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## The Line Drawn by the Fossils

( 1 )

THE discovery of fossil types of man or manlike organisms (other than the two skulls known at Darwin's time)—the australopithecine fossils from South Africa, in the early Pleistocene strata of 1,000,000 or more years ago; the fossil remains of various types of *Pithecanthropus erectus*, now classified as *Homo erectus*, from Java, from Peking, and from Heidelberg, in the middle Pleistocene strata of about 500,000 years ago; the Swanscombe skull found near London, dating back to about 250,000 years ago; the Neanderthal fossils from Germany and elsewhere in Europe, and the somewhat later but related finds in Palestine, in Java, and in Rhodesia, all dating back to between 40,000 and 100,000 years ago; the Cro-Magnon and many similar fossils that, dating back to about 35,000 years ago, represent the immediate ancestors of neolithic and historic man—all these discoveries would seem to confirm Darwin's hypothesis of man's evolutionary descent and also to support his conjecture that the missing types in the developmental picture would be found and would fill the gaps in the continuum. [1]

What I have just said is the usual interpretation of the post-Darwinian findings in paleoanthropology. But, in fact, a closer examination of the matter shows, on the contrary, that modern paleoanthropology departs from Darwin's views on man in certain striking respects.

Let me say at once that all contemporary anthropologists in good standing agree with Darwin about the evolutionary descent

of man and about the origin of the human species by exactly the same processes that are responsible for the speciation of all other forms of life. But as we observed in the preceding chapter, Darwin, in the absence of fossil remains, was forced to argue in support of his theory of man's origin by trying to establish the proposition that man and other animals differ only in degree. In sharp contrast, contemporary anthropologists regard their rich array of fossil finds as sufficient confirmation of man's phylogenetic continuity with earlier forms of animal life, so that they need not support that theory of man's origin by trying to show that man differs only in degree from other animals. On the contrary, having the various fossil specimens to interpret and explain, contemporary anthropologists must perforce try to show that all members of the family *Hominidae*—fossil as well as living types of man—really differ in kind from the other two most closely related family groups in the primate order—the *Hylobatidae* (i.e., the gibbon) and the *Pongidae* (i.e., the orangutan, the chimpanzee, and the gorilla).

If the contemporary anthropologists were to follow Darwin in thinking that man differs only in degree from non-man, they could not classify the fossil specimens into those that belong to the hominid family and those that belong to the pongid family—the fossil and living species of apes. In order for them to point a finger at the time and place where human life begins, they must be able to draw a sharp line between human and non-human; and, in order to draw that line, they have to view man as really differing in kind from non-man, not just in degree.

This is nicely confirmed by the fact that Darwin, in the light of his own insistence upon difference only in degree, writes: "In a series of forms graduating insensibly [i.e., by slight differences in degree] from some ape-like creature to man as he now exists, it would be impossible to fix on any definite point when the term 'man' ought to be used." [2] To which he adds: "But this is a matter of very little importance."

It may have been of very little importance for him, but it is of the greatest importance—it is crucial—for contemporary paleo-anthropologists who try to order and classify the fossil specimens into those that represent extinct species in the genus *Homo*, or at least in the family *Hominidae*, as contrasted with those that

represent extinct species belonging to the family *Pongidae* or the family *Hylobatidae*.

( 2 )

Having stated wherein they agree with Darwin and having pointed out how they depart from his central proposition about man, let me try briefly to summarize the views of such leading scientists today as Julian Huxley, Dobzhansky, Mayr, Simpson, Leakey, Rensch, Eiseley, von Koenigswald, Oakley, Washburn, and Le Gros Clark who, either as paleoanthropologists or as evolutionists in general, deal with the problem of man's origin and difference.

