

By the Same Author

ESSAYS IN POPULAR SCIENCE

THE INDIVIDUAL IN THE ANIMAL KINGDOM

ESSAYS OF A BIOLOGIST

THE STREAM OF LIFE

RELIGION WITHOUT REVELATION

BIRD WATCHING AND BIRD BEHAVIOR

AFRICA VIEW

WHAT DARE I THINK?

SCIENCE AND SOCIAL NEEDS

PROBLEMS OF RELATIVE GROWTH

THE CAPTIVE SHREW AND OTHER POEMS

IF I WERE DICTATOR

T. H. HUXLEY'S DIARY ON THE RATTLESNAKE

AT THE ZOO

THE LIVING THOUGHTS OF DARWIN

THE NEW SYSTEMATICS

MAN STANDS ALONE

DEMOCRACY MARCHES

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THE SCIENCE OF LIFE with H. G. and G. P. Wells

SIMPLE SCIENCE with E. N. DaC. Andrade

MORE SIMPLE SCIENCE with E. N. DaC. Andrade

THE ELEMENTS OF EXPERIMENTAL EMBRYOLOGY with G. R. de Beer

WE EUROPEANS with A. C. Haddon

EVOLUTION

The Modern Synthesis

by

JULIAN HUXLEY, M.A., D.SC., F.R.S.



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ERRATA

- Page 28, last line but 4: after "line" add asterisk.
 At bottom of page add footnote: "(asterisk) It should be added that Hogg was in 1931 concerned to stress mutation pressure as an agency of change then a new and not generally accepted conception. Since then he has allowed much more weight to the joint role of selection and mutation in producing adaptive change (see Hoggben 1940)."
- Page 38, line 9: For "Chap. 7" read "Chap. 9"
- Page 197, last line but 2: For "Weight" read "Wright"
- Page 213, line 22: For "increasing" read "decreasing"
- Page 239, line 3: For "*Noyrca*" read "*Nyroca*"
- Page 273, line 28-9: For "a lower temperature than" read "a lower metabolic than"
- Page 314, line 10: For "tetraploid" read "triploid"
- Page 315, line 31-3: For "(Finn, 1937: an incomplete reference for whose completion I should be grateful" read "(Finn, J. B., 1937, J. Hered. 28: 373)"
- Page 338, line 27: For "autopolyploidy" read "polyploidy"
- Page 345, line 14-16: For "Emmer . . . *Aegilops*." substitute "Allopolyploid appears to have occurred twice, once with an unknown form providing the B-genome, and subsequently with an *Aegilops*-like form introducing the D-genome."
- Page 381, bottom: Add new para.:
 "Postscript. Since first printing, E. Mayr has published his valuable *Systematics and the Origin of Species* (New York 1942) reference must be made to important conclusion that, in higher animals at least, with the exception of 'biological' differentiation (my p. 295), the only factor permitting group divergence is geographical isolation; neither ecological nor genetic isolation ever primary. I am bound to say that Mayr has convinced me on this point."
- Page 390, line 12: For "simplify" read "amplify"
- Page 427, line 20: Add "See Huxley & Bond, 1942, Proc. Zool. Soc. (A): 3: 2"
- Page 469, table at bottom of page: For "protected" read "unprotected"
 For "unprotected" read "protected"
- Page 475, line 17: After "selection" add "Though both have now adopted a more selectionist standpoint, these past views must be refuted as anti-selectionists still often cite them."
- Page 480, line 8: For "unisselective" read "unit-selective"
- Page 480, line 12: For "multiselective" read "group-selective"
- Page 492, line 11 from bottom: For "this" read "the"
- Page 497, line 7: For "habitat" read "habit"
- Page 536, line 10-12: For "is considerably . . . anticipated" read "for the most primitive genera is 1.8; thus in modern (hypsodont) horses, lengthening the face has been anticipated."
- Page 540, line 7: Insert "lower" before "jaw"
- Page 540, line 10: For "skull" read "snout"
- Page 586: For "Esuck" read "Eslick"
- Page 604, (reference to Reeve and Murray): For "(1941)" read "(1942)" and for Nature 148 read Nature 150.
- Page 630: "*Lymantria dispar*": For "463" read "436"
- Page 643: For "Poulten" read "Poulton"

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CHAPTER 10

EVOLUTIONARY PROGRESS

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I. IS EVOLUTIONARY PROGRESS A SCIENTIFIC CONCEPT?

The question of evolutionary or biological progress remains. There still exists a very great deal of confusion among biologists on the subject. Indeed the confusion appears to be greater among professional biologists than among laymen. This is probably due to the common human failing of not seeing the wood for the trees; there are so many more trees for the professional!*

The chief objections that have been made to employing *progress* at all as a biological term, and to the use of its correlates *higher* and *lower* as applied to groups of organisms, are as follows. First, it is objected that a bacillus, a jellyfish, or a tapeworm is as well adapted to its environment as a bird, an ant, or a man, and that therefore it is incorrect to speak of the latter as higher than the former, and illogical to speak of the processes leading to their production as involving progress. An even simpler objection is to use mere survival as criterion of biological value, instead of adaptation. Man survives: but so does the tubercle bacillus. So why call man the higher organism of the two?

