Fossil Man

Modern man has taken from the earth the remains of many creatures that dimly outline his evolution. Their bones offer no clue, however, to the forces which caused the rapid development of his unique brain

by Loren C. Eiseley

A student of man's evolution on the earth is confronted today with an odd paradox. From a wealth of skulls and bones unearthed in the last few decades we can now piece together a reasonably convincing account of how and from what forebears man first came into existence more than a million years ago. But there the story trails into mystery. How the primeval human creature evolved into *Homo sapiens*, what forces precipitated the enormous expansion of the human brain—these problems ironically still baffle the creature who has learned to weigh stars and to tamper with the very fabric of his universe.

To gain some perspective on the problem and on how much man has learned in the 20th century about his prehistory, let us go back to 1895. In that year scientists were celebrating "with a fearful joy" the news that Eugène Dubois had discovered, in a deposit near the village of Trinil on Java, the remains of a very primitive man, or a very manlike ape. Dubois regarded his discovery, which he named *Pithecanthropus erectus* (the erect ape-man), as a link about midway between the anthropoid apes and man. Putting together Pithecanthropus, some fragmentary fossil remains of earlier anthropoid apes that had been found in the Siwalik Hills of India, and the Neanderthal skull, which had been discovered in a cave in Germany nearly 40 years before, evolutionists of that day composed a simple story of human evolution. The Java man was dated at about the beginning of the Pleistocene epoch, approximately a million years ago. Neanderthal man, possessing a much larger brain, was reckoned to be about half as old. Many evolutionists agreed with W. J. Sollas in concluding that the evolution of the human race had "proceeded at a very uniform rate throughout the whole of Pleistocene time," and that man had originated from "the stem of the gorilla or chimpanzee, before these species had acquired their existing specialized characters."

There was a strong tendency then to overlook the "specialized characters" and to equate the ancestor of man with a creature not very different from a modern chimpanzee or gorilla. Few appreciated the fact that man and the living apes represented quite opposite adaptations: man having developed an erect posture for walking, and the apes long arms for swinging through the trees. Man was supposed to have come down from the trees in this stage and acquired an upright posture in some mysterious manner about which there were ingenious but unconvincing theories.

This, then, was the general conception that reigned at the close of the 19th century. How far have modern discoveries substantiated or disproved it?

The Influence of Grass

If there is one thing that can be stated with absolute certainty today, it is that man arose and went through the main stages of his evolution upon the Old World land mass—Africa, southern Asia and Europe. There is no paleontological evidence whatever that early man ever penetrated the New World or Australia, and his inability to navigate the oceans kept him out of the world's oceanic islands. Man's swarming numbers and ubiquitous distribution over the earth are late manifestations in his history. He arose in a limited area, probably as a quite isolated and rare experiment of nature. But from the beginning he was the most restless of all earth's creatures, and across two million years of time we can dimly make him out venturing on his first experiment: trying to walk and live on the grass.

Now grass, we are accustomed to believe, is even more ubiquitous than man; it seems as fixed as the stars. Nevertheless grass, like man, has had a history, and perhaps even more than man has changed the face of the earth and the course of life. In the closing period of the Age of Reptiles some 100 million years ago, a new form of plant life, the Angiosperms or true seed plants, began to spread over the world with almost explosive rapidity, supplanting the jungles and fern forests. By the Middle Tertiary the grasses, an Angiosperm adaptation, were widely distributed over the uplands and savannahs of the continents. We can trace the emergence of this new world through the transformations of the animals that got into it. In many areas the old-fashioned shrubbery-eating animals began to disappear. Their teeth were not adapted to the abrasive silica content of grasses. New forms of grazing animals, such as horses, began to evolve in the grass corridors. Then came carnivores adapted to preying upon the grass eaters. Into this new and sunny world, rather late in its history, there ventured a queer, somewhat old-fashioned mammal which had evolved, for reasons still not clearly understood, a fantastically awkward mode of progression. It walked on its hind feet, like something out of the vanished Age of Reptiles. The mark of the trees was in its body and hands. It was venturing late into a world dominated by fleet runners and swift killers. By all the biological laws this gangling, ill-armed beast should have perished, but you who read these lines are its descendant.

It has often been assumed that the first men must have been massive ani-

mals of gorilla strength, armed with formidable teeth. Strangely enough, we are beginning to find the story quite otherwise. Let us look at these primitive "men." We can call them men only by courtesy: though they walked upright and bear an undoubted family relationship to ourselves, they were on an evolutionary level below Java man—semihuman creatures oddly advanced in some respects and backward in others.

Charles Darwin's great contemporary Alfred Russel Wallace seems to have glimpsed very early this intermediate, ground-ape stage. In 1898 he said: "When [man] had reached the erect form, and possessed all the external appearance of man, his brain still remained undeveloped, and the time occupied by this development was not improbably equal to that required for the specific modification of the lower mammalia."

The Man-Apes

The finds that disclosed this early phase of human evolution began inconspicuously in 1925, when the fossil of the Taungs child was discovered in the Harts Valley of South Africa. Raymond Dart, Robert Broom and J. T. Robinson later dug up large numbers of bones of the famous Australopithecines, which have been called by various interpreters our true ancestors, late survivors of our "structural ancestors" and divergent ground apes. We can describe only a few of their more salient characters and then attempt to indicate what general conclusions can be safely drawn from the evidence as it stands. The reader must bear in mind that adequate reports on much of this material are still not available. Discoveries have been coming in so rapidly that many bones still lie imprisoned in their stony matrices in the laboratories.