In one set of terms or another, they all assert the *uniqueness* of man as an animal, by which they mean: first, that man possesses certain characteristics (*forms of behavior springing from certain powers or abilities on his part*) that are not possessed to any degree by non-human animals; and hence, second, that man really differs in kind from non-human animals, not just in degree. In addition, there are several unique human traits that are not behavioral: man's erect or bipedal posture, his flexible hand with thumb opposed to forefinger, and the dominance of his cerebral cortex by either the left or the right hemisphere. [3]

The behavioral characteristics of fossil species are partly inferred from physique, especially the size of the brainpan and the structure of the jaw, but mainly from fossil artifacts that indicate such things as the making—the *making*, not just the *using*—of tools (e.g., the hand ax), the use of fire, hunting, cannibalism, burial rites, permanent dwelling places, the adornment of the body or of tools, the decoration of cave walls by representative or symbolic drawings, the making of statues, etc. [4]

Fossil forms of the *Hominidae* are differentiated from other fossil forms in the primate order (such as the *Pongidae* and the *Hylobatidae*, both of which are *Hominoidea*) by morphological characteristics and by distinctive behavioral traits. The latter are either indicated by the fossil artifacts associated with their skeletal remains or inferred from anatomical properties, such as cranial capacity or dentition. The paleoanthropologists are in agreement that the behavioral trait that distinguishes all hominid forms from

the other fossil primates is toolmaking, and many of them associate this with what, in the earliest forms going back to 1,000,000 years ago or more, must be described as capacities for linguistic communication and for social organization. The basic disagreement among the anthropologists—with Raymond Dart, Robert Broom, and L. S. B. Leakey, on one side, and with most of the others against them in various degrees of doubt or indecision—concerns certain South African fossils that date between 1,000,000 and 500,000 years ago.

Both sides agree that these fossils were definitely hominids. The moot question is whether they belong to the genus *Homo* or to the genus *Australopithecus*—the two main divisions of the hominid family. Leakey claims that his fossils represent an early species in the genus *Homo*, a species that he has named *Homo habilis*. His opponents claim that these early hominid fossils do not belong to the genus *Homo*, but to the genus *Australopithecus*. The difference of opinion about the classification of these South African hominid fossils occurs within the context of agreement about the behavioral characteristics that differentiate the two hominid genera—the genus *Homo*, on the one hand, and the genus *Australopithecus*, on the other. Only sporadic or *ad hoc* toolmaking can be attributed to the earlier hominids of the genus *Australopithecus*; in contrast, to the later hominids of the genus *Homo* can be attributed sustained and systematic toolmaking, along with the use of fire and co-operative social behavior.

The South African anthropologists argue that the association of their fossil skulls with fossil artifacts that indicate the making of tools, the hunting of animals, and the use of fire, is conclusive evidence that their finds represent not only hominids, but also members of the genus *Homo*, belonging to the earliest of its species, *Homo habilis*. Their opponents doubt this interpretation of the fossil artifacts; they fortify that doubt by reference to the small brain size of these fossil forms; and, while conceding that they are, indeed, early representatives of the hominid family, regard them as belonging to the genus *Australopithecus*, not to the genus *Homo*. [5]

This difference of opinion concerns only the antiquity of the genus *Homo*, not the antiquity of the hominid family; and it in no way affects the agreement that prevails concerning the differentiation of the *Hominidae* from the *Pongidae* or, within the

hominid family, the differentiation of the genus *Homo* from the genus *Australopithecus*. These agreements are the significant points for us, for we are here concerned with *how* the anthropologists draw the line between human and non-human forms of life, as these are represented by fossil remains and living species, *not where* they draw the line in time and space, *nor how* they trace the line or lines of phylogenetic development along which living man descended from ancestral hominid forms.