A somewhat similar argument points to the fact that evolution, both in the fossil record and indirectly, shows as numerous examples of specialization leading to increased efficiency of adaptation to this or that mode of life; but that many of such

* For a fuller discussion of certain aspects of the problem see Huxley, 1923a, 1936, 1940; Wells, Huxley and Wells, 1930, Book 5, chap. 6, § 5.

specialized lines become extinct, while most of the remainder reach an equilibrium and show no further change.

This type of objection, then, points to certain fundamental attributes of living things or their evolution, uses them as definitions of progress, and then denies that progress exists because they are found in all kinds of organisms, and not only in those that the believers in the existence of progress would call progressive.

A slightly less uncompromising attitude is taken up by those who admit that there has been an increase of complexity or an increase in degree of organization, but deny that this has any value, biological or otherwise, and accordingly refuse to dignify this trend by a term such as progress, with all its implications.

Some sociologists, faced with the problem of reconciling the objective criteria of the physical sciences with the value criteria with which the sociological data confronts them, take refuge in the ostrich-like attitude of refusing to recognize any scale of values. Thus Doob in a recent book (1940) writes:

"In this way, the anthropologist has attempted to remove the idea of progress from his discipline. For him, there is just change, or perhaps a tendency towards increasing complexity. Neither change nor complexity is good or bad; there are differences in degree, not in quality or virtue. . . . The sweep of historical progress reveals no progressive trend. . . ."

By introducing certain objective criteria into our definition of progress, as we do in the succeeding section, this objection can be overcome, at least for pre-human evolution. In regard to human evolution, however, as we shall see in the concluding section of this chapter, the nettle must be grasped, and human values given a place among the criteria of human progress.

The second main type of objection consists in showing that many processes of evolution are not progressive in any possible sense of the word, and then drawing the conclusion that progress does not exist. For instance, many forms of life, of which the brachiopod *Lingula* is the best-known example, have demonstrably remained unchanged for enormous periods of several hundreds of millions of years; if a Law of Progress exists, the

objectors argue, how is it that such organisms are exempt from its operations?

A variant of this objection is to draw attention to the numerous cases where evolution has led to degeneration involving a degradation of form and function, as in tapeworms, *Sacculina* and other parasites, in sea-squirts and other sedentary forms: how, it is asked, can the evolutionary process be regarded as progressive if it produces degeneration?

This category of objections can be readily disposed of. Objectors of this type have been guilty of setting up an Aunt Sally of their own creation for the pleasure of knocking her down. They have assumed that progress must be universal and compulsory: when they find, quite correctly, that universal and compulsory progress does not exist, they state that they have proved that progress does not exist. This, however, is an elementary fallacy. The task before the biologist is not to define progress *a priori*, but to proceed inductively to see whether he can or cannot find evidence of a process which can legitimately be called progressive. It may just as well prove to be partial as universal. Indeed, human experience would encourage search along those lines; the fact that man's progress in mechanical arts, for instance, in one part of the world is accompanied by complete stagnation or even retrogression in other parts, is a familiar fact. Thus evolution may perfectly well include progress without being progressive as a whole.

The first category of objections, when considered closely, is seen to rest upon a similar fallacy. Here again an Aunt Sally has been set up. Progress is first defined in terms of certain properties: and then the distribution of those properties among organisms is shown not to be progressive.

These procedures would be laughable, if they were not lamentable in arguing a lack of training in logical thought and scientific procedure among biologists. Once more, the elementary fact must be stressed that the only correct method of approach to the problem is an inductive one. Even the hardened opponents of the idea of biological progress find it difficult to avoid speaking of higher and lower organisms, though they may salve their

consciences by putting the words between inverted commas. The unprejudiced observer will accordingly begin by examining various types of "so-called higher" organisms and trying to discover what characters they possess in common by which they differ from "lower" organisms. He will then proceed to examine the course of evolution as recorded in fossils and deduced from indirect evidence, to see what the main types of evolutionary change have been; whether some of them have consistently led to the development of characters diagnostic of "higher" forms; which types of change have been most successful in producing new groups, dominant forms, and so forth. If evolutionary progress exists, he will by this means discover its factual basis, and this will enable him to give an objective definition.

