suggested that these Folsom hunters had wandered over much of the United States in late Ice Age times, before Bison taylori died off. The main question now was whether the extinct bison (and thus the culture) actually belonged as far back as the last glacier, as the Folsom evidence suggested.

This question has been followed up by the later work of Roberts and others at the most important Folsom station, the Lindenmeier

site in northern Colorado. When the Folsom people camped here there was a valley with gently sloping sides, but this valley no longer contains a stream: changing stream beds have washed away both ends and one side of it, leaving it a sort of hanging terrace in another valley. Folsom stonework lies on the old floor, now covered by gravel which has gradually washed down to fill up the valley. All of this is part of one general process of changing stream levels, therefore this relic of a valley is related to other terraces along the sides of other river valleys in the same system of tributaries. And it has been traced by devious routes, down one valley and up another, until it can be tentatively connected with known mountain gravels which belong to the last phase of the last glaciation. This, it can be seen, is a geological train of reasoning, and does not depend on animals.

In the last decade several other cultures have come to light in western America, connected, like the Folsom, with evidence of a late glacial or immediately postglacial climate, different from that of today. The cream of them all comes from a cave in the Sandia Mountains between Santa Fe and Albuquerque, where Professor Kirk Bryan of the Geology Department of Harvard (who also analyzed the age of the Lindenmeier site) interpreted the layers in the cave floor in perhaps the most spectacular piece of geological detective work yet seen. The details of this would make the reader's head swim, and I will describe it only in outline. To begin with, the cave floor had grown up partly from rock falling from the cave roof and partly from minerals in water which came from the ground surface on the ridge above the cave, percolating down through the soil until it dripped through the cave roof onto the floor below. Now let us see what the layers in the cave floor revealed.

The topmost material was loose dust with pottery of the recent Pueblo Indians in it. Below this was a hard, limy layer, which not only acts to seal in everything lower down, but is a sign of a rainy period (such as would cause a good deal of water to drip into the cave) which Bryan believes to be one following after the last glaciation. Below the lime there is a layer (breccia) with Folsom points and the bones of extinct horses, camels, ground sloths, and so on. Next is a layer of yellow ochre (iron oxide), with nothing in it, and lastly, just above the rock of the basic cave floor, are more bones of the animals named, but with a stone culture (and fire-

places) different from the Folsom and, obviously, older. The sterile yellow band, like the limy layer higher up, signifies a peak in humidity, but Bryan declares that it must derive from a time much colder than now, when fir and spruce grew on the ground above the cave. These trees produce yellow ochre in certain soils, which the present vegetation above the cave does not do. Also, such trees grow today only at higher and colder altitudes. Dr. Bryan, therefore, believes that the lowest Sandia culture goes back to the period of increasing cold and wet which in New Mexico reflected the last minor pulsation of the fourth and final glacier, that the yellow layer formed during the peak of that pulsation, and that the Folsom culture, as at the Lindenmeier site, came into the region as the glacier waned for good. Here if anywhere, then, we have Ice Age man in the Americas. This last phase of the glacier is accorded an antiquity of some 25,000 years, and Dr. Bryan, without batting an eye, would accept the Sandia culture as having that age. That would mean that there were Indians in the United States about as early as the middle part of the Upper Paleolithic in Europe: nothing amazing in human development, but staggering enough to previous ideas about America.

The Oldest Indian Skeletons

We have not yet had the same good fortune with skeletons. It is true that such evidence as was brought into court before 1927 in behalf of ancient man was mostly a long series of skulls, putatively old, but mostly of such a suspicious character that they ended by giving their whole kind a bad name and strengthening the hands of the doubters. The most famous, or infamous, of these skulls is the cranium from Calaveras County, California, which, in view of the Jumping Frog, is probably the most implausible place in the nation to furnish anything so inherently unlikely as a geologically old Indian. The skull goes back to 1868, when it supposedly was found one hundred and thirty feet down in a mine shaft. It is physically unremarkable, and it was probably a cowboy hoax in the very beginning, but it made its way into politer society and enjoyed a brief dignity under the alias of Auriferous Gravel Man, because its resting place was allegedly in gold-bearing gravels of Middle Tertiary date! It raised enough of a commotion to inspire a satiri-

cal ode by Bret Harte,[3] but it shortly lost the respect of everyone and now sits with a tag proclaiming its notoriety in a case which is a sort of rogues' gallery of such skulls, in the Peabody Museum at Harvard.

Of far better repute, by way of contrast, are the Lagoa Santa skulls, a group found a full century ago in the region of that name in the state of Minas Geraes in eastern Brazil. These, partly fossilized and of a long-headed and somewhat primitive type, were recovered from caves along with bones of both extinct and living animals. The signs of antiquity in themselves are not very strong, but the type of the skulls is not that of the present Indians of the region, and their significance is sustained by the recent discovery of one more such skull in the Confins cave of the same region in the same circumstances, under more careful observation. This last find strongly suggested considerable age, though without proving it.

Many other skeletons have turned up in times past whose credentials were worthy of serious attention but were not convincing

[3] The following is an abbreviated version.

TO THE PLIOCENE SKULL

"Speak, O man, less recent! Fragmentary fossil!
Primal pioneer of pliocene formation,
Hid in lowest drifts below the earliest stratum
Of volcanic tufa!

. . . . .

"Eo– Mio– Plio– whatsoe'er the 'cene' was
That those vacant sockets filled with awe and wonder,–
Whether shores Devonian or Silurian beaches,–
Tell us thy strange story!

. . . . .

"Speak, thou awful vestige of the Earth's creation,–
Solitary fragment of remains organic!
Tell the wondrous secret of thy past existence,–
Speak! thou oldest primate!"

Even as I gazed, a thrill of the maxilla,
And a lateral movement of the condyloid process,
With post-pliocene sounds of healthy mastication,
Ground the teeth together.

And, from that imperfect dental exhibition,
Stained with expressed juices of the weed Nicotian,
Came these hollow accents, blent with softer murmurs
Of expectoration;

"Which my name is Bowers, and my crust was busted
Falling down a shaft in Calaveras County,
But I'd take it kindly if you'd send the pieces
Home to old Missouri!"

enough in any one case to satisfy scholars that they belonged to the Ice Age, or even to a time several thousand years back. (No human bones have yet been found in Folsom sites.) Dr. Hrdlička made a practice[3a] of investigating every such specimen as fully as he was able, and implacably punctured the claims of most of them. This, in Hooton's words,[4] was the situation in recent years:

"The unhappy but deserved fate of previous fossil pretenders to geological antiquity in America, mostly at the hands of one executioner, has so intimidated the younger physical anthropologists of this country that their attitude toward alleged fossil Americans is typically that of the poet toward the purple cow:

"I've never seen a fossil man,
I never hope to see one,
But I can tell you anyhow,
I'd rather see than be one.

"It now begins to appear, however, that the perennial heroism of one Dutch boy at the dyke is likely to prove insufficient to stop the increasing trickles of fossil men through the geological defenses. Dr. Hrdlička is already forced to use not only one finger but all of his capable digits to plug the holes, and still they come."

Still they come indeed. Probably the skulls with the greatest undisputed age are several found by Junius Bird of the American Museum, along with bones of the extinct native American horse, under nine feet of earth and ashes in a cave in Patagonia. They are certainly the clearest case of human bones yet found associated with extinct animals in this hemisphere. Their age is reckoned at 3,500 to 5,000 years at least. This is not much compared to the probable date of the Folsom culture, but it is very striking to have Indians this old at the southernmost tip of South America, furthest away from Bering Strait and surely the last place in America to be occupied.

Minnesota Man

But the find which has made the anthropologists stand up and be counted is the Minnesota Man. It is no man at all, but the skeleton of a fifteen-year-old girl, though this is not a point of importance.

[3a] See Bulletins 33, 52, and 66 of the Bureau of American Ethnology.

[4] E. A. Hooton, *Apes, Men, and Morons*, 1937.

It was found in the gravel bed of a vanished glacial lake in 1931 by a roadscraper, which in being used to rebuild a road had cut a trench to a depth of ten feet from the ground surface. The circumstances were noted by the foreman of the road workers, said to be as intelligent as any college professor by Professor A. E. Jenks of the University of Minnesota, who has been the guardian of the skeleton and has devoted his talents to an excellent description of it.[5] If this skeleton means what it seems to mean—if it belongs naturally in those gravels—then there is almost no question but that, some 20,000 years ago, an Indian girl jumped or fell into the icy waters of a lake which was fed from the edge of the last glacier, which then stood only half a mile from the spot.

The one great difficulty is the fact that the roadscraping machine innocently removed all the overlying gravels, making it impossible to say whether the body was buried in a grave having the surprising depth of ten feet (which might have happened at any period), or whether the gravels were undisturbed and showed the natural lines of their original Pleistocene deposition. Therefore, the battle has been fought out on other pros and cons, mainly in some candid exchanges between Dr. Jenks and that doughty doubter, Dr. Hrdlička. The gravel close to the skeleton clearly showed the banded nature (varves) of silt settling on the lake bottom from successive summer meltings of glacial ice. If the body had been buried in the last few thousand years, traces of pollen from the local vegetation, such as is always present in the air, could have been detected by a microscope in the soil around it, yet the silt enclosing the bones and lying within the skull was sterile, bespeaking the almost plantless, arctic climate of the glacial fringe. Dr. Hrdlička claimed that the skeleton belongs to the type of the Sioux, who most recently occupied this part of the country, and that in any case the body must have been buried in a grave, since if it had lain on a lake bottom it would have disintegrated before being covered up naturally. To this Dr. Jenks retorted that being like a Sioux doesn't make it a Sioux, and to the second point he cited from police records the case of an identified sailor who drowned in Lake Superior in 1930 and floated ashore again in 1936 without having lost so much as a toe bone.

Six years would have been ample for the Minnesota girl to have been covered with silt, and this was a lake still colder than Supe-

[5] *Pleistocene Man in Minnesota*, 1936.

rior. Geologists are equally divided as to the legitimacy of the find, with some of them considering the possibility that an earth slide accidentally covered a recent burial, and so brought about the illusion of some banded gravels over the bones as well as the apparent great depth of the grave. Perhaps the best evidence of recency is the fact that along with the skeleton were found an ornament made of a shell occurring today in the Gulf of Mexico, and traded in recent times up the Mississippi by the Indians, and also a group of random bones of small animals also living today in Minnesota, and seeming like the contents of a medicine bag such as was well known in this region in historic times.

Now these questions of antiquity are not yet thoroughly settled. Glacial geology, as I have remarked, is a difficult science, and students realize as well that many of the animals, now extinct in America and thought to belong to the Ice Age (like mammoth or native horse), may in reality have lingered on much longer, perhaps being hunted to death by the Indians only a few thousand years ago. Some writers remain conservatives, and Dr. Hrdlička was always inclined to regard the idea of an ancient Folsom culture as a delusion. But although no poll has been taken, I think that at least half of the interested students would accept Minnesota Man, and that still more are satisfied as to the considerable age of the Folsom and other such cultures.

The First Peopling of America

My recital has said more about Indian antiquity than Indian racial types, mainly because there is more to say. But this gives us some important ideas as to racial history, and I think the testament which follows would be agreed to by a number of archaeologists and physical anthropologists.[6]

The first Indians came over the Bering Strait as a hunting people, living like the Paleolithic Europeans of the same day; and this day was during late glacial times, fifteen or twenty-five thousand years ago, or even more. Probably they walked across because, even though glaciers billowed over most of North America, Alaska had no ice and the sea, being lower than it is today, apparently left dry

[6] See F. H. H. Roberts, Jr., "Developments in the Problem of the North American Paleo-Indian," *Smithsonian Miscellaneous Collections*, vol. 100, 1940; W. M. Krogman, "The Antiquity of Man and His Culture in the Americas," *Ciba Symposia*, vol. 3, 1941.

land between Asia and America.[7] It is thought that the first portion of the ice-locked New World beyond Alaska to open up before them was a lane east along the Arctic, and then a long corridor southward through Canada between two centers of ice, down to the eastern side of the Rocky Mountains, and by this way the Folsom and Sandia people probably came.

Doubtless, as the weather ameliorated with the retreat of the glacier, other Indians came in, by land or water, in small tribal groups, for a long time. It is hard to say whether Bering Strait actually become more difficult to cross, but, as I said, it is plain that Eskimos have occupied this region for at least two thousand years, so that the immigration must have stopped as long ago as that. However, it must have gone on for many thousand years.

