

THE MEANING OF EVOLUTION

A Study of the History of Life
and of
Its Significance for Man

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CONTENTS

Prefatory Note	ix
List of Illustrations	xiii
Prologue	1
Part I. The Course of Evolution	9
I. Geologic Time	9
II. The Beginnings of Life	14
III. Major Outlines of the Fossil Record	22
IV. The History of the Vertebrates	38
V. Records and Radiations of Reptiles	50
VI. Outlines of the History of Mammals	62
VII. The History of the Primates	78
VIII. Rates of Evolution	97
IX. First Conclusions from the Record	112
Part II. The Interpretation of Evolution	123
X. The Problem of Problems	123
XI. Oriented Evolution: Orthogenesis and Trends	130
XII. The Opportunism of Evolution	160
XIII. Racial Life and Death	187
XIV. Forces of Evolution and Their In- tegration	211
XV. The Concept of Progress in Evo- lution	240
XVI. Historical Retrospect: the Evolu- tion of Evolution	263

Part III. Evolution, Humanity, and Ethics	280
XVII. Man's Place in Nature	280
XVIII. The Search for an Ethic	294
XIX. The Ethics of Knowledge and of Responsibility	309
XX. The Future of Man and of Life	325
Epilogue and Summary	338
Index	349

ILLUSTRATIONS

Fig. 1. The time scale of earth history and of life	12
Fig. 2. Examples of the most important basic types, phyla, of animals	26
Fig. 3. The broad outlines of the historical record of life	30
Fig. 4. Examples of four main types of echinoderms	35
Fig. 5. The broad outlines of the historical record of the vertebrates	39
Fig. 6. The historical record of the reptiles	51
Fig. 7. Basic adaptive radiation in the reptiles	55
Fig. 8. Adaptive radiation of the dinosaurs	58
Fig. 9. Comparison of skeletons and of skulls of an extinct mammal-like reptile and of a primitive living mammal	64
Fig. 10. Part of the historical record of the mammals	67
Fig. 11. Continuation of the historical record of the mammals	68
Fig. 12. Continuation of the historical record of the mammals	70
Fig. 13. Continuation and completion of the historical record of the mammals	71
Fig. 14. The historical record of hoofed herbivores	75
Fig. 15. Representatives of the main groups of primates	82

XV
THE CONCEPT OF PROGRESS
IN EVOLUTION

IT IS impossible to think in terms of history without thinking of progress. With reference to what is at the moment, or to structure and relationships outside a framework of time, the concept of progress is irrelevant or at least unobtrusive. Classic chemistry and physics were sciences without time and the idea of progress simply did not arise in connection with, say, the union of sodium and chlorine atoms in a salt molecule. Even in these relatively nonhistorical sciences the newer concepts of the space-time continuum and the transmutation of elements through the periodic system introduce time, demand a historical approach, and involve ideas of progression or retrogression.

Life is so obviously a process in time and not merely a static condition of being that this study has always to some degree involved historical concepts. Development and progression are so plainly evident in animate nature that these features deeply impressed biologists long before the grand fact of the evolution that produced them was understood. The idea of biological progress is as old as the science of biology and it was already deeply imbedded in pre-evolutionary science. Although its actual historicity and its real relationship to the flow of time were scarcely glimpsed, this concept of a progression of life from lower to higher was fundamental both in primitive theology (such as the Semitic Creation myths) and in primitive science (such as that of Aristotle), and it was taken over, more or less as a matter of course, in later pre-evolutionary biology that still stemmed, in the main, from these two sources. Evolution, revealing the development of life as

an actually and materially historical process, gave meaning to these older observations and to the almost intuitive concept of progression if not, fully, of progress. The first truly general and scientific theory of evolution, that of Lamarck, had as its central feature the very ancient and previously nonevolutionary idea of a sequence of life forms from less to more perfect.

Examination of the actual record of life and of the evolutionary processes as these are now known raises such serious doubts regarding the oversimple and metaphysical concept of a pervasive perfection principle that we must reject it altogether. Yet there is, obviously, progression in the history of life, and if we are to find therein a meaning we are required to consider whether this involves anything that we can agree to call "progress," and if so, its nature and extent.

It is a childish idea—but one deeply ingrained in our thinking, especially on political and social subjects—that change *is* progress. Progression merely in the sense of succession occurs in all things, but one must be hopelessly romantic or unrealistically optimistic to think that its trend is necessarily for the good. We must define progress not merely as movement but as movement in a direction from (in some sense) worse to better, lower to higher, or imperfect to more nearly perfect. A description of what has occurred in the course of evolution will not in itself lead us to the identification of progress unless we decide beforehand that progress *must* be inherent in these changes. In sober enquiry, we have no real reason to assume, without other standards, that evolution, over-all or in any particular case, has been either for better or for worse. Progress can be identified and studied in the history of life only if we first postulate a criterion of progress or can find such a criterion in that history itself.