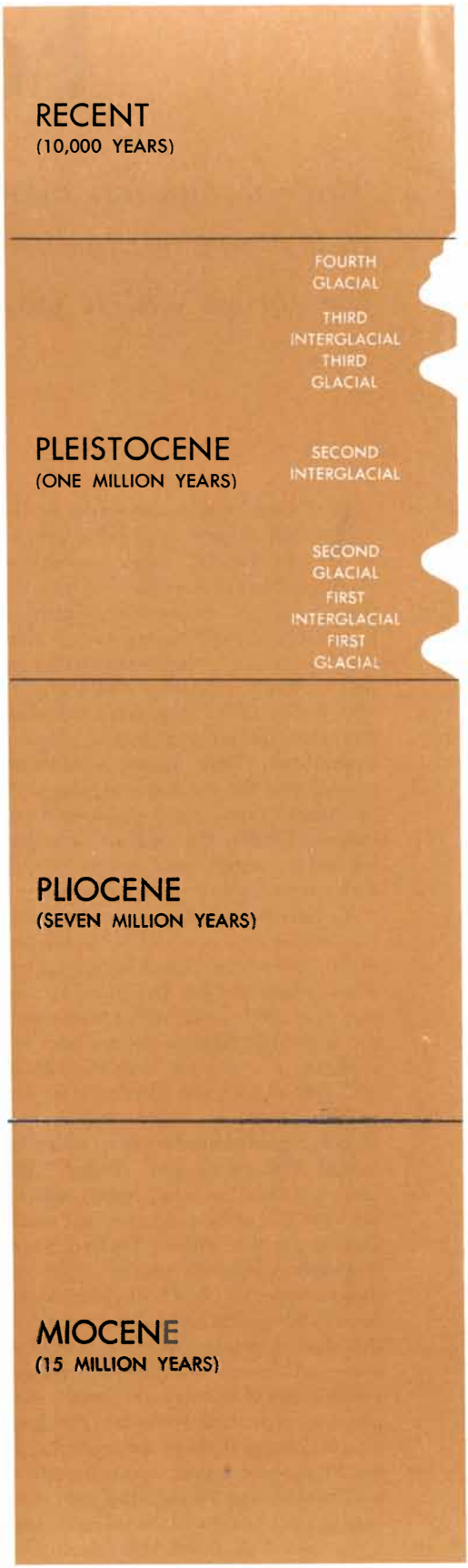
The teeth of these creatures were remarkably human: they had small incisor teeth, broad molars with complicated crowns and no pronounced canine teeth (such as apes have). They seem to have walked erect. Their cranial capacity was no larger than that of a modern anthropoid ape, but it is possible that their brains may have been more complex than an ape's. There has been much debate as to whether the Australopithecines were intellectually capable of using simple tools or of speaking.

Remember that we are dealing not with a single skull but with a whole group of forms of varying geological age and somewhat differing features. Unfortunately the age of the fossils has not been established: estimates range from the Middle Pleistocene to the Pliocene, the period before the Pleistocene. There is controversy over which of the species are the oldest and which the most recent. Many are inclined to believe that the Swartkrans man-ape (*Paranthropus crassidens*)—a big-faced, huge-jawed creature—may represent an extinct animal line which diverged from the group that later evolved into man by expansion of the brain. Paranthropus, incidentally, has taught anthropologists to be warier when estimating the size of fossil men from their teeth. Its teeth are almost as large as those discovered in Java during World War II by G. H. R. von Koenigswald—a find which led to talk of the "Java giant" and caused a sensation in the press and even in scientific journals. The only thing extraordinary about the size of Paranthropus is the massiveness of its jaw and teeth, and as a consequence the notion of supposedly giant forms of man deduced from other large teeth, such as the "Java giant" and Gigantopithecus of China, has been considerably deflated.

Of the place of the Australopithecines in the scheme of things it must be said that anthropologists at present are torn between whether to regard them as direct ancestors of man or as a specialized sideline. For all we know the Pliocene may eventually yield such a variety of ground apes as to make the selection of our true ancestor a quite embarrassing task.