It is fairly clear that the first Indians were long-headed, since that is the shape of all the actually or possibly ancient skulls, such as Minnesota Man, or the Lagoa Santa or Patagonian specimens, and since long-headed Indians of recent times have been found mainly around the edges of the continents, where oldest inhabitants usually are. Round heads must have begun to predominate among the later immigrants from Asia; and notice how this recalls the supplanting of long heads by round heads in Europe. This does not, however, imply any more variety among Indian types than I described at the beginning of the chapter. Early and late—the Minnesota girl or the living Pueblo farmer—all Indians have the same general physical character.

The last deductions lie in what all this says about Asia and the racial history of the world. Remember to begin with that the nearest thing to an American Indian outside of America is to be found in Indonesia, in Central Asia, or in Tibet: the fringes of the Old World Mongoloids. Consider next that we may regard the Indians as scoopfuls of people, out of the ancient population of northeast Asia, who chanced across the strait into America. This would seem to mean that the Indians are generalized, marginal Mongoloids, of a kind which once occupied the Far East. But the latest people prominent in northeastern and eastern Asia are the "specialized" Chinese and Paleo-Siberians, and very probably the last people to come into America, the Eskimo, are akin to these. It looks, therefore, as though, ten or twenty-five thousand years ago, eastern

[7] W. A. Johnston, "Quaternary Geology of North America in Relation to the Migration of Man." In *The American Aborigines*, D. Jenness ed., 1933.

Asia was populated by a generalized, large-faced, brown-skinned basic type of Mongoloid, represented by some of the Central Asiatics and by American Indians, while since this time a more specialized form of the stock, with especially flat faces and a marked Mongoloid fold, represented by the Chinese, the Paleo-Siberians, and the Eskimo, developed in the heart of this whole region and came to dominate that part.

CHAPTER XXII

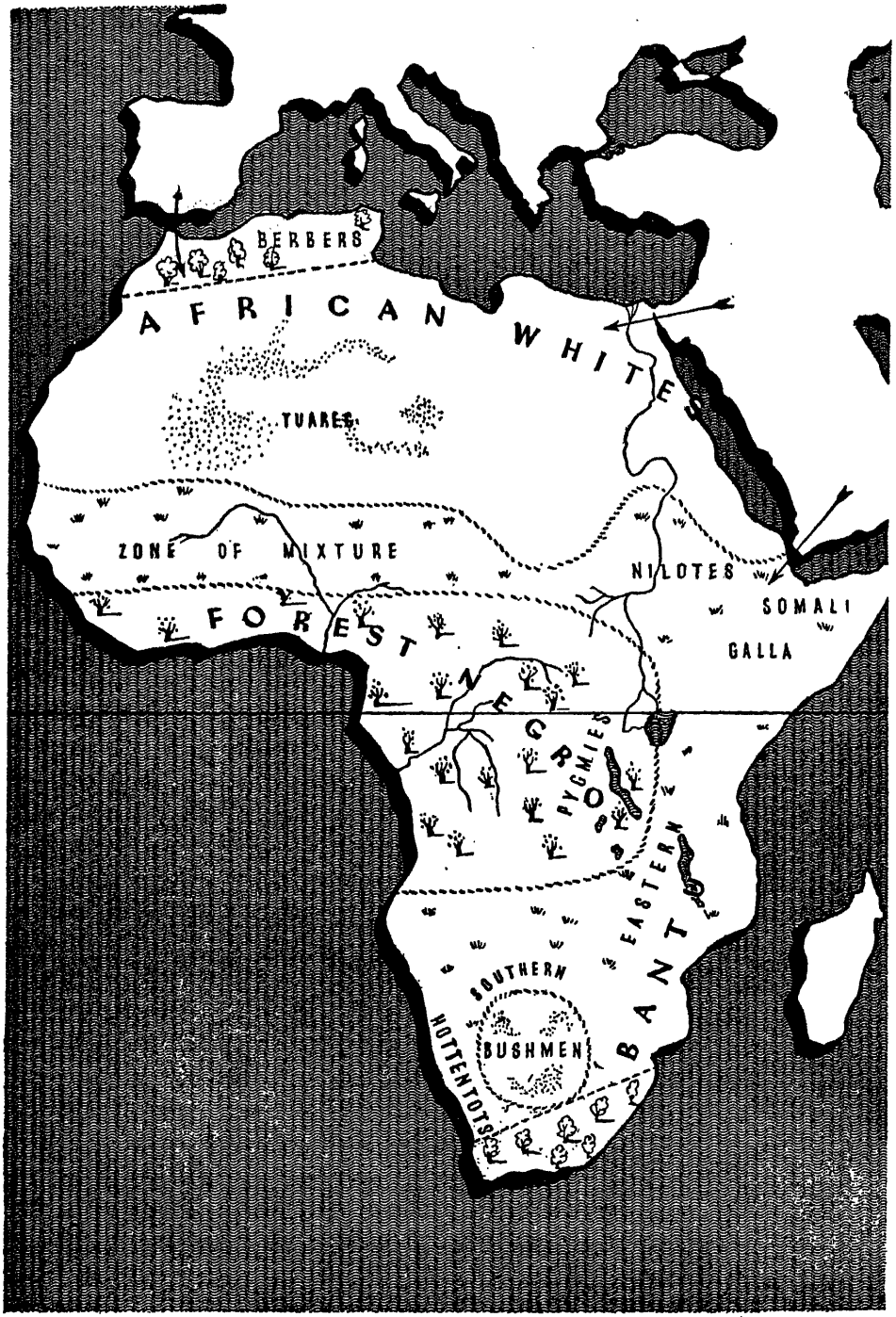
White and Black Africa

IN AFRICA everything depends on the weather. That is to say, climate makes a distinct and easily remembered pattern, and the people fit the same scheme.[1] The center of this is the jungle of the Congo and of the Slave Coast of West Africa, running to Liberia and Sierra Leone. If you take the point where the equator strikes the west coast, and use it as the center of a great rectangle 2,400 miles east and west and 1,200 miles north and south, this would enclose the jungle; the lower left-hand part of it would be in the Atlantic, but the rest would cover the western section of the waist of Africa, and this is the forested home of the Negroes. On all sides it is surrounded by semi-open parkland and grassland: the Sudan in the north, then East Africa, Rhodesia, and around to Portuguese West Africa (Angola) in the south; and in this territory live Negroid and Negro peoples who to a great extent herd cattle and use their milk. This zone fades in turn into two deserts, north and south, which continue until at the sea again, furthest from the equator, there are strips of fertile, temperate, inviting lands: South Africa, and the Mediterranean coast, with Algeria and Morocco and, by grace of the Nile, Egypt.

The southern desert, the Kalahari, is not very large or fierce, though none dispute it with the Bushmen who live there. But in the north the Sahara makes a desert belt of great width running from the Atlantic right through Arabia, broken only by the unnatural Nile and the Red Sea. When the glaciers held sway in Europe, the Sahara was a temperate, watered climate, but in the warm periods, as today, it has been a nearly complete barrier to human movement north or south.[2] As far as man is concerned, its

[1] General books on Africa are C. G. Seligman, *Races of Africa*, 1930, and W. D. Hambly, *Source Book for African Anthropology*, Field Museum of Natural History, Anthropological Series, vol. 26, parts 1 and 2, 1937.

[2] It has been drying up almost in modern times, for there are remains of settlements of Neolithic and Classical date out in the northern edge of the desert where such towns could not now survive.



RACES OF AFRICA

effect is to separate North Africa from the rest of the continent and join it to Europe and Asia as the southern rim of the Mediterranean basin. This is why North Africa has been mainly a narrow highway east and west for peoples coming in across the isthmus of Suez, or occasionally the Strait of Gibraltar, in all of recent times. The one other entrance to Africa is south of the desert, from southern Arabia at the bottom of the Red Sea into the Horn.

The African Whites

The Whites of Africa are a simplified version of the Europeans. Roughly, it is as if we had a parallel to European racial development which was arrested earlier in its career, leaving it a Mediterranean stronghold. Let us look first into antiquity. Even here, on a little evidence, the parallel with Europe is suggested. We cannot, of course, place the Rhodesian Man. But there are signs, as in Europe, that Homo sapiens may have been present in East Africa in the Lower Paleolithic;[3] and, furthermore, the archaeology of East and North Africa is related to that of Europe, and it gives us some reason, in the form of a Mousterian-like industry, to think that Neanderthal men may have inhabited the same regions, perhaps even at the same time,[4] although the only actual Neanderthal remnant from Africa is part of a juvenile upper jaw from Algiers. However this may be, in the Upper Paleolithic North Africa was racially indistinguishable from Europe, having the same kinds of big-headed White; and in East Africa as well there were men who cannot be classed as anything but White, though they differ from the northerners and are rather indefinite in type.

In the Neolithic there poured across Suez, and through other routes, the same kinds of general "Mediterranean" Whites as went to Europe, and in fact many of the Europeans themselves seem to have used this route. Large of head or small, the present North African population can in great measure be traced back to them (and in part to the Paleolithic people?). In the west—in Morocco, Algiers, the oases, and formerly in the Canary Islands—the indigenous people are the Berbers, who speak Hamitic languages and who live as far as food goes in a simple and representative Neolithic life, in villages of moderate size, raising both grain and truck gardens, with orchards as well, and keeping low-grade cattle in

[3] The Kanam and Kanjera skulls; see p. 199.

[4] L. S. B. Leakey, *Stone Age Africa*, 1936.

a desultory sort of way.[5] These Berbers are not unlike long-headed North Europeans in physical form, and some of them are blond. Now, blonds were certainly to be seen in Libya as early as 2,400 B.C., for Egyptian paintings show them, and the Egyptians were accurate as to color distinctions. This and other records, and every consideration, show that blondness in North Africa cannot be due to any late "Nordic" invaders, and so must have come in with the original population. I refer you back to Europe and the proposition that the Nordics are only an intensification of an ancient tendency in much of the White stock to lose pigment in the hair and eyes.

This body of Berbers, therefore, is racially "older" and simpler than European peoples, though it has the same beginnings. Another Berber branch lives a picaresque existence in the Sahara itself; these are the veiled Tuareg—nomads who raise their own camels and horses and steal other peoples'. French writers cannot make up their minds whether they are the world's most romantic people or just vermin. They are Mediterraneans with particularly tall stature and long heads. In the east, Egypt is basically a Hamitic nation, whose rather typical medium to small brunet Mediterranean form has not changed at all in over 5,000 years—a persistence which would be hard to show equally well for any other part of the world. A different variant of the same thing is to be seen in the Arabs, with their narrower faces and higher noses, who make a special element in North Africa. Their language is Semitic, and they came into Africa late, either as nomadic tribes or as cultivated conquerors or urban missionaries and scholars, and the energy of their immigration carried them at different times not only all across North Africa and into Spain, but also down to the Sudan and West Africa, where they Moslemized and Arabized much of the region and provided the foundation for a series of extraordinary medieval Negroid kingdoms, some of which persist today and whose sultans and warriors in chain mail could be put right back into the Arabian Nights without even using a shoehorn. But the racial influence of the Arabs has not gone appreciably beyond the settlements of their own tribes.

Abyssinia and Somaliland have, in their little-known past, suffered parallel incursions of Hamitic- and Semitic-speaking[6] peoples,

[5] C. S. Coon, *Tribes of the Rif*, Harvard African Studies, vol. 9, 1931.

[6] Not Arabic in this case.

doubtless from Arabia, who constitute the "Whites" of East Africa, which include Gallas and Somalis. There is Negro admixture throughout, making the hair bushy and the skin dark to an obviously disproportionate extent. But their features are Negroid only slightly or not at all, and their skulls would be recognized as of the Mediterranean type. (This fact, of what must have been a small proportion of Negro blood added to a probably brunet White people producing an unexpectedly dark skin, should be borne in mind in the case of India.) The Mediterraneans involved would seem to have been of more than one kind, some of the people being of a high-nosed type reminiscent of the Arabs (Emperor Haile Selassie) and others of a more generalized strain, like the North African Hamites. Further down the Nile toward Egypt the same sort of mixture is found in the Fuzzy-wuzzies—the Beja, Hadendoa, Bisharin, and others.

The Zone of Mixture

Most of the Sudan, the northern arm of the grasslands, is a zone of Negro-White mixture, the Negro element being much stronger than in the Horn. There is a little Negro blood in North Africa, brought up in a trickle through the desert by slavery, but the White pressure southward has been of a stronger kind, in spite of the desert. The effect is more obvious in culture than in race, however. The people look predominantly Negroid, except for a slight thinning of the nose and lips, a lightening of the skin to a copper color in some, and the occurrence of a tall and slender body, to be seen in such a people as the Fula or the Hausa. Nor do I mean that there is any homogeneity, even in a single people. From the Tuareg south, in fact, there are commonly castes in the social system based, in faint likeness to India, on color and on occupation, with those who are herders and flockowners lording it over farmers, artisans, and town dwellers. This is that region I spoke of where, all around in the big bend of the Niger, there are varied little states and kingdoms living a garish imitation of Arab civilization.