Whether or not certain fossil hominids, dating back to 1,000,000 years ago or more, are classified as belonging to the genus *Homo*; and whether that genus consists of three distinct species (*Homo habilis*, represented by the fossil forms just mentioned; *Homo erectus*, represented by the fossil forms found in Europe, Java, and China, dating back to about 500,000 years ago; and *Homo sapiens*, including the Neanderthal and Cro-Magnon fossils dating from about 120,000 to about 35,000 years ago) or the genus *Homo* includes only two species, *Homo erectus* and *Homo sapiens*, the line that divides hominids from non-hominids and the characteristics that differentiate the genus *Homo* remain the same. The evidences of industry (toolmaking, use of fire) and the evidences of culture (stable forms of association, linguistic communication) become more marked as we move, within that genus, from the species *Homo erectus* to the species *Homo sapiens*, less clearly in the case of Neanderthal man, more clearly in the case of Cro-Magnon man. Here the evidences of culture include such things as burial rites and other ceremonialisms, decorative art, painting, and sculpture. Oral speech, which precedes written speech, leaves no fossil remains, but the anthropologists infer that Cro-Magnon man and living man are of the same species from the evidences of Cro-Magnon modes of life and behavior to be found in the fossil artifacts associated with Cro-Magnon man.

The argument runs somewhat as follows. If Cro-Magnon man had sufficient intelligence or brain capacity for symbolic or representative works of art, he also had enough intelligence or brain capacity for articulate speech. The many rapid changes in technology and in culture that took place in Cro-Magnon times, it is further argued, indicate that Cro-Magnon man not only had a capacity for articulate speech, but also used it to develop a propositional language such as ours. He could not have done what he did without it.

Some anthropologists—for example, Oakley, Le Gros Clark, Leakey, and Dart—go even further. They argue that one piece of evidence may be decisive; namely, toolmaking. Toolmaking, Oakley maintains, indicates the power of conceptual, as opposed to perceptual, thought. But the power of conceptual thought is all that is needed for the development of all the other aspects of distinctively human culture, including symbolic art and articulate speech. Hence, even though we can find no fossil traces of them, articulate speech as well as the use of fire and symbolic art may have been present in the life of whatever fossil species is associated with fossil artifacts that are indisputable evidence of toolmaking. [6]

By this line of reasoning, the existence of men in all generic respects like living men may be carried as far back as 500,000 or 1,000,000 years ago, and the existence of hominids that have a family resemblance with living men may go back even further—to almost 2,000,000 years ago. The significance for us of this reasoning does not lie in the precise ascertainment of man's first appearance on earth, as represented by the antiquity of the genus *Homo* or the antiquity of the family *Hominidae*, but rather in the fact that what the anthropologists are asserting in effect is that the power of conceptual thought, possessed by man and not possessed to any degree by non-toolmaking animals, constitutes a clear difference in kind between man and these other animals.

The argument would have the same significance if some other human characteristic, such as propositional speech, were used as toolmaking is here used; namely, as the sign that man possesses the power of conceptual thought, a power totally lacked by animals that do not develop propositional speech to any degree whatsoever. The choice of tools or of fire as the sign of conceptual thought on the part of fossil man merely reflects the fact that these products of human behavior leave fossil remains; speech, at least *oral* speech, leaves none.

### ( 3 )

The foregoing summary indicates that the leading contemporary students of human evolution maintain that man really differs

in kind from other animals. They themselves epitomize their own position strikingly, in one of two ways. Simpson and Mayr declare themselves against the view that man is "nothing but an animal," by which they mean, I take it, "nothing but a brute." Julian Huxley and Dobzhansky flatly deny that man is "just a superior ape." It will be profitable, I think, to cast an eye on a few capital texts from the writings of these scientists, and then to examine passages in the writings of others that confirm or concur in these opinions.