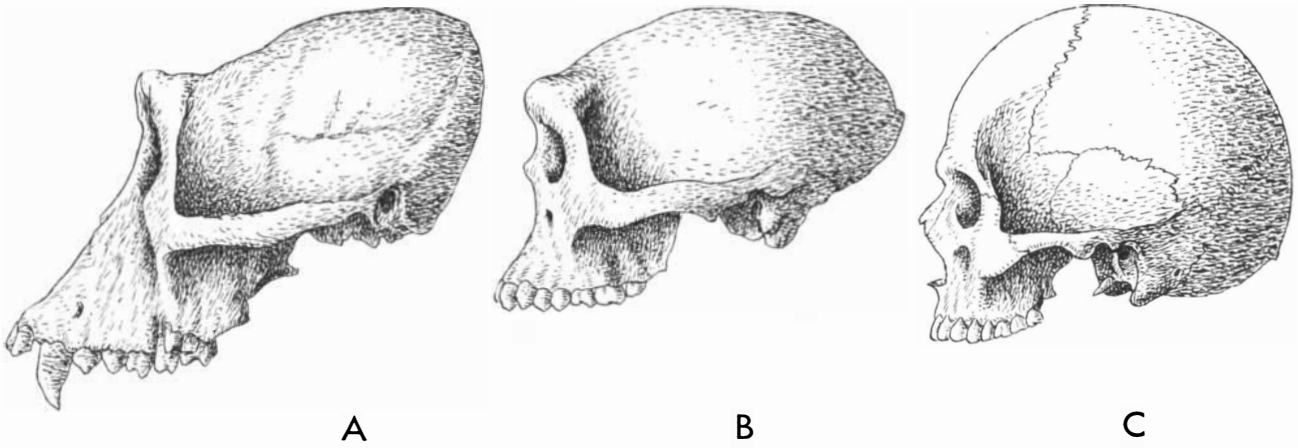
An important point under debate is: did man achieve his upright posture by preliminary training as an ape swinging hand over hand, or did he somehow manage to straighten up from the position of a monkey-like ape who jumped and ran on all fours among the branches? The latter interpretation would cause us to search further back in time for the point where man diverged from the trunk of the primate family tree. William Straus of The Johns Hopkins University believes that the "line leading to man became independent at a relatively early date, probably no later than the end of the Oligocene, and that the stock from which it arose was far more monkey-like than anthropoid-like."

Keeping this point in view, let us descend into the Lower Miocene of East Africa. Here we encounter a curious monkey-like ape known as *Proconsul africanus*. Although its teeth seem to ally it to the anthropoid line, its skull lacks brow ridges and its body is quite monkey-like. It was apparently a light, gracile creature, and the length of its limbs sug-

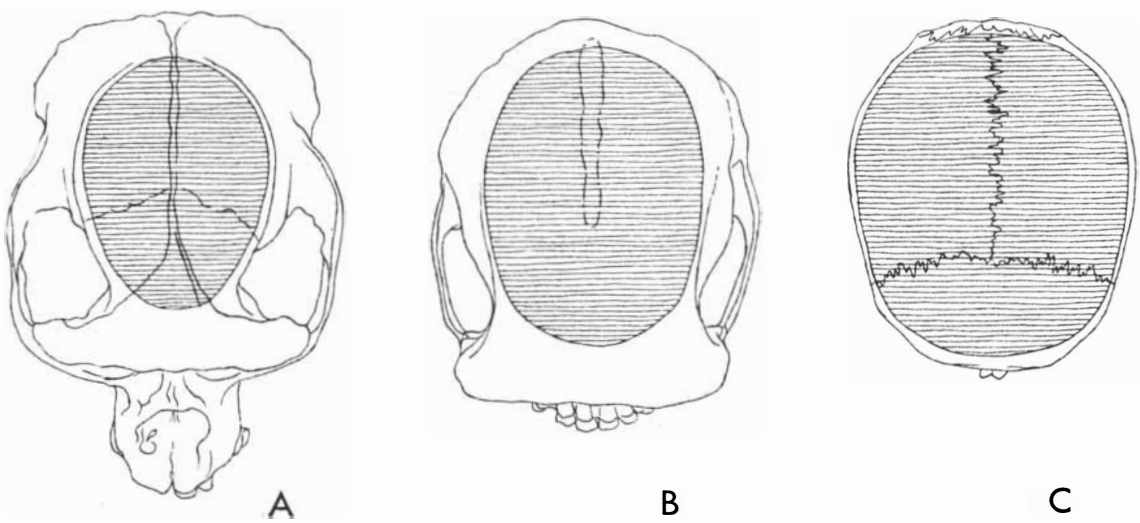


PRINCIPAL FOSSILS of man and his close relatives are arranged in time by this chart.

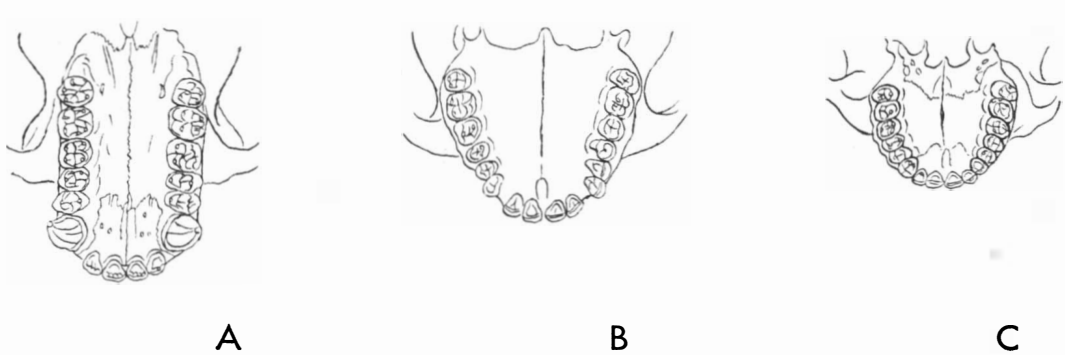
The time scale is at the left. The depth of each epoch does not represent its length but only its place in the sequence of time. The white strip running from top to bottom of the time scale represents the advance and retreat of the ice sheets during the Pleistocene.



Skulls of a male gorilla (A), *reconstructed male Pithecanthropus* (B) *and modern man* (C).



The same three skulls are shown from the top. The space occupied by the brain is shaded.