The Negro Family

The forest along the southern shore of West Africa and in the drainage of the Congo contains the Negroes proper. In West Africa, probably under the impact of the Sudanese kingdoms, they

have developed some kingdoms of their own, fairly highly organized and apt to be despotic, with Dahomey as the prize example. Such states are less developed elsewhere, however, and the people live generally in a jungle form of Neolithic[7] livelihood which is akin to the pre-rice culture of southeast Asia: they work truck gardens with the hoe, growing yams and bananas (and now corn and potatoes), and they keep chickens, pigs, and goats. It is worth taking notice of the contrast between this and the grain-and-cattle culture of the Neolithic Whites. The latter could not be imported into the Congo, for the grains are little suited to forest gardens, and the tse-tse fly kills all cattle.

These forest Negroes are pretty much all of a type. They have, of course, the classic Negro features, being hairless on the body and face and having woolly hair on the head, deep pigment, thick lips, a broad nose, and prognathism. The flat sides of the head make it look longer than it is, for the index is mesocephalic, centering around 78. The forehead is narrow but somewhat bulbous, and there is little if anything in the way of brow ridges. The index of the nose is about 90, meaning that it is about nine tenths as broad as it is long, and the face, too, is short and broad. As to general proportions, the Negroes do not conform to what is probably the popular notion. They are of average height or a little over (five feet, six inches is the human mean, American Whites being tall), with no tribes being exceptional; and they are also rather thickset and well-muscled, being long-armed but not long-legged.

Such is the "true" Negro, so-called, the racial group which is accepted by anthropologists as being the fundamental and central one of the stock. There seems to be little doubt that this is right. What now engages us is those Africans who vary from the type and so constitute sub-races of Negro.

The first of these extends upward into that Sudanic "zone of mixture," and its principal representatives are the Nilotics (the Dinka, Shilluk, et cetera) who herd cattle along the White Nile in the Anglo-Egyptian Sudan south of Khartoum. They are the world's tallest people, with whole tribes in which the men average six feet,[8] and they are correspondingly lanky. They are also very

[7]"Neolithic" refers to the culture level and not to stonework, for the Negroes are unrivaled ironworkers.

[8]This is a tremendous figure for an average, and quite different from simply saying that six-footers are common, as among ourselves. An average of six feet

long-headed, with indices of about 70. But here their differences from the "true" Negroes stop, unless their faces are relatively longer (as tall people's are apt to be) and straighter, and their noses also. Westward halfway to the Niger, around Lake Chad, live peoples of a similar type, like the Buduma, although they are neither quite so tall nor so long-headed. Between the two groups, and just west of the Nilotes, live the Nuba, who are not herders, but who have a Negro type of garden culture away from the forest, in semi-wooded hills in Kordofan. These Nuba are as tall as the Nilotes proper, but they are mesocephalic like the forest Negroes, whom they therefore resemble in every way but size.

Throughout the grasslands of East and South Africa live peoples, almost all Bantu-speaking (as is the Congo basin), who keep cattle and generally raise grain as well, from the aristocratic kingdoms of the lake region down to the large federations of the Zulus, Swazis, Bechuanas, and Basutos in the south. With the exception of certain ruling groups or clans who look something like Abyssinians of one sort or another, they are all Negro in their features, and appear to fit in between the forest Negroes and the Nilotes in body form and size. The South African Bantu in particular are above medium stature, and all of them have a head index of about 75. If anything, noses are a little narrower than in the "true" Negro.

It is a question how we should interpret the Nilotes and the Eastern and Southern Bantu. They may be natural variations of the Negro stock (toward larger size and longer heads), or they may be the result of some well-hidden White admixture. It is clear that White blood is present in the western Sudan, where the people are also somewhat taller and longer-headed than "pure" Negroes, and I have called this the zone of mixture. And we have seen that all the people of grasslands, west, east, and south, are cattle herders, and it can be taken for granted that cattle and grain were obtained from Whites, since these things surely originated in western Asia in the homeland of the Europeans. The presumption, therefore, is strong that all the grassland people are Negroes influenced culturally by herding Hamites and racially by tallish and long-headed Mediterraneans resembling the Tuareg or the Somalis. But this still does not explain the Nubas, up to the northeast of all the forest

means that, in such a population, men six feet eight inches are just as common as men five feet four inches, which hardly could apply to present-day America.

Negroes, who have a Negro culture but are as tall as the Nilotes. It is quite probable that one branch of the Negroes developed high stature as a special feature, and that this is the explanation.

The Pygmies are a variety of the Negro stock who are as significant as they are interesting. They live, enclosed among the forest Negroes, in many parts of the Congo basin (but not in West Africa): there is no territory which is purely theirs, but they roam the forests around the Negro towns and villages. Very primitive hunters, a band of them will live under the protection of a Negro tribe, so to speak, bringing meat for which they are paid in other kinds of food or metal objects, and they even speak the language of their partners in this association. There is not much intermixture although the Negroes sometimes take Pygmy wives. These are cheap in price but they are not good garden workers, having been brought up all wrong for such a life.

Pygmies, of course, are short, with some groups in which the males average four feet eight inches, but they differ from the Negroes in certain other ways. They sometimes have beards and also body hair, especially on the back, which is hardly known among Negroes. Their heads are round, their foreheads are bulbous, and they have rather infantile faces. But the nose is relatively very big, and broader than it is long (probably in sympathy with the short face). Altogether, the important thing is that the Pygmies can hardly be put down as Negro dwarfs of the circus variety, because they lack the usual symptoms of such dwarfishness and because, as we have seen, they differ somewhat in a racial sense from the homogeneous Negroes of the Congo.

South African Bushmen

More of a mystery than this by far are the Bushmen of the Kalahari and their relatives the Hottentots, an individual race which nobody has been able to explain. They are a pygmy people who, however, are not at all like the Congo Pygmies or the other Negritoes of the world. They are not so short, and they are typically yellowish in skin color, not black. Theirs is a distinctive kind of face, with a narrow forehead, broad cheekbones, and a pointed chin, which is at the same time flat with a small, low nose, and which has altogether a Mongoloid suggestion about it in which even the eyes participate, with a pseudo-Mongoloid fold more over

the middle of the eyelid. But at the same time the lips are very much turned out and the hair out-Negroes the Negroes: being of the type called "peppercorn," it woollies up so tightly that it forms little individual spirals rather than a mop. Finally, the Bushmen possess the most extraordinary specialization to be seen in the races of man. This is steatopygia, or the ability to lay up fat, not all over, but only on the upper thighs and backside, until it is very conspicuous, and to use this fat to help sustain life when on a starvation diet, apparently much as a hibernating animal does. Here, then, is a race which cannot be aligned with any other. Steatopygia alone would indicate that it has no near relatives. From the hair and lips it is probably closest to the Negro stock, and the Mongoloid resemblances are to my mind illusory. But what is it?

The Bushmen are nomadic hunters and trackers, very skillful in these respects, but nevertheless far down the scale of culture, being essentially in a Paleolithic stage. (The Hottentots are cattle herders, who, from their physical type, are pretty clearly Bushmen mixed with Negroes.) With the Hottentots, they speak a singular "click" language.[9] They are very much the past living in the present, for their culture runs right back into the Stone Age of this part of the world, corresponding to the Upper Paleolithic. The archaeology, as well as later history, shows that the Bushmen were formerly in possession of most of South Africa, and even extended well north into East Africa. In recent centuries they have been driven back and into the Kalahari first by the Hottentots (who came from East Africa with cattle) and then by the Bantu Negroes. But while we command a good section of Bushmen prehistory, we have no idea of their origins. Preceding them in the Stone Age were peoples, some of whom have left primitive crania like those of the Australians, and others of whom have left strongly Bushman-like skulls (Boskop, Fish Hoek) which are, however, very large, like all the Upper Paleolithic people and unlike the small and delicate skull of the present Bushman. A favorite theory, therefore, is that the Bushmen have descended from some of these older people by an assumed process of degeneration and reduction, but this would have had to proceed at an alarming rate, and to have taken place not only in the desert but also in the healthy Cape

[9]This means that they can begin a word with various difficult sucking sounds which we never use in this way and which, therefore, I cannot spell. They include a kiss, the exclamation which we for some reason render as "tsk," and that noise which, addressed to a horse, is a synonym for "giddeyap."

region, to do the trick. It would be appealing to explain them as the mixed descendants of Pygmies and of a large people like the Boskop type (which type is actually somewhat European in appearance), with the Pygmies supplying size and hair form. But there is no evidence for this, and a good deal against. We can say only that the Bushmen are almost certainly Africa's oldest living inhabitants, and that they have possibly undergone a good deal of their racial specialization there, wherever they came from.

Problems of the Past

This winds up the races of Africa. The present-day picture of distribution is not an old one. There is various traditional and other evidence, including the apparently recent spread of the big Bantu family of languages, of a confusion of movement among Negro and Negroid peoples. It is not well understood. But it seems to result in the main from the introduction of a herding-and-grain sort of pastoralism into the Horn of Africa at the hands of Hamitic Whites, and its spread through the grassland, west in the Sudan and south into South Africa, with the appearance of varying Negro-White mixtures in most of this range. The principal elements remain the North and East African Whites, the Negroes of the forest, with their hoe-using horticulture, and the vanishing Bushman hunters of the south. From what we know of the Whites and the Bushmen, it is the origin of the Negroes which becomes the great unsolved problem of the continent.

Antiquity in the Congo is almost an utter blank,[10] so that we cannot approach the Negro from the past. At the same time we cannot find ancient signs of him anywhere else. North Africa has been "White" as far back as Homo sapiens can be traced, even in such times as a different climate might have made the Sahara passable to a primitive people.[11] In South Africa it is the Bushman who is ancient, with no Negroid skulls being known archaeologically; and the stone industries indicate that the Bushmen reached up toward East Africa. Aside from this, East Africa seems to have been almost as "White" as the north, from the skulls of the Paleo-

[10]Archaeology in a forest area presents great difficulties when the cultures involved are simple.

[11]Such a circumstance, combined with a land bridge to Italy in glacial times, due to a lowering of the sea level by the water accumulated in the ice sheets, would be the logical suggestion to accept if one wanted to derive the mysterious Grimaldi Negroids from Africa.

lithic and Mesolithic; certainly there was nothing distinctly Negro in them. The Whites of East Africa seem to have come in, as I said, from Arabia, even in recent times, while the Negro strain of Abyssinia gives the appearance of having come from the other direction, which is to say the forest. We can account, therefore, for all of Africa except the forest, and we find no indications of Negro occupancy, or paths of travel. The only exception is an apparently Negroid skeleton of Mesolithic date from the Sahara, which might bespeak the last northward extension of the forest.

Another factor in the problem is the Pygmies. They could not have simply developed here and there among the Negroes, where they are now. It is impossible to conceive of any process by which they could have become segregated in both race and culture, and precipitated out, so to speak, from the otherwise homogeneous Negroes in the Congo, especially since there are other Negritoes, some of them still to be mentioned, elsewhere in the world and quite independent of full-sized Negroes. The only possible explanation is that the existing arrangement in the Congo is the result of the Negroes and the Pygmies arriving where they are now separately, from somewhere else, with the Pygmies coming first.

Now this arrival might have been from two other localities in Africa (perhaps even within the Congo), whence they spread out, came in contact, and took their present relations, provided these localities were separated enough to allow the Pygmies to become racially distinct from the Negroes. But this again fails to account for those Negritoes in other regions, and for the Pacific Negroes of Melanesia. There is reason, in short, to consider the surprising possibility that the Negroes and Pygmies are neither of them at home in Africa at all, but came from somewhere else. I shall come back to this.

CHAPTER XXIII

Islands of the Pacific

THE LAST great habitat of man differs strikingly from the others in its very form. Instead of being a continent, Oceania is an island world, a simple fact which has nevertheless caused it to become a veritable museum of races. Primitive people move about readily enough, usually being hindered slightly by foodless or inhospitable areas (deserts or arctic tundras), considerably by high mountain ranges, and very greatly by open water. Therefore, if different kinds of men enter some easily traveled continental region, each successive kind moves freely into the territory of its predecessors, mixing with them or blotting them out over large areas. But in the South Seas, where there are only separated islands, an earlier people may be preserved against being entirely swamped by a later one, simply because the later may not reach all of their island refuges.

