Mankind So Far

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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.

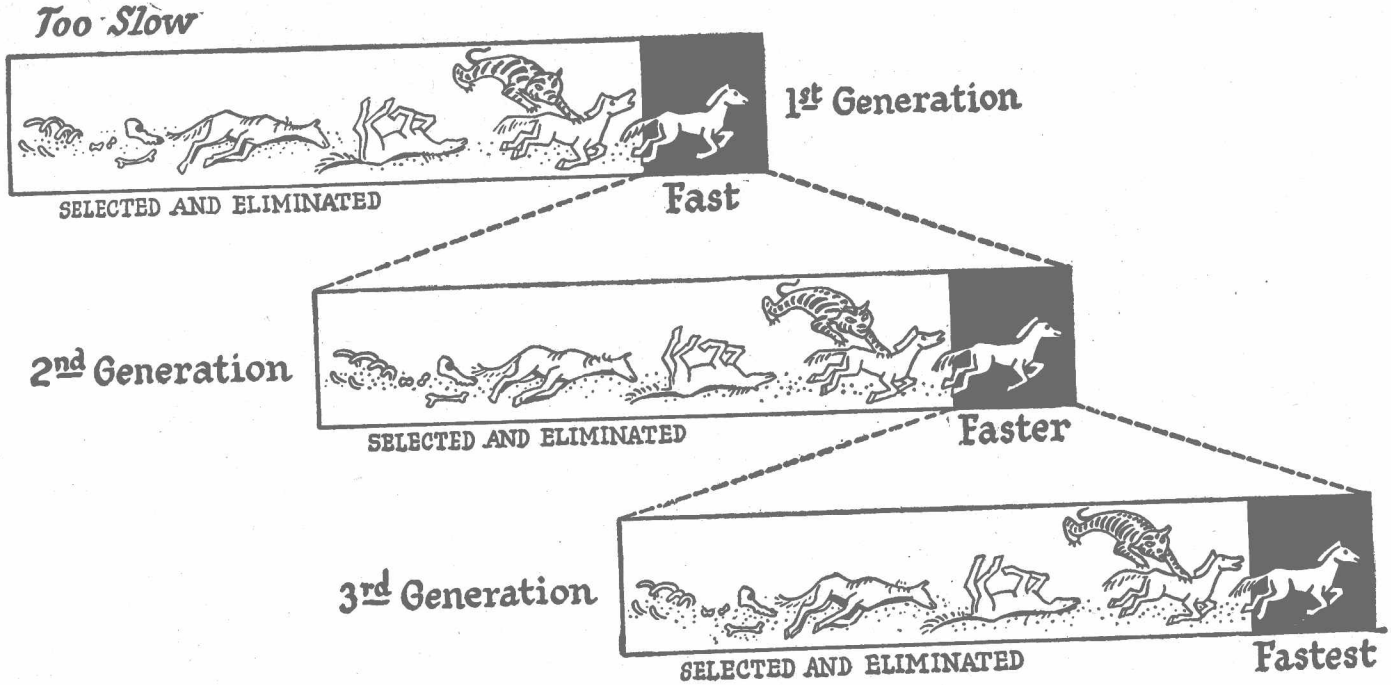
Evolution, as a word, has the sense both of development and of unfolding, and has been defined most simply as "descent with modification." In itself, it is no more than the inescapable presumption that existing kinds of life, with all their advanced or special organs, have been derived by some natural 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-