The palates and dental arches of the same three skulls are shown from the bottom.

gests that it probably ran and climbed on all fours and was not a highly specialized arm-user like the present-day apes. "Indeed," remarks the English paleontologist D. M. S. Watson, "Proconsul is perhaps at least as good an ancestor of the Australopithecines as it is of the modern 'manlike' apes."

If we assume that Proconsul or a similar form lies at the parting of the ways between man and the great apes, a considerable revolution in our thinking is in order. For many years man's bodily similarity to the existing apes has been taken as a sign of his descent from a tree-swinging anthropoid. Now there is at least a growing suspicion that some of the resemblances are the result of parallelism —that the broad chest and shortened trunk would have had equal survival value for hanging in trees and for bipedal locomotion on the ground. Only more fossils will satisfy our curiosity. If it be true that the Miocene anthropoids traveled largely on all fours, then arm-locomotion, at least in its full, elaborated phase, may be no older than bipedal walking. In that case, instead of one giving rise to the other, we may be forced to envision both as end specializations of the quadrupedal Proconsul line.

The Emergence of Modern Man

At about this point the reader is apt to inquire wistfully as to the present health and circumstances of Dubois' "missing link" of 1892. Is *Pithecanthropus erectus* safe from the heretical hands of the modern generation of anthropologists? The answer requires a little further review.

In the 1890s all that was needed to tell the story of human evolution was to arrange on a classroom desk the skull of a chimpanzee (with certain generally unheeded cautions), the skull cap of Pithecanthropus and the skull of Neanderthal. If the instructor placed his own head at the end of the line, a student could comprehend in a glance the full course of human evolution. There were then no obscurities, no anomalous apes, no poor relations whose genealogy was obscure, no little men with enormous teeth, no structural ancestors who persisted in fooling everyone by living deyond their time. The scheme was simple mainly because anthropology had scarcely any fossils.

Today this state of affairs is vastly changed. We have a series of low-vaulted massive skulls with jutting brow ridges whose faces bear hints of the primordial past—a fairly comprehensive gallery of "cave men." Pithecanthropus belongs in this gallery. Though at various levels of development in brain size, we can say with assurance that they are all men. They represent the true human plateau. We know that some used fire and had traditional flint-working techniques, though one group had a cranial capacity almost 500 cubic centimeters less than our own. They ranged from Java and China to the Middle East, Africa and Europe. Man was still Old World in distribution.

Pithecanthropus no longer can be considered as old as he was once thought to be; indeed, except for a human jawbone found near Heidelberg, Germany, it is difficult to pursue a single man with jutting brow ridges further back than the early Middle Pleistocene. This brings us down to the last 400,000 or 500,000 years. We have supposed we know that end of man's genealogical tree pretty well. But do we? Here is the point where tempers rise and staid investigators jab excited fingers at one another. In our gallery of beetle-browed ancestors there are three or four specimens that throw the whole sequence out of order. They are the well-known Piltdown skull, the Swanscombe skull and the Fontèchevade cranium. These three well-documented finds suggest not beetle-browed cave men but true *Homo sapiens* or something approaching him. They have been dated by the reliable method based on the accumulation of fluorine (the radiocarbon method does not work for so vast a time scale). And it turns out that one goes back to the second, the others to the third interglacial period—a time long before *Homo sapiens* used to be thought to exist. The Swanscombe skull is well nigh as ancient as Peking man, and the English anatomist W. E. Le Gros Clark has interpreted it as evidence that the brain typical of *Homo sapiens* had already developed by "early Paleolithic times." To be sure, we have only the back and one side of the Swanscombe skull, but the anatomical evidence compels us to recognize the possibility that Swanscombe was only a slightly more primitive version of ourselves.

Piltdown man has always been something of a riddle. As his name *Eoanthropus* ("dawn man") indicates, he used to be regarded as very old, and though he did not fit into the sequence of heavy-browed men, his peculiarities made it safe to regard him as a kind of specialized sideline. He had a thick-walled brain box, but a forehead as smooth as our own. His lower jaw—at least the one-sided fragment of it that has come down to us—cannot be distinguished from that of an existing great ape. If this is not an accidental combination of fragments from two different individuals (still a possibility in this case), we are forced to recognize a being quite distinct from our array of heavy-browed fossils, but one whose lower face was remarkably primitive. Unfortunately all the parts where the jaw fits the skull, and the palatal area as well, are missing from the specimen. It is this that arouses faint doubts as to the genuineness of the association. No other fossil like it has ever been found. The puzzle is further enhanced by the fluorine dating, which puts it into Upper instead of Lower Pleistocene time.

The skull known as Fontèchevade II was found in 1947 in the province of Charente, France. Its age is established as Third Interglacial, and thus older than many of the Neanderthals. Yet, in the words of the French prehistorian Henri Vallois, "he had a forehead constructed on the same type as our own and totally devoid of the torus so characteristic of the Neanderthals." The cranial capacity is fully up to the modern European average. Only the absence of the lower jaw and lower facial skeleton prevents us from labeling it positively as an early *Homo sapiens*.