More than that, the Pacific is also something like a coal grader, for the further out into it you go from Asia, the smaller and farther apart the islands become, and therefore the more difficult of approach. If you stand at Singapore, the logical point of entry from Asia, right on the equator, and look off east by south into the ocean, the nearest islands (East Indies) will appear huge and close together, readily accessible to any kind of an Asiatic who has a small boat or even a raft; but farther away the distances call for ever-greater skill and better boats, and the islands themselves become so poor in natural food that invaders would have to bring their own sources of food with them. That is to say, a people ignorant of agriculture could not have colonized Hawaii at all, regardless of the difficulty of getting there.

These are the reasons why the racial complexity of the South Sea Islands is great. It is like a widespread pageant, for variety not unlike the beginning of the second act of *Aïda* (without the traditional wrinkled stockings). Our problem is to reconstruct the manner and the order in which the actors wandered onto the stage and disposed themselves as we see them. Let us first describe the

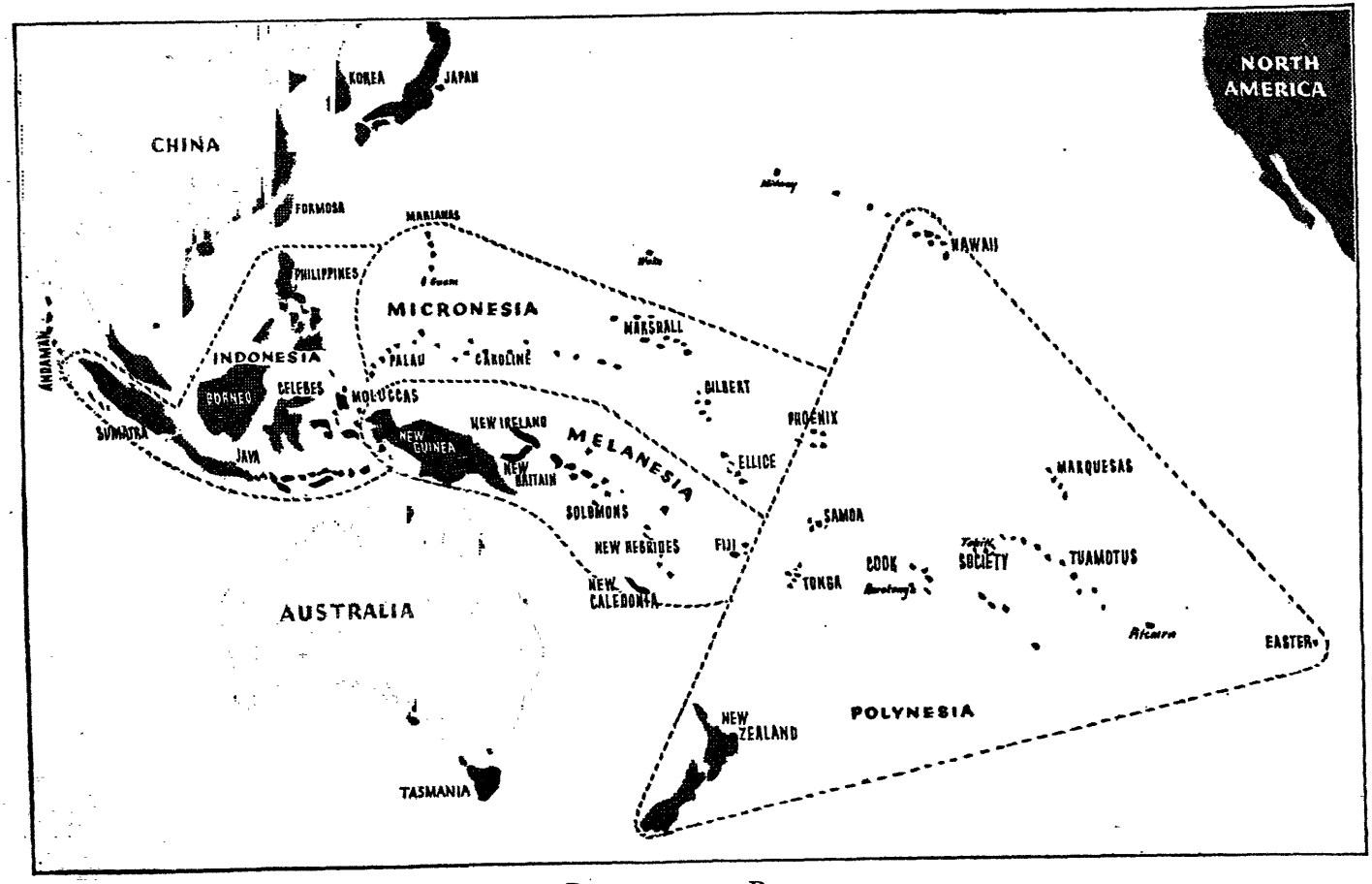
scenery, part by part, and the present position of the personae. To begin with, the Oceanic islands fall into five natural divisions, both as to geography and as to people. Indonesia includes all the great islands off southeast Asia. Eastward are three areas: Micronesia in the north, Melanesia in the center, and Australia in the south; and eastward again, bounding all of them, is Polynesia.

Indonesia

Indonesia looks like a bulge of Asia which has begun to break up into pieces and float away. It is, actually, a part of Asia, but one which has sunk somewhat and become partly flooded. All of it, from the Philippines around through Celebes and back to Sumatra, shares an Asiatic animal and plant life to a great extent, some of it so fully that these parts must have become separated from the mainland only in very recent times, probably late in the Pleistocene. Its humanity also is continuous with that of southeast Asia. As on the mainland, this runs the gamut from rather simple pagan peoples, like large numbers of the Filipinos, Borneans, or Sumatrans, through more cultured town-living, wet-rice-raising people who are Hindus or Moslems, up to the glittering courts of rajahs and sultans which go back through the last thousand years and more. These all seem to represent different levels or stages of the same type of culture, affected also by powerful Chinese and Indian influences.

The people—Indonesians, or Malays—are all racially Mongoloid, in a generalized way, being brown-skinned and shortish; with many of them not even having the characteristic flatness of the typical Mongoloid face, and few of them being marked by that "specialized" Mongoloid character to be seen in China and the north. The Indonesians can be compared in this respect with the American Indians, and they vary among themselves like the latter; but their particular type is different and they are on the whole lighter in body build than Indians.

That describes the vast body of the seventy-odd million people of the Indies but does not include certain minor racial elements. Much of the most important of the latter are the Negritoes, whom we have met before. Their great home is the wilder regions of the Philippine Islands, including the province of Bataan; here they are of the familiar sort: short, intensely black, woolly-haired, and



PEOPLES OF THE PACIFIC

round-headed. Elsewhere in Indonesia (in Celebes and Borneo) they exist only as a mixed strain, apparently indicated by occasional curly hair and small size. But they are found again in the Andaman Islands in the Bay of Bengal, which is not, properly speaking, a part of Indonesia. The Andamans have been used for eighty years as a penal colony and naval base by the British, and the natives who submitted to them have gradually become extinct. In the wilds, however, they still flourish in total freedom and purity, in this place which in all the world is the single area which was occupied by Negritoes only.

Other possible non-Mongoloid types in Indonesia are so vague and overlain with Indonesian blood as to be most elusive. There are many individuals who suggest an affinity with the White stock, but only suggest it. However, in the easternmost islands nearest to New Guinea there is evident a mixture of dark-skinned types—Negrito, Australian, and possibly Negro—which is not pushed beyond recognition by Malay blood.

Micronesia

Bordering Indonesia on the east are three other areas. In the center line, just below the equator, Melanesia carries out the theme of islands diminishing somewhat in size and getting farther apart. But north and south are two regions exceptional as to land area and nature. Above the equator, Micronesia is made up very largely of the tiny coral islets of the Carolines, the Gilberts, and the Marshalls, with only a few others of better size, like Guam and Truk, and Micronesia totals altogether not much more than the average American county. The disappearing population is not well known, but it seems to have been, in race and culture, allied to the Polynesian though with strong Indonesian influences. The language also occupied an intermediate station between the two, all three being related. Little more, unfortunately, can be said about them.

Australia

South of Melanesia lies another extreme of land size, with a true continental character: Australia. The natives lived, when the Dutch and the English first saw them, perhaps the most primitive life of any known, providing us with what is probably a fair

sample of existence during the Paleolithic. They had no bow and arrow, to say nothing of such arts as pottery or agriculture, and they wandered naked about their tribal territories throwing spears and boomerangs at kangaroos and emus in an anxious quest for sufficient meat for their needs; and their one method of cooking was the crudest kind of roasting by tossing their meat into the fire.

The natives appear to be a fourth major racial stock, equal in importance to the Whites, Negroes, and Mongoloids, and so primitive into the bargain that they might almost be the common parent from which the others have all descended. They are dark in skin color, and have a relatively broad nose. Here, however, resemblance to the Negroes practically stops. Their hair has no hint of woolliness, but is anything from straight to curly, like a European's, and, also like a European, they grow full beards and sport a plentiful amount of hair on the body. They have narrow, receding foreheads, very heavy ridges over the eyes, and a deep recession of the root of the nose, giving them a specially primitive and ferocious look. Their mouths are large, but their lips are only of moderate fullness, and not so thick as the Negro's. The mouth region protrudes and the chin recedes. If you examine the skull of one of them you will be struck by the rather small size of the brain volume and by the weight of the bone, and also by the handsome size of the teeth. Convincingly, this suggests a primitive kind of Homo sapiens. It does not, however, bear any particular likeness to the Neanderthal skull.

Some of my colleagues think that the Australian is not actually a "pure" race, but one which is mixed, resulting perhaps from a Negrito crossed with a very primitive "White" strain and perhaps a Negroid element as well;[1] the White supposedly being responsible for the type of hair. This is conceivable, though I think the evidence is contrary. It rests on the idea of a supposed primitive White race. Such a strain, if it produced something like the native Australian when it was mixed with Negro or Negrito, must have been appallingly primitive in a pure state; so much so that it would have to be regarded as a separate, fourth major race anyhow, instead of as belonging to the White stock. The Australian racial type pops up elsewhere (e.g., India) in a more obviously mixed form,

[1]Dr. Joseph Birdsell discovered a somewhat Negrito-like tribe of Australians in Queensland, and the extinct inhabitants of Tasmania, though otherwise like the Australians, had woolly hair.

but it always seems to reflect the same type which is seen in the flesh in Australia, and not something else. Therefore, I do not believe it is a mixed race. But, at any rate, there is no questioning its great significance.

Melanesia

Melanesia is the central track into the Pacific, pricked out by mountain ranges which rise from the ocean floor, running off to the southeast. The western part, north of Australia, comprises New Guinea and the Bismarck Archipelago: New Britain, New Ireland, and the Admiralties. New Guinea, the largest island in the world, is made up of a spine of particularly rugged mountain ranges flanked, like a flounder with its fillets, by wide plains and swamps both north and south. It is today, in spite of the war, still the least known part of the world. Eastward the Melanesian islands ring the Coral Sea: the Solomons, the Santa Cruz group, the New Hebrides, and New Caledonia. Still further east, sitting on the international date line, is Fiji.

The one racial type which seems proper to the area is Negro (Melanesia: Black Islands), of a sort which seems indistinguishable from the African. The difficulty lies in the presence of so many other racial elements. To say that this Negro type is the characteristic one is to say that it is what would probably be left if all the other distinguishable types could be extracted from the conglomerate. In the center of New Guinea, especially in the highest mountains, there are certainly Negritoes, though they seem not quite pure in form, and this same element is present, less definitely, in New Britain and even in the New Hebrides. In New Guinea again there is also a strong dose of the Australian type, thoroughly mixed with Negrito and giving a stumpy, heavy-nosed, broad-mouthed, beetle-browed form of incredible ugliness. The Australian element, mixed apparently with Negro, is also present in two other astonishing places, off the beaten track:[2] the region of Rabaul in New Britain, and in northern New Caledonia. The Negro proper seems to be more characteristic of the main coastal routes, being found on the shores of New Guinea (especially the north coast) and of the islands to the east. These, in turn, have been

[2]By the "beaten track" I do not mean the track of the "Tokyo Expresses," but that which would be followed by primitive peoples exploring eastward in canoes from southern Asia.

racially contaminated by influences from further afield. Indonesian blood is apparent in parts of New Guinea, and indeed there is a whole zone where Indonesia shades into Melanesia. At the other end, Polynesian influence is obvious, mainly in Fiji, which would seem to have drawn half of its racial clay from this source; otherwise such infiltration takes the nature of small Polynesian colonies rather than mixture. In the main central portion of Melanesia similar influences from Micronesia have been strong, so that natives from the coasts of, say, Guadalcanal or Malaita show the fact in their faces in an unmistakable way. The Micronesian and Polynesian pressure has been so strong that isolated islands or groups (Lord Howe group, or Rennell or Bellona) are peopled by almost pure members of those stocks.