The criterion natural to human nature is to identify

progress as increasing approximation to man and to what man holds good. The criterion is valid and necessary as regards human history, although it carries the still larger obligation of making a defensible and responsible choice among the many and often conflicting things that men have held to be good. The criterion is also perfectly valid in application to evolution in general, provided we know what we are doing. Approximation to human status is a reasonable *human* criterion of progress, just as approximation to avian status would be a valid avian criterion or to protozoan status a valid protozoan criterion. It is merely stupid for a man to apologize for being a man or to feel, as with a sense of original sin, that an anthropocentric viewpoint in science or in other fields of thought is automatically wrong. It is, however, even more stupid, and even more common among mankind, to assume that this is the *only* criterion of progress and that it has a *general* validity in evolution and not merely a validity relative to one only among a multitude of possible points of reference.

On the other hand we may find, and we will as the discussion proceeds, that criteria *not* selected with man as the point of reference still indicate that man stands high on various scales of evolutionary progress. It would then be foolish to cry "Anthropomorphism!" After all, it may be a fact that man does stand high or highest with respect to various sorts of progress in the history of life. To discount such a conclusion in advance, simply because we are ourselves involved, is certainly as anthropocentric and as unobjective as it would be to accept it simply because it is ego satisfying. The phase now seems to be passing and we can look with amazement or with condescension on the once more general attitude among scientists that a sense of values, and especially one that values our own species, is unscientific.

As a start in the enquiry, it is quickly evident that

there is no criterion of progress by which progress can be considered a *universal* phenomenon of evolution. There are the cases in which change, and therefore any possible sort of progress, has been arrested except for minor and local, not progressive, fluctuations. There are also few possible definitions of "progress"—I think only one, and that one not really acceptable—under which the term could be applied both to the rise of the marvelously intricate organism of a typical crustacean, such as a crab, and to the change of this organism, in connection with parasitism, to an almost formless mass of absorptive and reproductive cells. Whatever criterion you choose to adopt, you are sure to find that by it the history of life provides examples not only of progress but also of retrogression or degeneration. Progress, then, is certainly not a basic property of life common to all its manifestations. This casts further doubt (at least) on the finalist thesis, still more on the concept of a perfecting principle, but it certainly does not justify a conclusion that progress is absent in evolution. In a materialistic world the very idea of progress implies the possibility of its opposite. To find that progress is universal would certainly be far more surprising than to find that it is only occasional.

In considering the record of life, we sought progressive changes that involve life as a whole, and not only the evolution of particular groups within the total process. Only one was found: a tendency for life to expand, to fill in all the available spaces in the livable environments, including those created by the process of that expansion itself. This is one possible sort of progress. Accepting it as such, it is the only one that the evidence warrants considering general in the course of evolution. It has been seen that even this, although general, is not invariable. The expansion of life has not been constant and there have even been points where it lost ground temporarily, at least. The general

expansion may be considered in terms of the number of individual organisms, of the total bulk of living tissue, or of the gross turnover, metabolism, of substance and energy.¹ It involves all three, and increase in any one is an aspect of progress in this broadest sense.

This general expansion is only imperfectly helpful in providing a criterion of progress applicable to a particular case. Any group that has persisted and that does make up part of the sum total of existing life must be granted a share in this progress and from this point of view protozoan and man stand on a level. There are, however, different degrees of contribution to the expansion. The little sphenodon on its islands off New Zealand is certainly not contributing very much to the filling of the earth with life. Man is making a large contribution, not only in the persons of his bulky millions but also—almost uniquely among all organisms—in his vast swarm of domestic plants and animals. A criterion is also provided for evolutionary movement within any given group. As one group replaces another the net total of life may or may not be changed, but by this particular criterion alone, within the history of one group, its increase in variety and abundance may be considered ipso facto progressive and its decline retrogressive. In this sense extinction is not merely the end but also the very antithesis of progress—but ultimate extinction (the inevitable fate of all life) is no sign that progress was earlier absent in the rise and history of the group. As regards direction and intensity of expansion at any one time, man is right now the most rapidly progressing organism in the world. The actual bulk of material incorporated in *Homo sapiens* seems now quite clearly—and from other points of view, most unfortunately—to be increasing more rapidly than any other species.