Where does this leave the men with big brow ridges? Did they mingle here and there with *Homo sapiens* or the earlier form of him, but pass away leaving little of their blood behind? This is a subject we cannot explore at length, but one curious fact can be noted. In the caves along the slopes of Mount Carmel in Palestine has been found a strange assortment of skeletons showing numerous characters of modern man. These remains suggest either Neanderthals in the course of evolutionary transition to *Homo sapiens*, or, as is more likely, a hybrid mixture between true *sapiens* and some Near Eastern type of Neanderthal. The discoveries are generally dated as Third Interglacial, though they may be slightly later than the Charente deposits in France and there has been one suggestion that they may fall within a fluctuation of the fourth ice advance. Among the recovered remains, however, are lower jaws. The mandible of one in particular shows a prominent chin like that of modern man.

Posture and Brain

Now let me make plain why I chose to remark at the start of this article that man's origin has been greatly clarified but not, paradoxically, the mystery of

man. Two facets of that mystery deserve our particular attention: (1) How did man achieve his upright posture, and (2) how did the human brain arise, and what has carried it to its present peak of achievement? Neither of these questions has, in my opinion, been satisfactorily answered.

The reason why a given form of life chooses to launch upon a new adventure is always apt to remain mysterious. One thing, however, seems rather plain: Animals do not evolve new organs for the specific purpose of intruding into new environments. Instead they start with what the biologist calls a "pre-adaptation"—an existing organ, habit or other character which offers the possibility of being used successfully under new environmental circumstances. The first vertebrates to leave the water successfully, for example, had already acquired a primitive lung, utilized for survival in swamp waters of low oxygen content. Other pre-adaptations, such as a muscular fin capable of being transformed into a primitive foot, contributed to the success of the venture. What we cannot so readily clarify in certain of these instances is whether events *forced* the movement across into the new corridor, or whether the restless impetus, the exploring curiosity, the vital drive of the animal promoted the crossing.

In the case of man it is easy to see what pre-adaptations promoted the dramatic emergence from the forest world into the world of grass. The hand of the Old World monkeys is one of them. The fingers are free and flexible; they can be put to uses other than climbing. Straus says of the rhesus monkey: "I am convinced that there is not a single primary movement that can be made by the hand of man that cannot be made by the hand of this monkey." Man's developing brain would have been of small use to him, if his forelimbs, say, had been those of a hoofed runner on the open grass. Only an apprenticeship in the trees, only limbs adapted for climbing, made possible man's curious achievement of an upright posture. This trend toward an occasional assumption of the vertical position is documented even among some of the oldest and most primitive of today's primates—the lemurs. A missionary visiting Madagascar in the 1850s recorded with amusement how the pet lemurs kept by some of the villagers would stand on their hind legs, leaning like little men against a wall in the sun with their forelegs spread out like arms, in order to dry themselves after a heavy rain.

It is difficult to see precisely why only one group took to bipedal habits. Other primates, notably the baboons, have taken to a ground existence, but in spite of a considerable manual dexterity, they have retained a four-footed posture. Some factor coming at just the right time in man's anatomical evolution must have provided the impetus for a new adjustment. That factor, it has sometimes been contended, was the great period of mountain building which occurred during the Middle Tertiary.

The primates are an old order of mammalian life. Their roots reach into the Paleocene and perhaps beyond. They have known the damp rain forest which prevailed over vast areas before the Asian world was swung skyward by the Himalayan upthrust. That upthrust of the high Asian plateau, with its enormous destruction of the ancient forests, its desiccation of vast areas, its promotion of steppe and grassland, forced some group of early prehominids out upon the ground, according to the hypothesis. The great geological movement progressed slowly enough so that the human ancestor had time to readjust his body over many thousands of years. Finally he teetered off upon his new adventure, leaving behind him in more favored areas of the earth his old tree-dwelling relatives, who intensified, as the living orang has done, their arm-lengthening adjustment to progression across the forest ceiling.

There is just one troubling thing about this picture: We are no longer sure that the human precursor first arose in Asia. The great tablelands of Tibet and the neighboring regions have yielded no traces of this early stage. One of our greatest authorities upon fossil man in Asia, Pierre Teilhard de Chardin, has become so impressed with the new finds in Africa that he is now convinced that Africa is the original homeland of the human race.

The Rise of Man

Let me briefly re-examine the evidence. In South Africa we have a variable assemblage of walking apes with many human anatomical characters. They are the most primitive bipeds of whom we have any knowledge. Below that point, so far as Africa is concerned, we have to drop 20 million years into lower Miocene times in Kenya. Here we are back among four-footed, agile apes of the Proconsul variety. They possess certain generalized characters, a fact which has promoted the notion that they may represent our four-footed prototype before he had achieved an upright posture. Nevertheless little is known in detail of the Miocene anthropoids. It may be that the dearth of material has caused us to overemphasize characters which may have been widely distributed among numerous genera of Miocene apes or sub-apes. There is no real unanimity of opinion as to whether Proconsul should be placed on the human line.

Do we have anything from the long gap between Proconsul and the upright Australopithecines? Two teeth and a palatal fragment from the Nagri beds of the Pliocene in India are regarded by some as representing ancestral Australopithecines. Perhaps the ancestral ape first rose to the precarious upright posture somewhere in the great green belt that once stretched from Africa to southwestern Asia. Once the venture was made, a rapid spread along the grasslands was possible. The presence of Meganthropus in Java during the early to middle Pleistocene suggests wide diffusion at that time.