Melanesia, one can see, presents us with a sort of racial pousse-café or perhaps a layer cake, and therefore from the point of view of racial history it is the most significant region of Oceania, if not of the whole world.

Polynesia

Polynesia occupies half of the Pacific—everything east of the date line—but except for New Zealand most of the land area is minor and all of it is isolated. From Fiji the main land axis of Oceania continues, thinning out, through Samoa and Tonga to the Societies, with Tahiti, and then to the corally dots of the Tuamotus, the Low Archipelago. The corners of an enormous triangle enclosing all of Polynesia are formed by New Zealand, Hawaii, and Easter Island, with the Marquesas lying between the last two. All the livable lands were reached and occupied by one people, speaking one language, the romantic Polynesians.

They are among the world's tall peoples, and they are of a light brown skin color. They are patently a hybrid race, compounded of White, Mongoloid, and a modicum of Negroid. The White element is manifest in the general physique, in features of the face, and in the wavy hair and growth of beard. The Mongoloid strain is harder to detect, but it contributes to the general form of the face and to its size, and appears to be more in evidence in the west, in Samoa and Tonga, than in the east, or in New Zealand. A certain heaviness of the nose or other features in some localities, as well as a frizziness of the hair, suggests the Negro element; but this is probably slight, considering the color of the skin.

The ingredients may seem to differ in various parts of Polynesia, but nevertheless the people all are one. Furthermore, they were the world's most accomplished native seafarers, and even remote Hawaii and New Zealand kept some kind of contact with islands in the center like Rarotonga and Tahiti, and the unity of culture was considerable. This culture seems simple at first glance and poor in material objects. But they were expert house and canoe builders, and there is clear evidence that they once possessed a fuller culture but have relinquished certain arts for lack of resources (metals?) or for lack of need (pottery?). They depend to a great extent on fish, but the cultivated plants which they brought with them are equally important in their lives, and these are the same plants (banana, breadfruit, taro) which seem to have been the staff of life in southeast Asia and Indonesia in the days before rice. Whether the Polynesians ever were acquainted with rice is not known. They could not, at any rate, have transplanted it to Polynesia.

Here ends our description of the Oceanic setting. Plainly, a series of people have come off the Asiatic mainland, representing most of the known races of the earth. And the order of their coming could tell us much about the racial history of the rest of the world.

Recent History: the Indonesians and the Polynesians

We know more or less what happened during the latest phase of the story. The Mongoloid peoples of Indonesia have usurped that territory, beginning certainly well before the Christian Era, by a simple expansion from the mainland and in great enough force to scour the islands of almost every other racial type except the Negritoes. This expansion carried nearly to New Guinea and has continued to some degree in the historic period. It is difficult to see what was present in Indonesia earlier, except by inference, and the archaeology of the islands is almost unknown. As to the Indonesians themselves, there are good indications that the latest among them to arrive are more "Mongoloid," or specialized in that direction, while the earlier tribes seem more generalized; so that, as in America, there is support for the belief that the highly specialized Mongoloid type of face evolved and spread at a later time.

The Polynesians have also preserved strong hints of the time

of their migration in a peculiar way: their genealogies. Birth and rank were everything in Polynesia, and lists of ancestors were recited on ceremonial occasions, and there also existed an unwritten literature telling of great voyages in exploring canoes, and adventures in the past. The genealogies and stories agree well enough in various islands of Polynesia to show that the people must have made their original journeys from the west shortly after the beginning of the Christian Era, figured by counting back the number of generations to the leader of one of the legendary expeditions.

It is certain that they did not occupy Melanesia, but rather bypassed it, coming almost in a jump all the way from Indonesia. Melanesia itself shows no evidence of any settlement by them, and therefore it must already have been occupied by Melanesians at the time. It is equally certain that the Polynesians started from Indonesia. All of them had traditions of their ancient home in the west, generally known as Hawaiki, which has not only given its name, of course, to Hawaii, and Savaii (in Samoa), and various other Polynesian islands, but also is the same linguistically as "Java." This may, of course, be only a linguistic accident, but nevertheless the Polynesian accounts are most explicit about their great voyage and their westward origin. Another of their traditional homes has a name apparently signifying Great-Atea-covered-with-rice, seeming to indicate that they did indeed come from a place where rice was grown.

It looks as though it might have been the pressure of Malay peoples which sent them on their course. But in spite of all the hints given in their legends it is not possible to discover their actual Indonesian home. All that can be said for the Javanese suggestion is that it is logical. The Polynesians have a culture which is allied in a general and basic way to that of Indonesia, and their language is of the same family, but there is no place in the Indies where there exist specific and precise likenesses between the two cultures. Nor is there any reliable indication of what part of the mainland they, or the White element in them, might have come from before their Indonesian sojourn. Their origin is one of the great mysteries of anthropology.

At any rate, the discernible doings of the last three thousand or more years are all concerned with the Indonesians and the Polynesians. Until their appearance on the scene, all the people of the Pacific must have been dark-skinned, and must have occupied only

Indonesia, Melanesia, and Australia. For these people we have neither history nor tradition to guide us, but only what we see of them today, together with a little archaeology. Let us start at the beginning and see what probably happened.

Ancient History: the Dark-skinned Peoples

The beginning, of course, was in the time of Pithecanthropus, or of Solo Man. But this was when Java, at least, was a part of Asia, and I am talking instead of Homo sapiens and his outward expansion from island to island, which doubtless did not start until far more recent times.

I believe that the first people to leave Asia were the native Australians. They seem to be at the bottom of the racial heap, and they must have passed through Indonesia and New Guinea in early times, for their culture is so poor that they would have been stymied by any other people who had reached the islands before them, and so would never have got to Australia at all. At any rate, the Wadjak skulls of Java (see p. 191), earliest of Homo sapiens in this part of the world, were of their type. There is little other evidence of their passage, though we have seen how they apparently left remnants, in mixture, along their trail. These are to be found in India and Ceylon, in the last islands of the Timor Archipelago, or Sunda Chain, east of Java, and in New Guinea. They also seem to have reached the remoter parts of western Melanesia, being unmistakably present in northern New Britain (and New Ireland) and in northern New Caledonia. How they managed to cover the respectable distance over water to the latter is a mystery unless, as seems probable, they became mixed with later seafaring Negroes in New Guinea and were ferried over only as hybrids.

The arrival in Australia must have taken place many thousand years ago—just about at the end of the Paleolithic—because the culture is of so low a grade.[3] Furthermore, certain skulls found in Australia seem to be of considerable age.[4] Yet the Australians must have been in command of some simple boats because of the water crossings they would have had to make, for there has not been a

[3]See D. S. Davidson, "The Antiquity of Man in the Pacific and the Question of Trans-Pacific Migrations." In *Early Man*, edited by G. G. MacCurdy, 1937.

[4]A. Keith, *New Discoveries Relating to the Antiquity of Man*, 1931.

American Museum of Natural History photo

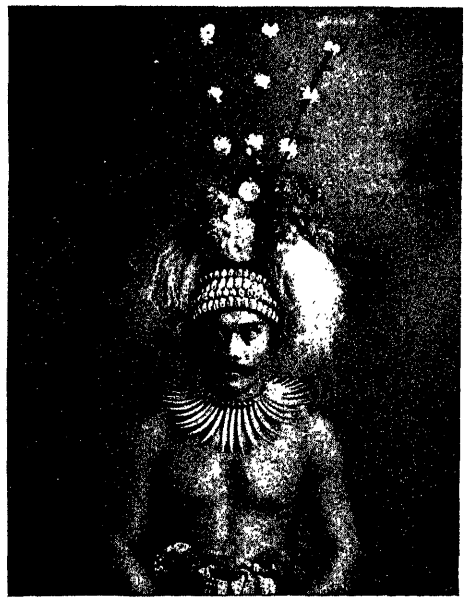
INDONESIAN, PHILIPPINES. AN UNSPECIALIZED MONGOLOID TYPE

American Museum of Natural History photo

NEGRITO WOMAN, PHILIPPINE ISLANDS

Peabody Museum photo

MELANESIAN MAN. NATIVE OF GULF OF PAPUA, NEW GUINEA



American Museum of Natural History photo

POLYNESIAN MAN, SAMOA

land bridge from Australia to Asia for millions of years. Boats suggest a "Mesolithic" culture stage; something, that is, late in the Stone Age. So does their domesticated dog. The latter is not definitely known to have been brought by man, however, and it never reached Tasmania. In any case, the whole business of date is most questionable, so that to say 10,000 years in the past is simply to make a guess.

The next people to appear in the Pacific would obviously be the Negritoes. They must have had boats of some fair quality in order to get to the Andaman Islands and the Philippines, and this, as well as the fact that the rest of their culture is also on a slightly higher plane than that of the Australians, indicates that they made their trek later.[5] They penetrated the western Pacific pretty thoroughly. It is true that there is little trace of them in Indonesia generally, but the fact that they survive in the Philippines shows that they must have been linked with those in Malaya and the Andamans by way of Borneo and doubtless by Sumatra as well. Celebes also must have received them, since it is the logical route to New Guinea, where they are found, as we have seen, not only in a representative state but also mixed with Australoids. Whether they made their way as well to the Solomons or to other parts of eastern Melanesia is very hard to say. At any rate, wherever they are now found in contact with another people, they are (as in Asia and in Africa) surrounded and enclosed by them, and therefore earlier. The only exception to this statement about the Negritoes seems to be the Australians.

Certainly the Negroes proper did not come on to the scene until after the other two races. The Australians are low-grade hunters and the Negritoes are (typically) high-grade hunters, as far as their general culture goes, but the Negroes are gardeners, with a full "Neolithic" stage of culture which includes pottery. The Negroes enclose the other types in Melanesia, having taken the desirable areas along the most accessible coastal routes and having gone further out in the Pacific, all the way to Fiji. The remarkable thing is that, with all their better, more sedentary culture and their boats, they left no detectable impression on Indonesia. There are groups of the lowly Negrito in the Malay Peninsula and the Phil-

[5] It does not prove it, however. There are a few grounds for arguing the opposite. If you believe that the woolly hair of the Tasmanians was due to Negrito blood, then you are led to suppose that the Negritoes passed through Australia before the Australians themselves arrived. (See p. 285.)

ippines, but of the passage of the more recent Negroes there is no sign. But then there is no sign of the Polynesians either. It may be that, of the people in the path of the oncoming Indonesian Malays, the Negritoes could not escape, and more or less succumbed; the Negroes, with better command of their food, and with useful boats, pushed on ahead; while the Polynesians, with the best boats and the greatest ability of all, shot out like a watermelon seed from between the pincers constituted by the earlier Negroids and the later Malays, and traveled practically non-stop until they came to untrammeled territory in Samoa.

The Pacific, therefore, has received from fecund Asia at least five waves of peoples in the last ten thousand years or so, each flowing over the one ahead and going on beyond it until, in the time of the Malays, the pattern has been destroyed by an improvement in ships so great that the Pacific could be penetrated from any direction, and not from southeast Asia alone, so that it has suffered inroads from Arabia, India, Spain, Portugal, Holland, England, America, and Japan.

CHAPTER XXIV

Racial History of the World

If you have ever played charades (and who, alas, has not?) you will remember that, when your friends on the other team come into the room drolly dressed in lampshades and blankets, and carrying egg beaters and other such bric-a-brac, there is a hidden meaning in their antic action. Lurking in the foolery there is a spoken word, a certain meaning, or a special emphasis which, trapped and put with others in the show, will give you an unmistakable logical thread, like "hippopotamus." So it is with the events of that last great epoch before history begins, during which the races of modern man were taking their places. We have just seen where it all ended, or rather where it stood before the travel-minded navigators of Portugal and Spain began their work. If we could only settle on the true and significant clues in the recent distribution of mankind, we might see the logic of how it came about, and arrive by reasoning back at that original focus in time and place where Homo sapiens began to split up into races. This means looking into mixtures to see what races mixed, and, though bewildered by such paradoxical people as the Bushmen, the Ainus, or even the American Indians, to see which of the signs are of supreme importance. Perhaps the reader is tired of puzzles, or of having me say, "I don't know the answer to this one"; if he is, I can only counsel him to close the book now, and put it in the guest room.