1. This last aspect, particularly, is discussed in the extremely interesting paper by Lotka cited earlier.

In the search for, as nearly as may be, objective criteria of progress applicable to a particular case and yet widely valid, such considerations lead to the criterion of dominance, which has been stressed almost to the exclusion of any other by the leading student of the subject, Huxley.² We have seen how throughout the history of life each group has tended to expand and to have one or more periods when it was particularly abundant and varied. We have seen, too, how at any given time certain groups tended to be much more varied and abundant than others, in other words to dominate the life scene, and that there has been a succession in these dominant groups. It is this succession that provides a criterion, though plainly not the only one, of evolutionary progress. Thus among the aquatic vertebrates, it is fully justified, as long as we keep in mind the particular kind of progress that we mean, to say that successive dominance of Agnatha, Placodermi, and Osteichthyes represents progress and that Osteichthyes are the highest, Agnatha the lowest, group among the three. It is worthy of note, in passing, that the Chondrichthyes are generally admitted in this sequence as higher than Placodermi but lower than Osteichthyes, yet the Chondrichthyes by this criterion are really neither lower nor higher than the Osteichthyes. The same sort of sequence applies in the successive dominance of Amphibia, Reptilia, and Mammalia.

We do not, however, find successive dominance between, say, Osteichthyes, Aves, and Mammalia. All three are dom-

2. Throughout this chapter I am deeply indebted to his various profound and extended treatments of the subject even though I do not very closely agree with him. Not only in this chapter but throughout this book I am especially indebted to *Evolution. The Modern Synthesis*, a work so rich in details that it is sometimes hard to disentangle the principles and one with a relative weakness on the historical side of the study of life, but still the best single and general statement now available on the modern theory of evolution, which should be read by everyone interested in this subject.

inant at the same time, during the Cenozoic and down to now. Taking the animal kingdom as whole, it is clearly necessary to add insects, molluscs, and also the "lowly" Protozoa as groups now dominant. If one group had to be picked as most dominant now, it would have to be the insects, but the fact is that all these groups are fully dominant, each in a different sphere. The conclusion is emphasized by cases like that of the Osteichthyes and the Amphibia—the Osteichthyes were dominant later. If this criterion were really given general validity and were objectively applied, it would be necessary to conclude that bony fishes are higher forms of life and represent a further degree of progress than amphibians, or than reptiles, for that matter.

It is true, as Huxley says, that "biologists are in substantial agreement as to what were and what were not dominant groups" and that they usually arrange these as if they constituted a single succession symbolized by the stereotyped "Age of Invertebrates," "Age of Fishes," "Age of Amphibians," "Age of Reptiles," "Age of Mammals," and "Age of Man." The fact is that such a sequence does not follow a single or a wholly objective criterion. It is not based solely, or even in the main, on the objective facts of dominance in the history of life. Two other criteria have been sneaked in: that of ancestral and descendant relationship, which is an objective and general criterion but an entirely different matter from dominance, and that of approximation to man, which also has nothing to do with the facts of dominance and which, although perfectly all right as long as we know what we are doing and do not think we are following a general and objective criterion, is specific to a single point of reference and subjective to that point, i.e., man.

The criterion of dominance is not invalidated by the fact that it does not yield a single sequence for progress in evo-

lution. That there is or should be a single sequence was a fallacy of the pre-evolutionary perfecting principle idea and this can be a required condition of progress only when progress is defined with reference to a point and not as a general principle. Of course even as a general principle it *might* have been found that progress was a one-line affair, and should be if there were anything in most vitalist or finalist contentions, but as a matter of fact this does not turn out to be the case with the criterion of dominance or, as will be found, with any other criterion *except* that of approximation to some specific type such as man.

The various different lines of progress that are involved in successive dominance are defined by adaptive types or corresponding ways of life. Thus there is broadly one for aquatic vertebrates and broadly another, quite distinct from this, for terrestrial vertebrates, with bony fishes at the top in the former and mammals simultaneously at the top in the latter. Within each of these groups there are other, more closely circumscribed ways of life and corresponding lines of dominance and of progress (in this sense) for each of these. Among the bony fishes, there are separate lines for marine and freshwater fishes, for shallow and deep sea fishes, and so on.

In relationship to man, not taking him as point of reference but adhering to strict dominance as objective criterion, we find that he is a member of a progressive group, and generally of the most progressive, in each of the various dominance sequences in which he can properly be placed. (His dominance cannot be compared with that of molluscs or insects, for instance, because the ways of life and corresponding dominance sequences are grossly different.) A major category might be that of self-propelled, unattached organisms of medium to large size: vertebrates are dominant here; man is a vertebrate. Among these, terrestrial forms subdivide the major way of life: mammals