In *The Meaning of Evolution*, George Gaylord Simpson, Professor Emeritus of Vertebrate Paleontology at Harvard University, writes:

To say that man is nothing but an animal is to deny, by implication, that he has essential attributes other than those of all animals. [7]

As applied to man the "nothing but" fallacy [for naming which Simpson gives credit to Huxley] is more thoroughgoing than in application to any other sort of animal, because man is an entirely new kind of animal in ways altogether fundamental for understanding his nature. It is important to realize that man is an animal, but it is even more important to realize that the essence of his unique nature lies precisely in those characteristics that are not shared with any other animal. [8]

Simpson then makes what would at first appear to be the paradoxical statement that man is both "unique in degree" and also "unique in kind." [9] I say "paradoxical" because a strict meaning of the word "unique" entails the possession, by one of two things being compared, of characteristics not possessed at all by the other, neither specifically nor generically, whereas a difference in degree entails that the two things being compared both possess the same trait, one more of it and the other less. Hence, it would seem as if "uniqueness in degree" were a contradiction in terms. Since not only Simpson, but many other scientists also refer to man's uniqueness as, in part at least, a uniqueness in degree, it is important to understand what they mean by this mode of speech.

The meaning is as follows. The statement that only man has

a brain large or complex enough to function linguistically asserts the *unique degree* of man's brain capacity as compared with that in other animals. The statement that only man is a maker of sentences, or that only man is a maker of tools, asserts uniqueness in kind, as contrasted with uniqueness in degree; for it points to something that man does which no other animal does at all—in any degree.

Simpson mentions four things that exist in man to a much higher degree than in other animals (intelligence, flexibility, individualization, and socialization). In each of these respects, Simpson considers man unique in the degree of his capacities or attainments. [10] But though he thinks man is clearly the highest animal in all these respects (highest in degree), he also maintains that "it is still false to conclude that man is nothing but the highest animal." His reason is that there are other respects in which man is unique in kind (e.g., speech, moral sense, cumulative cultural development, self-awareness). [11]

In *Animal Species and Evolution*, Ernst Mayr, Professor of Zoology at Harvard University, expresses similar views. Considering the evidences of man's evolution, he speaks of "the gradual emergence of man's being 'not merely an animal.'" [12] A page earlier he writes: "No more tragic mistake could be made than to consider man 'merely an animal.' Man is unique. . . ." What Mayr means is plainly "unique in kind," for he refers to the distinctive properties of man (i.e., possessed by man alone) that, he says, have been pointed out by "Huxley, Haldane, Simpson, Dobzhansky, and other recent writers." [13] The properties he mentions are such things as speech, toolmaking, cultural traditions, [14] to which he adds one property that is not directly observable, "the ability of abstract thinking." [15]

In *Mankind Evolving* and in *Evolution, Genetics, and Man*, Theodosius Dobzhansky, of Rockefeller University, writes in the same vein.

Man is not simply a very clever ape. On the contrary, he possesses some faculties that occur in other animals only as rudiments, if at all. [16]

Human intellectual abilities seem to be not only quantitatively but also qualitatively different from those of animals other than men. [17]



Man, in other words, is not just superior in the degree to which he possesses the same abilities (i.e., he is not just unique in degree), but he is also unique in kind because he possesses traits not possessed at all by other animals. As examples of these, Dobzhansky cites man's "symbolic language," [18] man's toolmaking, [19] and man's cumulative transmission of culture. [20]

In three books—*The Uniqueness of Man*, *Evolution in Action*, and *Evolution, The Modern Synthesis*—Julian Huxley says, again and again, that "man . . . is in many respects unique among animals." [21] That he means unique in kind is plain from such passages as the following:

The first and most obviously unique characteristic of man is his capacity for conceptual thought; if you prefer objective terms, you will say his employment of true speech, but that is only another way of saying the same thing. . . .

This basic human property has had many consequences. The most important was the development of cumulative tradition. The beginnings of tradition, by which experience is transmitted from one generation to the next, are to be seen in many higher animals. But in no case is the tradition cumulative. . . .

The existence of a cumulative tradition has as its chief consequence—or, if you prefer, its chief objective manifestation—the progressive improvement of human tools and machinery. . . .