The new grass world was sunny and attractive, perhaps particularly so to creatures who relied as greatly upon their visual powers as do the primates. Insects, small mammals, seeds and roots in season—all must have been sought by those eager and nimble fingers. The animals may still have had recourse to trees in times of fright. Century by century the proto-men must have wandered farther and farther afield as the foot and pelvis, under the intense selective forces of the new environment, began to be reworked and modified. By his peculiar structure man escaped the environmental trap of the cursorial grass eaters. He remained unspecialized in everything except his brain and his ground-adapted foot.

His diet was omnivorous but probably more concentrated than that of the tree world behind him. He seems to have increased in size beyond his four-footed predecessors. Probably his habits were not at all nice. It is very likely that he was not above indulging in the carrion left by carnivores of more ferocious propensities than himself. In tooth and claw he was one of the weaker mammals. "It is with powerlessness," says one investigator, "that thought comes." This beast was on the verge of something; he had hands completely divorced from locomotion. They could explore things in the surrounding environment; they could close around sticks and stones, move things from place to place. They could be manipulated in a hundred ways by

the brain. The creature had set out on the loneliest road in the universe, though he was not yet aware of it. He was destined to grow aware of the past and the future; he was about to go behind the hitherto accepted face of nature, and to people the dark with gods.

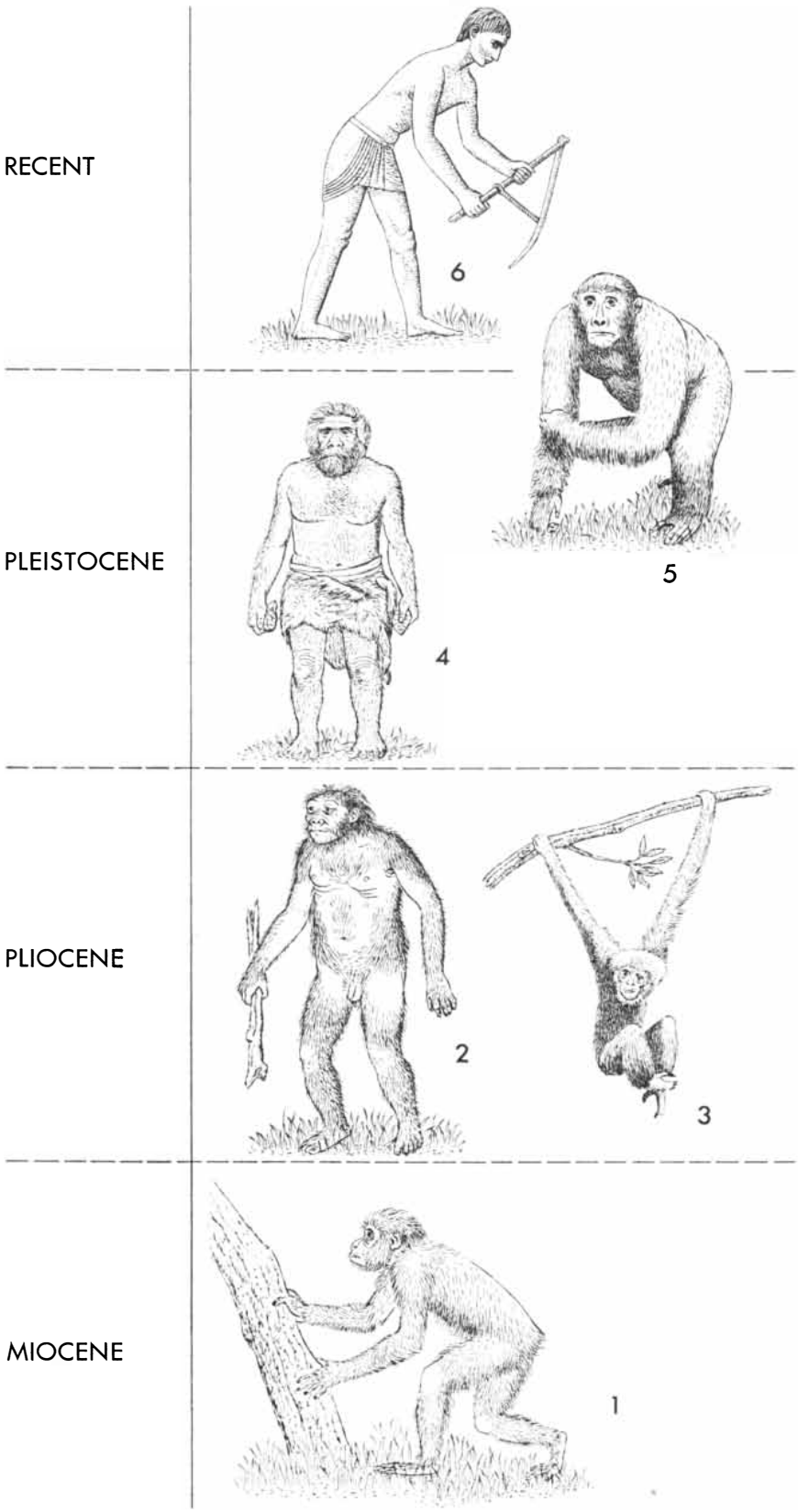
The Explosion of the Brain

"Nature," the philosopher George Santayana remarked with deep insight, "is full of coiled springs." And never did a spring release with more devastating violence than that which projected the human brain upon the helpless living world about it. The event, measured in geological terms, appears to have been surprisingly sudden. If the man-apes of South Africa were in truth our direct ancestors, and not holdovers from an earlier level of evolution, then man has multiplied his gray matter at a prodigious pace. Within something like 500,000 years or less that brain doubled itself. By the time of Swanscombe man in the Second Interglacial it had reached its present size. The brain with which man is plumbing the deeps of space and tampering with the atom is the same as the one that shaped the Acheulean hand ax.