Culture and Population Expand

Circumstances as well as races conspire to hide what happened. In recent ages man has done some striking things to his world, and thereby to himself. His material accomplishments began to hurry along faster and faster. Let us assume, again, that the period we are speaking of began with the Upper Paleolithic. This was roughly 50,000 years ago, and this amount of time is, also roughly, one twentieth of that since the Pleistocene opened. Culture was

progressing faster than heretofore, but it only really began to speed with the Neolithic, about 10,000 years ago,[1] or when only one per cent of Quaternary time remained. I have tried already to convey the incomparable importance of the Neolithic departure, and to show how it must have increased the population of those who became farmers. For suddenly the world could hold far greater numbers of people: instead of depending on the breeding and the migrations of wild game, men had their source of food bottled up in their own back yards; new mouths to feed were no problem, because "with every mouth God sends a pair of hands" to hoe a new garden plot, and it would be a long time before the earth should become so crowded that garden plots were scarce. On top of this, however, the Bronze Age way of life, appearing about 5,000 years ago, opened another era of new possibilities. With ox-drawn plows instead of Neolithic hoes, farmers in rich lands could raise far more than they needed to eat, and with this surplus of food a surplus of men could live in cities, working as artisans at other trades. Such possibilities were organized politically and developed up through the Middle Ages. Then came the period of world-wide expansion of the Europeans, with highly developed trade and transportation, and almost simultaneously the Industrial Revolution, with the substitution of natural resources like coal for human energy, through machinery; all offering in various ways new opportunities again for the growth of the human population. It is not really so simple, but we could say that in the last 10,000 years humanity has been granted an impetus to increase enormously three times: with the Neolithic, the Bronze Age, and the European expansion.

Now we have not had censuses very long. But we do know that there are about two billion people alive today—nobody knows exactly, which is the fault of China. We also know enough figures for the last three hundred years—the time of the European expansion—to see that the population of the world has increased to about five times what it was in 1600, and that the increase is coming to a stop. And it is fair enough to suppose that similar great increases took place in the Neolithic and after the Bronze Age, and that 10,000 years ago the world population was accordingly between one hundred and two hundred times smaller than it is today.

[1]Ten thousand is further than the full Neolithic can be traced anywhere archaeologically, but this is a round number, and I also mean to include a period during which a Neolithic economy had been developing—a slow process—and had already begun to affect some segments of mankind.

Toward the close of the Paleolithic and the Mesolithic there were probably something like ten million people only, in the whole world. The thinness of those primitive tribes who still live in a Paleolithic way of life, like the Bushmen of South Africa, or the Australians, and the limited distribution of Paleolithic implements, both indicate that this is so.[2]

The stupendous growth of the last 10,000 years gives us two things to bear in mind about the recent spread of man. One is that this spread was only partly (perhaps in the case of the American Indians, for example) a leisurely search for fresh game or territory; it was also, with the coming of the Neolithic, a process in which strong forces were at work: internal pressure among expanding groups and external pressure against others, coupled with new aids to travel, like boats to cross water, or herds to keep men alive in the open plains. The other thing is that progress and expansion did not take place equally among all races or peoples—in the last century there were still many tribes living in a Neolithic age, and a few, as I said, lingering on in the Mesolithic or even the Paleolithic. Therefore, the proportions of the living races are something relatively new. Just as in the last few generations most of the remaining "Neolithic" people, like the American Indians, have gone down before the Europeans, so in earlier times a hunting, Paleolithic people would have been crushed before the advance of tribes in a Neolithic stage of culture. This means that, in getting back to racial beginnings, we must be especially careful to give such dying peoples as the Bushmen, the Australians, or the Negritoes, or any apparent remnants of them, their due importance in the racial scheme, realizing what has happened to them.

The Homes of the Races

If we look, first of all, for that part of the world which was the hothouse of races, we can make only one choice. All the visible footsteps lead away from Asia. We know nothing about the Negroes, but we are certain that the main body of the Whites came from Asia, and we are aware that the main body of the Mongoloids is still there. In the Far East there are two great land

[2] L. Krzywicki, "Primitive Society and Its Vital Statistics," 1934; H. de Terra, "The Quaternary Terrace System of Southern Asia and the Age of Man," *Geographical Review*, vol. 29, 1939.

funnels, one in the north and one in the south, and we know very well that peoples have flowed out through them, to America and Oceania respectively. Finally, even today the center of all the races is in Asia. They all lap against the land block of the Himalayas, and from this you could divide the world very roughly into pie-shaped pieces. If the hands of a clock turned on Mount Everest, then between the hour and twenty past you would find the Mongoloids, between twenty past and twenty before the dark-skinned races, and from twenty before back to the hour, the Whites. I hasten to say, however, that this prospectus is entirely too glib, and that we must look a little more painstakingly for the breeding grounds of the several major races.

The Whites do not give us any particular trouble. They would seem to have been entrenched in southwest Asia, perhaps more specifically in Persia and Afghanistan, from their beginnings, apparently with the Neanderthals to the north and west of them. But they may have made their way into both Europe and Africa in the Lower Paleolithic, and during the Upper Paleolithic they almost certainly traveled east through Central Asia into China (which is not a difficult route if there are few peoples to oppose you), and this may explain the Ainus and the Polynesians. The Whites are probably an old form, being one which is generalized even though it is advanced. Whether or not it really existed in the Lower Paleolithic, there is, of course, no doubt at all that it was in being by the Upper Paleolithic.

The Mongoloids pretty clearly arose somewhere east of the Whites and north of the mountains. But we know almost nothing about their age except what, it seems to me, can be gathered from the American Indians. The Indians look like a most unspecialized and Paleolithic kind of Mongoloid, having as Mongoloid features only the broad face, the hairlessness, the generally straight hair, and an occasional Mongoloid fold, and they would seem to recall a time, before their migration to America, when North Asia was full of such people. This means that while the unspecialized type or stage of Mongoloids (including the Asiatic groups) may be ancient, the specialized form is recent. Since this specialized type now runs well into the northeast of Asia, it must have come into shape too late to be included among the Indians except for the Eskimos, but probably before the full Neolithic, since it is especially characteristic of the culturally primitive peoples of northeasternmost

Siberia. It is, therefore, the latest distinctive racial type to appear, excepting perhaps the Nordics, Alpines, or Dinarics.

But the unspecialized Mongoloids are probably old, as I said, like the Whites, and the two stocks may have some special relations. It is not difficult to imagine that they came in contact and mixed, because of the relatively easy movement east and west which the geography of Central Asia allows. But there is no particular evidence that this happened. If the Indians are what they seem to be—unspecialized Mongoloids who in some ways resemble Whites, and above all resemble the skulls of the Paleolithic Europeans—then the Whites and the Mongoloids were probably anciently related. That is to say, there was once a race distinct from the darkest-skinned peoples but not yet divided into Whites and Mongoloids. This, of course, would push the first racial partings further than ever back into the Lower Paleolithic. (I doubt, by the way, that the Ainus and the Polynesians have any bearing on this, or that they are more than accidents of migration and mixture.)

The dark-skinned peoples of the world are a far more formidable puzzle. These are, of course, the Negroes, the Negritoes, the Bushmen (?), and the Australians, and I lump them here only for geographical convenience. The South African Bushmen, at one of the dead ends of the world, are not traceable, but they are surely old. The Australians, at another such dead end, can be traced. They could not have done otherwise than come from Asia in any event, and we find them in dilute form along the path back from Australia to prove it: in Melanesia, in the Timor Archipelago, and in India, which I should guess to be their homeland; and possibly even as far as southern Arabia, which makes it conceivable that they might have reached Africa. That is about all there is to say about them. We can judge that they are an extremely ancient race, relative to others, from their very form. Besides, the Wadjak people show that they were in Java in the late Pleistocene (?), and there are those few seemingly ancient skulls from Australia itself. Then there is the question of Australian culture, which is largely Paleolithic; a culture such as began to give ground in Europe some time after 10,000 years ago, though it may have lasted in southeast Asia far longer. But the Australians would probably have needed boats to reach Australia, and boats are "Mesolithic." So the chances are that they arrived in the island continent, and were subsequently nearly exterminated in Asia and Indonesia, at roughly the time

that the Indians were going to America, perhaps 10,000 B.C. Considering their wretched material culture, we might be surprised to see that any traces of them have survived in India at all, and more inclined to think, therefore, that they must have once been present on the mainland in what for them would have been considerable numbers.

It is with the Negroes and the Negritoes that the fun begins, and the important point is their relations to each other. Let us take the Negroes first. Physically, they are no more like the Australians, altogether, than are the Whites—the black skin is probably misleading. Culturally also they are no submerged remnant, but a flourishing, basically "Neolithic" people (with the south-east Asiatic type of foods) both in Africa and in Melanesia. Now this is the great problem: finding no true signs of them in Asia, how can we understand their presence in two such widely separated homes? We have seen how, though we know nothing of the Negro past in the Congo, the eastern part of Africa along the Indian Ocean has long been in the hands of peoples mainly White or Bushman. It is quite impossible to believe that the Negroes could have gone from the Congo to Melanesia, or the other way. If they were found in Africa only, it would be easy to think that they had actually evolved there, from an old offshoot of Asiatic Homo sapiens. Some believe this, and explain the Melanesian Negroes as enlarged Negritoes, and therefore different in origin. But I think this is pulling rabbits out of hats, and anyhow it only calls up further difficulties which will be seen in a minute. Let us turn to the Negritoes and see what can be made of them.

It has been suggested that the Negritoes are remnants of the first men. But we know that early men were full size, and we can be sure that they were not of Negro type. The Negritoes can only be an offshoot of the Negroes, after the latter had developed, which became dwarfed. And this can only mean that their point of origin was somewhere near that of the Negroes, though still apart from it.

Now look at their distribution, the crowning enigma. They are spotted among the Negroes in the Congo forest, and they turn up in the southern fringe of Asia (the Andaman Islands, the Malay Peninsula, probably India and possibly formerly in South China), in the Philippines, and in New Guinea, and perhaps Australia, with probable traces in Borneo, Celebes, and various Melanesian islands.

All of these are "refuge areas," the undesirable backwoods to which the Pgymies have obviously taken as later, more powerful people arrived in the same regions. Almost everywhere the Negritoes are pure hunters, and they all speak borrowed languages, except possibly in the Andamans, the only territory which in recent times was theirs alone.

Several things stand out from these facts. The Negritoes must have had a migration from a common point. This migration or spread must have been separate from any taken by the Negroes proper, because they are found mostly in different places. The Negritoes must have spread earlier than the Negroes, for where they are found together (Africa, New Guinea) the Negritoes are enclosed by the Negroes, in places where they could not have penetrated, with their poor culture, had the Negroes been there first. And it is hopeless to assume that their point of origin was at either end of their range, breaking out from among the Negroes of Africa and going as far as Melanesia, or vice versa. It is much more likely that they came from some point midway, which is Asia.

This says a good deal about the Negroes. The ideal solution to it all would be to suppose that the Negro stock and its Negrito branch appeared in near-by habitats in India or southeast Asia. They are doubtless "newer" races than the Australian, because they are specialized, particularly in hair, but, at the same time, the Grimaldi skeletons of Europe indicate that Negroes existed by the Upper Paleolithic. Their final outward spread, however, would have been recent, because the Negritoes would have needed true boats to arrive in the Andamans or the Philippines. The Negroes would have made their Asiatic exit still later, with a higher (Neolithic) culture, and probably also with boats. A relatively recent arrival of Negroes in Africa[8] should not shock anthropologists who until fifteen years ago believed that the Indians had reached America only in the last three thousand years or so. And there are no archaeological signs of pre-Neolithic people in the Congo at all, and it might have been empty when the Negritoes and Negroes came.

The great stumbling block is of course the lack of Negroes not only in Asia but also in the approaches to Africa or Melanesia, where we would certainly expect to find traces of them had they

[8]There is a little evidence of Negroids in Africa as early as the Mesolithic and perhaps earlier, but it is not weighty.

migrated out of Asia by land. Not much can be said in the face of this. Without the Negroes, however, the Negritoes and the Australians are left to account for all the dark skin in India by themselves. Furthermore, both the American Indians and the Polynesians also migrated from Asia in late times, and yet neither of these has left racial relics which will show exactly where they came from. Finally, a people with a higher culture may travel more rapidly, until they take root and expand, especially if boats are involved, which might have something to do with the relations of the places where Negroes and Negritoes now are found.

If I say that my guess is still, at the moment, that the Negroes evolved in Asia, it is not because I am trying to fatten up the argument that Asia is the home of races. That thesis is solid enough, and it would not upset it to imagine that the Negroes developed in Africa from an early Homo sapiens which wandered there (even though all the races are basically so much alike that I feel that their ancient roots draw together geographically as well as physically). I am only trying to fit the facts of Negro and Negrito distribution together, for I cannot explain them reasonably otherwise. It puts me in a state of some discomfort to discuss them at all.

I will end now with an outline of man's history, calling up what was said in Chapters VIII and XVII once more as well. The present chapter has been made up of inferences based on the facts. What follows will be speculation on the grand scale, with one deduction playing leapfrog over another. I shall make a series of periods, and give them dates which will be mainly for the purpose of showing their relative distance into the past.