Speech, tradition, and tools have led to many other unique properties of man. . . . [22]

In man's mental organization, according to Huxley, the two crucial novelties are speech and the creation of a common pool of organized experience for the group. Though he adds other unique human traits, such as toolmaking and "a sense of right and wrong in the abstract," he regards these two as "man's major uniqueness." [23] That Huxley thinks of man as unique both in degree and also in kind is seen in the following passage: "The last step yet taken in evolutionary progress . . . is the *degree* of intelligence which involves true speech and conceptual thought: and it is found *exclusively* in man." [24] (*Italics added.*)

Other evolutionists and paleoanthropologists concur, in whole or part, with slightly different emphases. For example, the German zoologist Bernhard Rensch, in *Evolution Above the Species Level*, says that "man has reached a unique evolutionary position in the realm of organisms," which he attributes to man's acquirement of "a fundamentally new evolutionary faculty"—rational speech. [25] Others—Washburn, Oakley, Le Gros Clark, Dart—stress not just speech, but the conjunction in man both of sentence-making and toolmaking; and among these authors, Washburn and Oakley explicitly express the view that these two distinctive properties of man imply his exclusive possession of the power of abstract or conceptual thought. [26]

This last point is confirmed by two observers of the behavior of apes. In *The Year of the Gorilla*, George Schaller not only distinguishes between man's *toolmaking* and the *tool-using* of gorillas (as do Oakley, Dart, Leakey, and others), but also asserts that the absence of language on the part of gorillas implies the absence of concepts on their part, with the consequences that they make no reference to past or future. [27] The eminent Gestalt psychologist Wolfgang Köhler, in the second edition of *The Mentality of Apes*, makes a similar point about chimpanzees; he associates the narrow limits of time within which they live (largely the immediate present) with their lack of speech. "Besides lack of speech," he writes, "it is in the extremely narrow limits in this direction that the chief difference is to be found between anthropoids and even the most primitive human beings"—and it is this limitation "that prevents the chimpanzee from attaining even the smallest beginnings of cultural development." [28]

#### ( 4 )

Let me now summarize—from the literature that we are engaged in reviewing—the various things that are said to be distinctive of human behavior and are made the basis for saying that man differs in kind from other animals. *With the one exception of language* (sentence-making behavior), there are minority dissents on all these indications of man's uniqueness in kind—dissents that treat these indications as signifying only superiority or uniqueness in degree.

In the sphere of what is plainly overt and observable behavior:

1. Only man employs a propositional language, only man uses verbal symbols, only man makes sentences; i.e., only man is a discursive animal. [29]
2. Only man makes tools, builds fires, erects shelters, fabricates clothing; i.e., only man is a technological animal. [30]
3. Only man enacts laws or sets up his own rules of behavior and thereby constitutes his social life, organizing his association with his fellows in a variety of different ways; i.e., only man is a political, not just a gregarious, animal. [31]
4. Only man has developed, in the course of generations, a cumulative cultural tradition, the transmission of which constitutes human history; i.e., only man is a historical animal. [32]

In the sphere of interpreted behavior, involving an admixture of inference with observation:

5. Only man engages in magical and ritualistic practices; i.e., only man is a religious animal. [33]
6. Only man has a moral conscience, a sense of right and wrong, and of values; i.e., only man is an ethical animal. [34]
7. Only man decorates or adorns himself or his artifacts, and makes pictures or statues for the non-utilitarian purpose of enjoyment; i.e., only man is an aesthetic animal. [35]

These wholly or partly overt forms of behavior, said by the majority of the scientists in this group to be distinctive of the human species or genus are often interpreted by them as implying the presence in man of psychological processes or abilities that are not present in other animals. Distinguishing between what they call perceptual and conceptual thought, or between generalization on the sensory level and the formation of abstract concepts, they attribute conceptual processes or the ability to form abstract concepts to man and man alone. [36] They ground this attribution—this inference to unobserved processes or abilities—on the fact that propositional speech, toolmaking, and cumulative

cultural transmission all involve a transcendence of or emancipation from the immediate environment as that is momentarily present to the senses; and so, in their view, these distinctively human performances must have their basis in psychological processes or abilities that go beyond sense perception and even beyond sensory residues, such as images. [37]