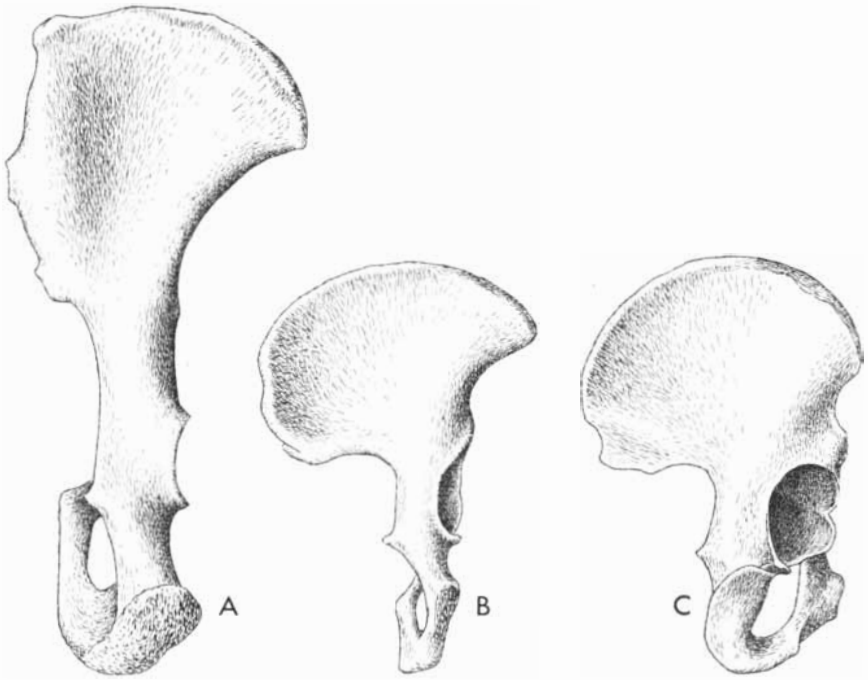
One theory has it that the brain tends to lag after changes in bodily structure, that it catches up, as it were, with the new functions it must carry out. Man, with an anthropoid brain, achieved vertical posture; he entered a new environment where, for a considerable period, he doubtless underwent genetic selection for longer limbs, better-adjusted feet and more complex upright neurological adjustments. Then something happened: tools were invented, and, so it has been argued, under the stimulus of competitive struggle the brain "exploded" into its present position of great size and enormous effectiveness.

That the use of tools, particularly the transmission of toolmaking techniques, has been of inestimable importance in the history of man is undeniable. That it can be regarded as the sole stimulus which precipitated the remarkable explosion referred to above is less clear. The argument threatens to run in a circle. We have to have the tools to get the brain, and the brain to get the tools. Moreover, pursuing the tool argument to its conclusion, we are faced with the problem of explaining why the Stone Age savages of today are capable of learning to fly airplanes, play chess and in general take on readily the virtues and vices of the advanced societies.

This problem so puzzled Wallace that



EVOLUTION OF PRIMATES from the Miocene is depicted in generalized form. In the Miocene numerous four-footed apes such as Proconsul (1) probably inhabited sparsely wooded grasslands. In the Pliocene man-apes such as Paranthropus (2) began to walk and apes such as the gibbon (3) began to swing from trees using their arms as their principal means of locomotion. In the Pleistocene men such as the Neanderthal (4) acquired an advanced brain and used tools, while apes such as the gorilla (5) had returned to the ground. Man of the recent epoch is depicted here as an Egyptian agricultural worker (6).



HIP BONE of the chimpanzee (*left*), the man-ape Plesianthropus (*center*) and man (*right*) are compared. The similarity between the latter two indicates that Plesianthropus walked erect.

he proposed a spiritual solution. He felt that the qualities of the human brain could not be explained by the process of natural selection. He was not satisfied with the usual Darwinian explanation that the most effective weapon-makers destroyed other primate groups. He recognized that a present-day savage who lacked modern tools and weapons was not a living fossil but had potentialities far beyond what the struggle for existence, as then conceived, should have given him. "We are driven to the conclusion," said Wallace, "that in his large and well-developed brain he possesses an organ quite disproportionate to his actual requirements—an organ that seems prepared in advance only to be fully utilized as he progresses in civilization. . . . The brain of prehistoric and of savage man seems to me to prove the existence of some power distinct from that which has guided the lower animals. . . ." By way of answer to this view some suggested that modern tribes were not true primitives but "fallen" people who had inherited brains of greater capacity than their needs. Similar observations, it was noted in class-conscious England, could be made among the peasantry.