I. Late Tertiary. 7,000,000 B.C. to 1,000,000 B.C.

The anthropoid apes were widespread, in Europe, Africa, and Asia, and some of them were rather man-like, at least in the characters of their teeth. One branch, probably in Asia, became fully differentiated into men, coming to the ground, walking erect, and developing a human form of skeleton, though as far as its head went it long remained an ape. Nevertheless, this creature had specialized to the extent of choosing for all future time to walk upon its legs alone, and Satan began stuffing mischief into its idle hands right away.

II. Lower Paleolithic. 1,000,000 B.C. to 50,000 B.C.

Man's head and brain were improving and developing gradually and in different ways. Several species were now present, some ad-

vanced and some backward. One of them was, or became, Homo sapiens, which was radically progressive in the reduction of the weight of its skull and jaws. This one probably inhabited southern Asia, though there is evidence of its members getting to Europe and to North and East Africa in the middle of the Pleistocene. There were other species besides Homo sapiens on the fringes of the Old World: in the Far East, in Africa (where there were even man-apes still surviving in the south), and in Europe, where the Neanderthals in particular came into flower in the third interglacial, extending into Asia and North Africa as well. (One major school of anthropologists thinks that Homo sapiens was late, and that these other species were stages still leading up to him; while I have been suggesting that they are to be looked on as no more than holdovers from the Tertiary or early Pleistocene, just as today in the corners of the globe there are still cultural holdovers from the vanished Paleolithic—some of the Indians in America, Bushmen in South Africa, Australians, or Negritoes.)

Homo sapiens was a product of the continuing differentiation which divided the apes and produced man, and then divided man and produced several species. Starting from something perhaps like the natives of Australia, this species itself began again to divide, possibly in the long, mild second interglacial in the middle of the Pleistocene. Some of these divisions advanced, or specialized, or both, and the major racial stocks of man appeared. The fact that this, a necessarily gradual process, had come about by the end of the Lower Paleolithic is a sounder argument than Galley Hill Man for the antiquity of Homo sapiens.[4]

III. Upper Paleolithic, Mesolithic. 50,000 B.C. to 8,000 B.C.

Apparently no other species survived into this period, whose duration was marked by the spread of Homo sapiens through most of the world, arriving sooner in some parts than in others.

Homo sapiens was doubtless becoming more numerous, and still developing. Certainly the main races were fairly well distinguished and were found, if not in their final homes, at least so to speak aimed at them. One character the several races of the time had in common: a certain ruggedness and large size of cranium compared to today, whether among the early Indians, the Whites, the Mongoloids, the Australians, or the Bushmen, something which is hard to explain.

[4]A. Keith, *New Discoveries Relating to the Antiquity of Man*, 1931, pp. 340, 712.

As the period took its course there was a continued expansion of races, probably without great mutual conflict or competition. The Europeans at the beginning established themselves continuously from the Near East through North Africa and western Europe. A related branch, the Mongoloids, may very well have been at home by then in the north of Asia whence, later in the period, the American Indians took their departure across Bering Strait. If this is so, the Whites would have been west and south of them, and some of these Whites might have passed below them north of Tibet into China and the Far East, to explain the Ainus and perhaps the Polynesians. It is probable that glaciers in the north and in the highlands did something to separate the Whites and the Mongoloids in the first part of the period and keep them from losing their separate identities.

The dark-skinned races were probably in India and southern Asia and were not disturbed in the beginning by the northerners. Toward the very end of the Old Stone Age, however, they migrated outward, into the Pacific and Africa, in successive movements, with the Negroes being the last. This is all extremely obscure. But something of the sort took place, and probably under external pressure, since migrations are not pleasure trips. This pressure may have come from the expansion of Mongoloid peoples southward in the Far East, and conceivably of Whites into India.

The wider distribution of races during the Upper Paleolithic would have allowed a renewed differentiation of types, leading to the formation of some of the sub-races of the major stocks, aided, possibly, by the unknown effects of the impact of new surroundings on evolutionary velocity. At any rate, by the end of this period, after the long era of racial development going back into the Lower Paleolithic, the races of man had probably reached the height of their distinctiveness, with the specialized Mongoloids and the blond Europeans appearing at the last.

IV. "NEOLITHIC." 8,000 B.C. TO A.D. 1492.

The Neolithic was marked, as we have seen, by a gradual spread of higher culture and a thickening of population which in many regions must have struck peoples in its path with the force of a lava flow from a volcano. This took, of course, many forms and many avenues. The period did not see as much in the way of new races as of conflicts between older ones. The Whites streamed once more into Europe, Africa, and Asia and into India. The Mongol-

oids expanded in the east and in Indonesia. The Negroes and Negroids flourished in Africa and Melanesia, whether or not they brought a Neolithic culture with them to these places. In America an entirely independent Neolithic, evolved by the Indians, produced much the same results, a little later in time. Yet all around the fringes of the land mass, oddments of peoples with mixed and varied cultures persisted for a long time, affected by Neolithic life or not, and giving rise racially to such as the Eskimo, the Ainu, the Japanese, the Polynesian, and others—all settlers of the last few thousand years. The total racial framework was considerably altered, with many older strains which were once equal with the rest now stamped out, absorbed or reduced to mere vestiges, like the Paleolithic Whites, the Australians, or the Bushmen.

CHAPTER XXV

1492 to 1,000,000 A.D.

WHEN it comes to crystal-gazing, an anthropologist has all the advantages over a follower of the turf or the ticker. He puts up no money, and he can be as irresponsible as he likes: he can unloose a a resounding prophecy about the future man, happy in the knowledge that when his prophecy comes due he will have been dead for untold thousands of years.

But that is also one of the drawbacks to the game, because anyone can play it. If you are going to prognosticate about the shape of men to come, you should by rights be an anthropologist with a Ph.D., but it actually happens that horoscopes for the Hominidae are principally purveyed by the funny papers. As far as I can make out, these conceptions of what we will someday look like follow one of two themes. According to the first school of thought the beast in us will continue to recede and the brain to advance, until we have huge bald heads together with spindly legs and wormy little bodies. We shall all wear glasses, talk algebra, and live on food pills. This, apparently, is to be the triumph of science, and a prospect at which we well may shudder. But there is another possibility, according to the pulp-paper seers. We might, instead, develop a physical perfection and turn out like Superman (the Man of Tomorrow), who has enormous strength, X-ray eyes, a bulletproof skin, and an obviously lowered mentality since, even when he is exploiting his marvelous powers, all he does for the betterment of society is to sleuth around after a variety of racketeers and other such wrongdoers, something at which he manages only slightly better than the Cop of Today. In this latter alternative we may look forward to a future in which we wear tight clothes and make conversation with people like Superman. It is not a cheery choice.

Luckily, however, we are not really faced with it. I think there is little chance of either trend of evolution coming to prevail. Knowing what we do about animal life and natural selection, we

need not fear that our legs and arms and chests are ever going to dwindle away into a really puny form. As I have said before, man is actually a giant animal, and if his large size has been important to him it is likely that he will keep it, and keep it in good functioning order. It is true that man seems slenderer and lighter of bone than the large apes, and flatter-chested, but this is almost certainly a matter of increased efficiency in design, and not degeneration: the same amount of support and strength is achieved with a lighter skeleton, which is certainly an advantage. Notice that there is nothing diminished about human legs, which have responded to function by becoming very large, relative to the anthropoids. Altogether, it is sure that whatever happens to him, man will continue to look, to an anatomist at least, like a normal kind of animal, rather than like a walking brain, with a physique good for nothing but pushing buttons.

On the other hand, we will certainly not turn into Superman. We might look like him, to the casual eye, even to all the muscles. But we will not, being unspecialized animals, suddenly develop such an extraordinary specialization as a bulletproof skin, even under the pressure of present events; not, at any rate, without some more definite signs of it, such as a layer of turtle shell several inches thick. For the same reason we will not have X-ray eyes, to make us all Peeping Toms, nor a muscular strength which would break every bone in our bodies if we should exert it.

But while I try to raise your spirits by rescuing your children from a dismal outlook, do not let me lead you to think that we shall not change. It is likely that, by working up through the Primates and the fossil men in a series of thoughtfully arranged chapters to the unveiling of the final product, I have created a false impression; that by setting man up at the apex of the animal kingdom I have made him look like the creature evolution had in mind all the time. Such an idea would make of man a finished animal, with little if anything remaining to be done.

Nothing could be a greater mistake. Look once again at his history. How long have the vertebrates been evolving? About five hundred million years. How long has man existed? Perhaps six million years, more or less. How long since Homo sapiens appeared? Possibly half a million years; and that estimate is the estimate of one school only, for others would say a mere fifty thousand. And he has eons ahead of him in which to proceed with

his evolution, which has so far been rapid. (You may not think it is a speedy change when a jaw shrinks an inch or so in a million years, but in evolution this is a pace which is sheer frenzy.) And man is still a highly generalized animal, so that his capacity for evolution, judging by other animals, has not been limited to any great extent; whether he develops queer specializations or whether he becomes a far more highly organized animal than he is now, he is going to be radically different someday. Nor does it carry weight to claim that man is now civilized, and therefore immune to the processes of nature: natural selection and the appearance of new mutations or features. That is nothing but an assumption. Man has continued to change even during the time he has had fire and weapons; and no matter what he tells himself, he is still just an animal in clothes.

In fact, civilization may turn out to be responsible for an actual increase in the speed of evolution in a very simple way. It has caused the enormous population of the world today, and great numbers of individuals mean more chances for new features to appear. In looking for sports or new varieties, someone who raises primroses in a window box stands no chance against someone who grows them by the acre. Perhaps the one unnatural effect of civilization will be that the old-fashioned tendency for a species to split up into independent new species (as man has started to do in his races) will be ended because, whether or not different segments of modern man interbreed thoroughly in the future, they will certainly not allow each other complete independence. There will be, on the contrary, as the world grows smaller, a tendency for the privileged varieties of man to submerge the rest.

There is, however, a qualification to be added to intemperate predictions of hurried evolution still to come. It may not be so hurried after all, for we should remember that evolution is apt to go by fits and starts, and asymmetrically as well. And the actual speed of human development may be shifting already. Man's great emergency was when he came down to the ground and looked his first bear in the eye. He survived it. That is, he developed a ground-going foot satisfactorily, and then refined his whole skeleton to conform more and more to this gait, thus achieving a major adjustment.[1] Having accomplished it, he will probably tinker with

[1] I am again using picturesque rather than scientific language: man, of course, had nothing to do with his evolution, nor can we assume that he followed an ordained

his frame in a more leisurely way, and indeed there seem to have been only fairly slight modifications and improvements from the skeleton of Pekin Man to our own (ignoring the hulking Neanderthals). The skull, of course, seems to have provided a general example of asymmetry by lagging behind the skeleton in its departure from the form of the apes, catching up only in more recent times; and it still does not seem to have given an impression of losing its evolutionary enthusiasm. But of course this is a guess. We actually cannot tell yet what evolution is doing with us at the present moment, let alone what it is providing for the future.

We cannot predict new features, that is, any more than a dinosaur could have predicted feathers for his descendants, the birds. We can only be sure of changes, and point out which would be the least surprising ones, in the light of the past. With what we know from apes and fossil men, forecasting about specific parts of the body can be done fairly readily, and if the reader has faithfully attended to the preceding chapters of this book he can indulge in it himself. Dr. Harry Shapiro wrote an enlightening article ten years ago[2] on the subject, and since none of his predictions have gone wrong as yet, I will borrow some of them and add others.

Dr. Shapiro suggested that men will be taller. This is because during the last century or longer men have unquestionably increased, considerably and steadily, in height, to a gain of several inches. Harvard freshmen of the years from 1906 to 1915 were over two inches taller on the average than those who entered from 1856 to 1865. But this is probably the effect not of evolution but of a sort of hothouse forcing, provided by better food and excellent medical care. Do not forget that the fossil men were all roughly of modern size and that Cro-Magnons were apparently taller than most Europeans of today, while one race of men, the Negritoes, has actually become exceptionally small. There seems, therefore, to be no strong evolutionary trend toward greater height, and the present-day increase is a recent, sudden fillip which will doubtless reach its limits before long. We shall probably retain these added inches, but we shall not become gigantic, since this would be a terrific strain on our skeletons, and especially on our feet.

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pattern. For reservations about evolution and natural selection, please turn back to Chapter I and the footnote on p. 15.

[2]H. L. Shapiro, "Man—500,000 Years from Now," *The Journal of the American Museum of Natural History*, vol. 33, 1933.