But while such authors as Dobzhansky, Huxley, Mayr, Oakley, Rensch, Carrington, and others, place this psychological interpretation on what they regard as distinctively human performances in the sphere of overt behavior, they also say things that are either inconsistent with this interpretation or qualify it considerably. Thus, for example, Huxley asserts that conceptual thought is to be found only in man, but he also says that the lack of true speech on the part of apes indicates "an inadequate faculty of forming concepts." [38] He goes further in this direction: "Chimpanzees can construct some sort of concepts; but conceptual thought only became efficient and productive with the aid of proper tools, in the shape of verbal symbols." [39]

To say that conceptual thought is found only in man is to assert a difference in kind; but to say that conceptual thought is more developed or more efficient in man than in chimpanzees is to assert a difference in degree. The two assertions cannot both be true. What Huxley may intend, though it is certainly not entirely clear, is that man differs in kind from apes with respect to the use of verbal symbols and propositional speech, and that this difference gives man superiority in degree with respect to concept-formation. We shall return to this point later.

Similarly, while Dobzhansky says that the power of "abstract thinking" on man's part is the source of his use of verbal symbols—his ability to bestow meanings on meaningless sounds or marks [40]—he also says that animals can form non-verbal concepts. [41] Unless Dobzhansky carefully distinguishes between perceptual generalizations and conceptual abstractions (which it is not clear that he does), the two statements would appear to be inconsistent; for one seems to say that only man has verbal symbols because only man has concepts, while the other seems to say that animals have concepts, too, though these are non-verbal.

Again, Oakley, while attributing man's language and tool-making to his "capacity for conceptual thinking, in contrast to the mainly perceptual thinking of apes and other primates," [42]

admits, in another place, "the possibility of gradation between these two extremes, perceptual thought in apes, conceptual thought in man." [43] In spite of this, Oakley does insist that we must not underestimate the gap (in *kind* or *degree*?) that separates man's invention and construction of tools for relatively remote future use and the ape's improvisation of tools for immediate employment in the present situation.

Rensch best exemplifies the way in which some of these authors qualify their correlation of human language with abstract thought on man's part. His contention is that man's possession of speech, itself directly the result of his enlarged brain capacity, is in turn the source of all the rest of man's distinctive performances or abilities: his abstract or verbal concepts, his reasoning, his political institutions, his cumulative cultural inheritance, etc. [44] He says that all animals capable of learning have the power of abstraction (without the aid of language), and so he attributes non-verbal concepts, non-verbal judgments, and non-verbal reasoning to animals other than man. [45] What this comes to, in short, is that man differs in kind from other animals, or is unique, only in his possession of language, not in the possession of psychological processes or abilities. With respect to the latter, he differs in degree from other animals, and this difference in degree is, in part at least, a function of his having language. At the opposite extreme from Rensch is Carrington, who makes the power of abstract or conceptual thought man's "unique distinguishing feature"—the source of his distinctive properties, such as language, toolmaking, and cumulative cultural transmission. [46]

In view of the foregoing recitation of dissents, inconsistencies, and qualifications, how can we formulate the minimum clear concurrence of the group of scientists that we have been considering? I think it can be done as follows.

*In the first place*, it is necessary to separate statements about observable behavior from theoretical interpretations of them, especially those that posit psychological powers or processes of a given sort in order to explain the observed behavior. When we do this, we can say that the leading paleoanthropologists agree without dissent or qualification that only man makes sentences or has the power of propositional speech, that only man makes tools, fire, clothing, etc., that only man makes his own laws of behavior and thereby constitutes his social life, that only man has

a cumulative cultural tradition. We shall find dissent from all but one of these statements, both by comparative psychologists and by ethologists, and will consider such dissent in the chapter to follow. The *one exception* is the statement that only man makes sentences and has the power of propositional speech. Yet if that one statement alone is agreed upon by all as unimpeachable fact, at least as far as evidence at present available goes, that by itself would suffice to warrant the assertion that man differs in kind from other animals and that this difference is real, not apparent; for between the ability to make sentences and the lack of that ability, no intermediates are possible.