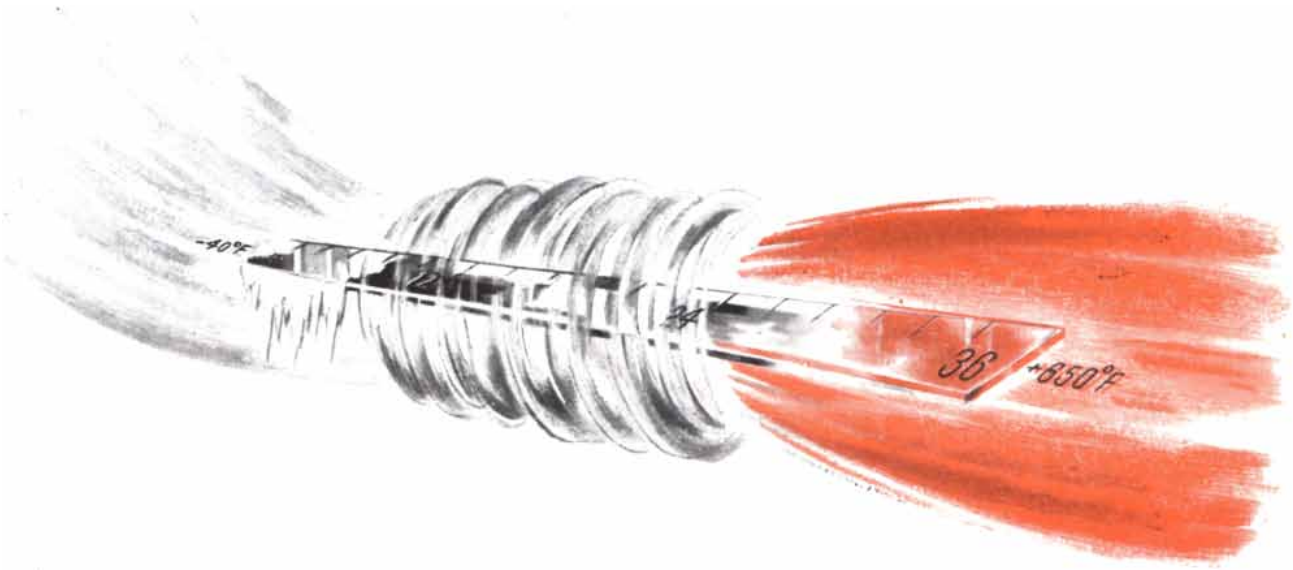
These arguments will not stand careful scrutiny, but I do not believe that the solution of the enigma demands that we follow the road Wallace took, even though one recognizes the importance of some of his comments. It is one thing to say that we can trace man's intellectual capabilities into the past by the tools he used; it is quite another to assume that man has acquired his modern brain through the competitive use of these tools alone. Yet we can do no more at present than hint at a possible solution. It is possible that communication began before tools and is more significant. Moreover, the ability to grasp time, to look toward the future, is of great significance in the awakening of the impulse to *make* rather than merely to pick up and *use* a makeshift tool. Another problem unanswered by simple arguments about tools is the great spurt of human brain growth in the first months after birth and the prolonged infancy of our species. It is apparent that man is an anomaly among apes. Did culture promote these changes, or did the changes influence man's curious evolutionary history? Complex, not simple, forces seem to have been at work.

The Freedom of the Brain

Finally we may observe one curious point in which man's case is perhaps unique. His only really important bodily specialization is this huge mushroom of a brain, which has arisen magically between night and morning. He could have survived in the war of nature with less, but now he shows strange talents of little "practical" importance. He tries to write beautiful things; magnificent symphonies roll from the tissues of his brain; he creates a symbolic world of mathematics which has meaning only to others of his kind. When I said that the human brain exploded, I meant no less. There was nothing to keep it to the careful, limited perfection of a horse's hoof. It does not move in a narrow channel. It is the one specialization which has brought unlimited freedom.

Somehow, when man left his four feet for two, and abandoned the fixed natural world for a social world of vertical moving bodies forever circulating around him, he was promoting flexible, intelligent adjustments rather than the instinctive ones to a fixed environment. Under unhindered mutation pressure evolution built his unbelievably complicated brain. Evidence has accumulated that mutation rates themselves may be inheritable and that this tendency may revolve around particular loci, in this case let us say the genes controlling brain growth. Then, if in the early stages of evolution such growth had a genuine selective advantage, the rate of increase may have well carried the brain beyond what was purely necessary, speaking in a utilitarian sense. Whether this great creative burst has now become completely stabilized, we cannot discuss here. Life, as always, is more strange than the explanations we give of it. Seemingly some brain of the Middle Pleistocene could have written Beethoven's sonatas. It lacked only the necessary cultural background.

Not many months ago I sat in a conference of scholars listening to several distinguished men debate the way in which man had obtained his brain. As the voices rose, my mind wandered far back along the ill-lit road by which we had come to this meeting. This was the way man had come along that whole dark million-year-long road—shouting, arguing, talking boldly to his fellows, whistling by thickets filled with the eyes of night prowlers, devising rickety intellectual houses that a single cold blast of thought would blow away, and then proceeding to reside comfortably within them for millennia. We wouldn't recognize any more, I thought a little wistfully, the world from which we have emerged. We wouldn't recognize the heat that burned us, or the mud we crept through, or the teeth that snapped at us. They are all back behind us there in the deeps of time. Worlds we have passed, worlds where we wriggled and crept or swung and dangled to reach a warm house and a pleasant fire. I think I know at last how man has reached this place, I thought to myself. It has not all been by the use of tools.



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