In fact, we should probably lose efficiency rapidly as we increased in height, simply by becoming unwieldy. The most remarkable thing about Primo Carnera (known also as Old Snaggle Tooth and Old Satchel Foot) was that he managed to be sufficiently active in the first place to contend with other leading heavyweights at all. We would become slower, and would have heavier bones and eat a lot more food, like elephants, all to no visible good purpose. An elephant's size gives him protection, but we have no enemies against whom this would help us. However, what I am saying does not mean that we might be still better off if we were smaller yet, for small animals simply do not have large enough brains and sense organs to attain a high development like man. The conclusion appears to be that we are just about the right size for people, and if natural selection has its way we shall probably stay much as we are.

It seems to me that arguments of the same kind would apply to the size of our brain. It is true that it has been getting larger in evolution, particularly during the Pleistocene, and there is no doubt that to man this is the most important of all changes. But perhaps we might use what brains we have before we beg for more. To take it for granted that brain and stature will continue to grow may seem like supposing that the rain will stop because it always has, but it is not the same. The mammal-like reptiles, had they been given to speculation, might have been justified in thinking that their internal temperature, which was rising, would continue to go up until their blood literally boiled. But it rose only to some 98 degrees and never wavered again. We really have no assurance, then, of a larger brain at all, and our present one has already made the process of childbearing extremely difficult by its size. Finally, let it be remembered once more that brains of today are actually slightly smaller, if anything, than they were in the Upper Paleolithic among the first unmistakable group of Homo sapiens, though this alarming fact is probably partly because the Cro-Magnons were also somewhat larger in body size.

On the other hand, it is incredible that we should remain as imperfect mentally as we are, considering all the premiums in natural selection which intellectual power would bestow. We have only begun to explore the larger possibilities of brains since we left the caves, and the persuasion toward better ones has, therefore, certainly increased. Improvement might come about through refine-

ment of the existing article, but larger size is still the ultimate answer. I am afraid that my prediction as to whether our brains will increase is a flat yes and no.

Aside from body size and bulk of brain, two obvious concerns, the other possibilities of change lie in lesser matters of detail and contour. And in many of these, as I suggested before, man gives an impression of being, while not perfect, at least adapted to his upright position. His whole skeleton has been straightened up and nicely balanced over the arches of his foot, in a way which even the Neanderthals had not achieved. His neck curves back to hold his head upright, his chest is flattened, so as not to cause him to teeter forward and back, his pelvis is large and solid, to serve as the sole support for his torso, and his heavy legs are straightened out at the knees. His feet, the most specialized thing about him, have become firm but resilient platforms, while his hands, simple and unspecialized as they are, have given him such great satisfaction that they will doubtless keep their present shape for a very long time.

All is not beer and skittles, however, for there is plainly some unfinished business here and there; some weaknesses where the frame has not yet become fully adjusted to uprightness. Although the legs are so much larger than an ape's, it may be that they are still somewhat weak for a lifetime of walking, for they begin to falter and tire late in middle age. Possibly they will get stronger, though there has been no sign of increase in them between Sinanthropus and ourselves. But there are worse flaws at either end of the legs. Marvelously contrived as our arches are, they are still all too prone to lose their firmness and collapse, leaving us with flat feet, which are an evolutionary step back as well as a misery; so there is room for improvement and solidification here. Our worst features, however, are to be found in the lumbar region, where standing upright has forced some drastic compromises with efficiency. The region was, of course, evolved for the use of a four-footed animal. In man, however, the lumbar vertebrae not only must bear the weight of the whole upper part of the body, unaided by front legs, but they also must enable this upper part to be erect by bending themselves into the lumbar curve—a semicircle which is a poor design for weight-supporting. No wonder that the spine here sometimes complains of its burdens, or that the sacrum undergoes such strain that the sacro-iliac joint may become slightly but pain-

fully dislocated. The lumbar part of the spine might, therefore, be expected to continue its process of becoming still shorter and thicker. Worst of all, straightening up left the unfortunate abdomen exposed in a wider gap between the ribs and the pelvis, and pushed forward from behind by the lumbar curve. If it chooses to get fat it receives little helpful support from the skeleton, and is left to its own devices. In a quadruped mammal, of course, the attachments are better and the exposure is not so great. In our becoming erect no provision was made for this dilemma, and it is still a fundamental defect in our posture.

What will become of our heads and faces is certainly hard to say. The head in general will follow the lead of the brain, whatever that does, but it is pretty certain that it will become round in shape all over the world. Not only has this trend been manifest already in several races, but a round head is also more economical of bone than a long one, and long heads are probably, therefore, simply relics of the day when the face and the neck muscles had more to say about head shape than did the brain. As to the face, this has tended always to become smaller and more pulled in, and we might look for ever-higher noses and more pointed chins protruding from ever-more-sunken faces. But here again it seems as though a face which receded further than that of the Whites would cease to be efficient for breathing and chewing, and already the facial skeleton is extraordinarily delicate for a creature so large as a man. We certainly are not going to do without faces altogether.

Dr. Shapiro made some prophecies on which your money would be perfectly safe. The secret of them is that they concern strongly variable features, which are very apt to be a sign of evolution in the process. Without a shadow of doubt we are going to lose our wisdom teeth, which are in the act of disappearing now. They exhibit great variety, and few people today have them full size and in the proper place: the others have small ones, or impacted or non-erupted ones, or, most fortunate of all, no trace of them whatever. They are a source of discomfort and danger, our mouths can no longer contain them properly, and they will go. This will be a relief to the rest of our teeth, which will probably get smaller themselves and be less crowded and maladjusted.

Dr. Shapiro also suggests that we may lose our little toes, because they obviously have been getting steadily littler and more decrepit, with no strength or use in them. They have degenerate

toenails and sometimes none at all. I do not think this implies that our feet might be narrower, for the broad ball of the foot is essential to our balance. Essential would hardly be the word for the fifth toe, however, and it will, as Dr. Shapiro believes, probably follow the third molar into oblivion.

When these things have taken place, the four-toed zoologist of the future will at last be able to make simple distinctions, such as a different tooth formula, between men and apes; whereas even now we have to rely on things like the non-opposable big toe and the chin. When that day comes we ourselves will be looked on simply as an extinct transitional form.

According to Dr. Shapiro something else is also vanishing, and that is hair. This can be looked on in two ways. We, the Whites, have vestigial traces of the suit of hair which invested our ape ancestors, and these traces will gradually vanish, as they have in the Negroes and the Mongoloids. So far so good. But we, the Whites, also have an alarming tendency to overdo it and to lose all the hair on the top of our heads as well. It is difficult to imagine how this will proceed. Baldness is apparently a special feature, a sport or mutation, which has somehow become common in the White race, and it is largely inherited in family lines. It is rare, however, in other races. Being hereditary, it can hardly spread from the Whites to the others, and whether it is likely to become universal in the Whites is anybody's guess. I doubt whether science will be able to do the slightest thing about it.

What I have been saying is all in the nature of short-term prophecy, and good only for a million or so years. I have explained why it is impossible to look far into the future, or do more than extend current trends. It is true that all sorts of dire fates have been predicted for man, but they are mainly out of the province of an anthropologist. An astronomer will tell you how the whole world is likely to end, and a soil chemist will say that some of the chemicals necessary to life are steadily being changed into forms which cannot be used as food. Closer to zoology, however, it is sometimes suggested that some other form of animal life will rise up and replace humanity. This obviously could not come from any of man's near relatives, the mammals. Even if man were not here, no group of animals other than the apes seems unspecialized and progressive enough to give rise to something like a man, with a great brain, peerless eyes, and nimble hands—"lion-men" and such are an im-

possibility. But, in any case, man is here already, and he would easily destroy any aspirants to his throne among the vertebrates, and I have no doubt that he will similarly control insect rivals and even bacilli.

Others claim man will destroy himself, which is of course a political prediction. This seems to me a fate as unlikely as committing suicide by holding your breath. Man, for all his frailties, is now one of the toughest, most tenacious, most adaptable animals in the kingdom, and still unspecialized withal; and I am sure that he is here to stay. Other types, particularly the specialized ones, automatically become extinct if conditions change or even if their numbers are reduced below a certain point, but I cannot imagine a man-made catastrophe or any cataclysm, short of the destruction of all land life, so great that man would not survive it.

No, we shall have an infinity of descendants. In this final chapter, as all through the book, I have been dealing with Man, as a kind of animal, not with men in the multitude. The actions of men may have control over what sort of man—what race, for example—will come to dominate. But man the animal, the biological quantity, will go on into a distant future, changing gradually as he goes, without diverging to achieve either a machine-like perfection or an evolutionary degeneration. That is what his past history seems to show, and the history of all his previous forebears back into the Paleozoic seas. Let us not, therefore, imagine that man may look forward only to some kind of a day of judgment. In the march of the earth's animal development, we are perhaps too much awed by the transitory presence of one species, Homo sapiens.

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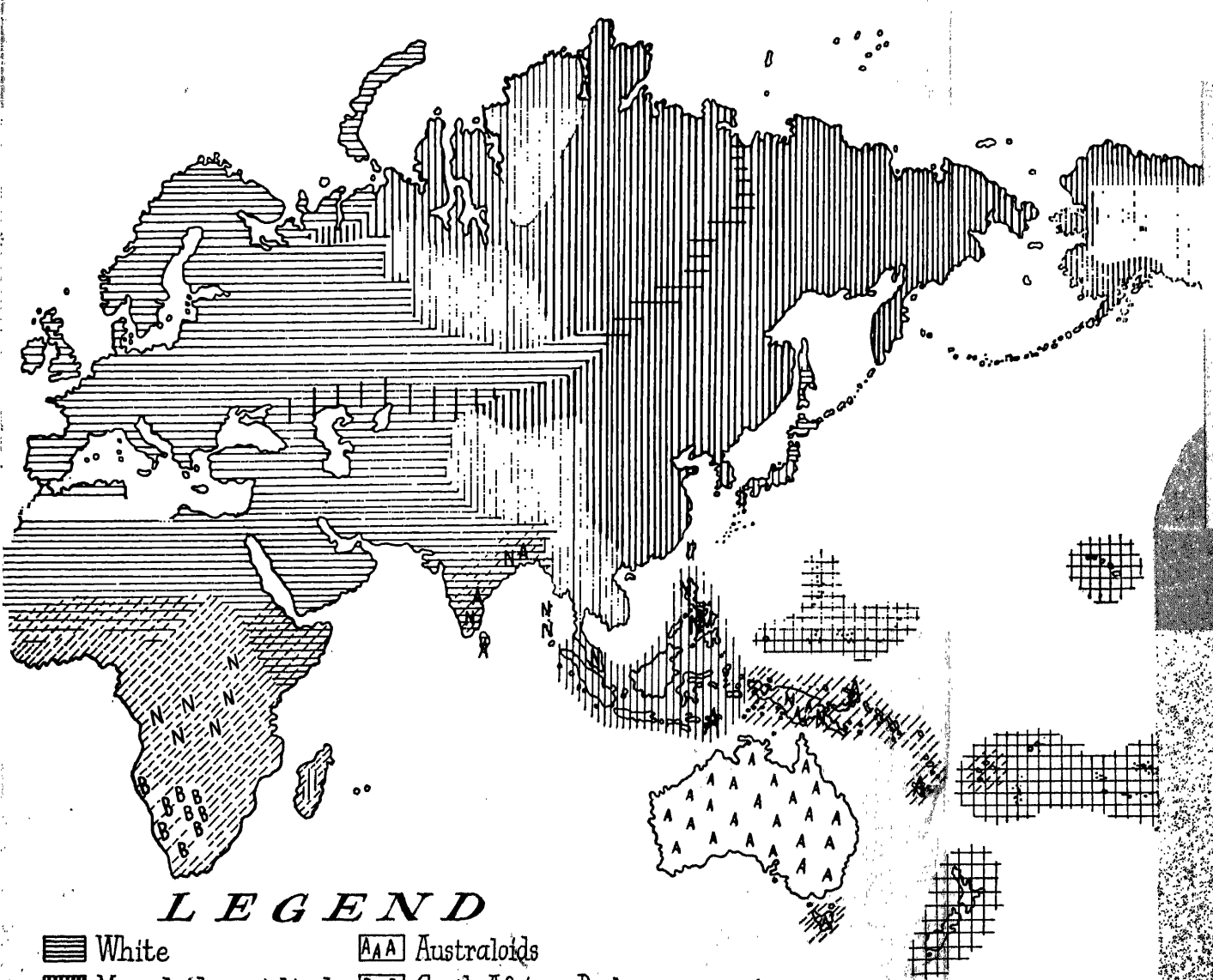

LEGEND

- White
- Mongoloid, specialized
- Mongoloid, unspecialized
- Negro
- AAA Australoids
- BBB South African Bushmen
- NNN Negritoes