*In the second place*, when they come to interpreting the fact that man and man alone has a propositional language, some, like Rensch at one extreme, make man's brain capacity the direct source of his linguistic ability, and his possession of language, in turn, the source of his verbal or abstract concepts; whereas some, like Carrington at the other extreme, make man's brain capacity the direct source of his power of abstract or conceptual thought and that, in turn, the source of his having a propositional language. Most of the others are indecisive on this question of causal sequence. But they tend to agree that man's possession of speech and whatever psychological powers are associated with it, either as cause or as effect, give rise to all his other distinctive achievements—his technological productions, his cumulative transmission of culture, his legally constituted forms of social organization, etc.

*In the third place*, while the paleoanthropologists are not clear on whether man's exclusive possession of propositional speech implies that man alone has the power of conceptual thought and the use of abstract symbols (as we have seen, they often take back in one place what they have asserted without qualification in another), they do appear to be clear on a matter that relates to the question whether man's difference in kind is superficial or radical. They never, of course, raise this question explicitly, for they do not seem to be aware of the distinction between a radical and a superficial difference in kind. Nevertheless, we can easily determine how they would answer the question if it were raised for them and if they understood it. They are almost unanimous in attributing man's difference in kind to the much greater magnitude of man's brain, as compared with the brains of living chimpanzees, gorillas, and orangutans; in their view, the same

comparison holds for the brainpans of the fossil species that they classify as *Hominidae* or as *Pongidae*. They regard the phylogenetic series as involving a continuum of degrees of brain magnitudes and complexity, with a critical threshold above which the unique behavioral characteristics of man first make their appearance. [47] Hence, if asked the question, they would certainly say that man's difference in kind is only superficial, not radical.

( 5 )

Neither the position taken by Darwin (that men and other animals differ only in degree) nor the position taken by post-Darwinian paleoanthropologists (that man differs superficially in kind from other animals) is established by the evidence to which their proponents respectively point. The position taken in each case is taken in order to be consistent with the general theory of evolution and the particular theory of speciation held by the proponents of the position. In Darwin's theory of speciation, species differences are at most only apparent differences in kind, resulting from the absence of intermediate forms. In contemporary theories of speciation, the same holds for most species differences, but there may be some that are real differences in kind, i.e., those resulting from polyploidy or from quantum jumps or what is called "saltatory speciation." Having admitted real differences in kind, the post-Darwinian evolutionists, in order to be consistent with phylogenetic or developmental continuity in the origin of all species, must then regard these differences in kind as merely superficial, to be accounted for by a critical threshold in an underlying continuum of degrees of organic complexity.

The only position that is inconsistent with, and therefore excluded by, the theory of evolution (and with it, the principle of phylogenetic continuity) is the position that man differs radically in kind from other animals. But inconsistency with the theory of evolution does not eliminate that position as false, any more than consistency with the theory of evolution establishes as true the alternative positions—that man differs only in degree or at most only superficially in kind. The truth of evolutionary theory in general, even if it were as firmly established as it could be by

research, may or may not apply to the origin of man. To assume that it does apply, and then to use that assumption as a basis for saying that man's observed difference in kind from other animals is either only an apparent or at most a real but superficial difference in kind, is to beg the question.

To avoid begging the question, we must resolutely follow Darwin's line of reasoning even if he did not always follow it himself. We must proceed from the comparative evidences of human and animal behavior to a conclusion concerning how man differs from other animals; and from that conclusion to the support or rejection of the evolutionary hypothesis as applied to the origin of man—*support*, if our conclusion is that man differs only in degree or at most only superficially in kind; *rejection*, if our conclusion is that man differs radically in kind from other animals.

Let me digress for a moment to comment briefly on the logic of *confirming and infirming scientific principles*. The evolutionary principle of phylogenetic continuity and the more general scientific principle of the continuity of nature are regarded by scientists as amply confirmed by empirical data of all sorts, and as not yet infirmed or falsified by a single piece of decisively negative evidence. In this appraisal of the situation, the scientists are correct, at least so far, but this should not lead anyone acquainted with the logic of empirical confirmation of general principles to conclude that the special and the more general principle of continuity are established beyond the shadow of a doubt as certain and incorrigible truths. That is not the case. Furthermore, until the last shred of relevant evidence is in, such principles as these are subject to the infirmative force of evidence having a contrary tenor and they are open to being falsified by decisively negative evidence.

If the principle of phylogenetic continuity were established as finally true, instead of merely having its relative truth highly confirmed by all the evidence so far amassed, the truth of that principle would eliminate as false the proposition that man differs radically in kind from other animals; for radical difference in kind is incompatible with phylogenetic continuity. Whatever evidence tends to show that man differs in degree or only superficially in kind tends to confirm the truth of the principle of phylogenetic continuity. But, by the same token, whatever evidence tends to show that man differs radically in kind from other



animals is infirmative in its effect and may even, if it becomes decisive, render the principle of phylogenetic continuity inapplicable to man while leaving it applicable to the rest of living things.

( 6 )

The paleoanthropologists do not have in all their fossil skeletons and artifacts the kind of evidence that is needed to decide whether the manifest difference in kind (which they assert) between man and other animals is only superficial or is radical. The series of brain weights for the various fossil specimens, inferred from the size of their brainpans, is by itself not decisive; for it is necessary to discover whether in that series there is a critical threshold functionally related to the absence and presence of such observed behavioral characteristics as propositional speech, toolmaking, cumulative cultural transmission, rule-making, and variable forms of association, etc.

The inadequacy of the paleontological evidence is not relative to the present stage of research, to be remedied by further fossil finds. Nor is its inadequacy a matter of the tenuous interpretations and inferences that the paleoanthropologists are forced to make from the kind of data they handle. Its inadequacy is absolute and irremediable for the simple reason that no amount of fossil data, no matter how carefully and soundly interpreted, can establish the existence of a critical threshold in the continuum of degrees of brain size and complexity. Without that being shown, it is impossible to tell whether a difference in kind that certainly looks like a real difference in kind, and is thought to be so by the paleoanthropologists, is superficial rather than radical.

How, then, can this matter be settled? *In the first place*, only by behavioral comparisons made with respect to living species—comparisons of human behavior with the behavior of other animals—whether based on laboratory data obtained by experimental psychologists or on data gathered by ethologists working in the field with animals in their natural habitats. The latter type of evidence has been greatly improved in precision and objectivity since the time of the naturalists on whose accounts, too often in the form of anecdotes about animal behavior, Darwin had to rely because he had no other evidence to go on.

Nevertheless, Darwin's procedure—that of comparing the behavior of men and of other animals—is the only sound procedure, and it must still be employed today even though we now have fossil remains lacking to Darwin. The fossil evidences are at best data from which we can infer the behavior of species not now living; and it is in terms of the inferred behavior that we classify the fossil species as human or non-human.

*In the second place*, if comparative behavioral data do establish an observed or manifest difference in kind, then in order to determine whether that difference in kind is superficial or radical, we need other types of evidence. Behavioral comparisons by themselves cannot make this determination. We need evidence in support of one or another psychological interpretation of the observed behavioral differences. We need neurological evidence, especially data gained from the comparative study of the neurological correlates of behavior. In addition, as we shall see, we may need evidence of the sort that can only be obtained by computer technology and by experiments with artificial intelligence, i.e., with machines devised to simulate human behavior.