2. THE DEFINITION OF EVOLUTIONARY PROGRESS

Proceeding on these lines, we can immediately rule out certain characters of organisms and their evolution from any definition of biological progress. Adaptation and survival, for instance, are universal, and are found just as much in "lower" as in "higher" forms: indeed, many higher types have become extinct while lower ones have survived. Complexity of organization or of life-cycle cannot be ruled out so simply. High types are on the whole more complex than low. But many obviously low organisms exhibit remarkable complexities, and, what is more cogent, many very complex types have become extinct or have speedily come to an evolutionary dead end.

Perhaps the most salient fact in the evolutionary history of life is the succession of what the paleontologist calls dominant types.* These are characterized not only by a high degree of complexity for the epoch in which they lived, but by a capacity for branching out into a multiplicity of forms. This radiation seems always to be accompanied by the partial or even total extinction of competing main types, and doubtless the one fact is in large part directly correlated with the other.

In the early Paleozoic the primitive relatives of the Crustacea

* For fuller summary, see Wells, Huxley, and Wells (1930), Book 5.

increases of aesthetic, intellectual, and spiritual experience and satisfaction.

Of course, increase of control and of independence is necessary for the increase of these spiritual satisfactions; but the more or less measurable and objective control over and independence of external environment are now merely subsidiary mechanisms serving as the material basis for the human type of progress; and the really significant control and independence apply to man's mental states—his control of ideas to give intellectual satisfaction, of form and colour or of sound to give aesthetic satisfaction, his independence of inessential stimuli and ideas to give the satisfaction of mystic detachment and inner ecstasy.

The ordinary man, or at least the ordinary poet, philosopher, and theologian, is always asking himself what is the purpose of human life, and is anxious to discover some extraneous purpose to which he and humanity may conform. Some find such a purpose exhibited directly in revealed religion; others think that they can uncover it from the facts of nature. One of the commonest methods of this form of natural religion is to point to evolution as manifesting such a purpose. The history of life, it is asserted, manifests guidance on the part of some external power; and the usual deduction is that we can safely trust that same power for further guidance in the future.

I believe this reasoning to be wholly false. The purpose manifested in evolution, whether in adaptation, specialization, or biological progress, is only an apparent purpose. It is just as much a product of blind forces as is the falling of a stone to earth or the ebb and flow of the tides. It is we who have read purpose into evolution, as earlier men projected will and emotion into inorganic phenomena like storm or earthquake. If we wish to work towards a purpose for the future of man, we must formulate that purpose ourselves. Purposes in life are made, not found.

But if we cannot discover a purpose in evolution, we can discern a direction—the line of evolutionary progress. And this past direction can serve as a guide in formulating our purpose for the future. Increase of control, increase of independence, increase of internal co-ordination; increase of knowledge, of

means for co-ordinating knowledge, of elaborateness and intensity of feeling—those are trends of the most general order. If we do not continue them in the future, we cannot hope that we are in the main line of evolutionary progress any more than could a sea-urchin or a tapeworm.

As further advice to be gleaned from evolution there is the fact we have just discussed, that each major step in progress necessitates scrapping some of the achievements of previous advances. But this warning remains as general as the positive guidance. The precise formulation of human purpose cannot be decided on the basis of the past. Each step in evolutionary progress has brought new problems, which have had to be solved on their own merits; and with the new predominance of mind that has come with man, life finds its new problems even more unfamiliar than usual. This last step marks a critical point in evolution, and has brought life into situations that differ in quality from those to which it was earlier accustomed.

The future of progressive evolution is the future of man. The future of man, if it is to be progress and not merely a standstill or a degeneration, must be guided by a deliberate purpose. And this human purpose can only be formulated in terms of the new attributes achieved by life in becoming human. Man, as we have stressed, is in many respects unique among animals: his purpose must take account of his unique features as well as of those he shares with other life.

Human purpose and the progress based upon it must accordingly be formulated in terms of human values; but it must also take account of human needs and limitations, whether these be of a biological order, such as our dietary requirements or our mode of reproduction, or of a human order, such as our intellectual limitations or our inevitable subjection to emotional conflict.

Obviously the formulation of an agreed purpose for man as a whole will not be easy. There have been many attempts already. To-day we are experiencing the struggle between two opposed

* For a full analysis of the biological peculiarities of our species see Huxley, 1940.

ideals—that of the subordination of the individual to the community, and that of his intrinsic superiority. Another struggle still in progress is between the idea of a purpose directed to a future life in a supernatural world, and one directed to progress in this existing world. Until such major conflicts are resolved, humanity can have no single major purpose, and progress can be but fitful and slow. Before progress can begin to be rapid, man must cease being afraid of his uniqueness, and must not continue to put off the responsibilities that are really his on to the shoulders of mythical gods or metaphysical absolutes (see Everett, 1932).

But let us not forget that it is possible for progress to be achieved. After the disillusionment of the early twentieth century it has become as fashionable to deny the existence of progress and to brand the idea of it as a human illusion, as it was fashionable in the optimism of the nineteenth century to proclaim not only its existence but its inevitability. The truth is between the two extremes. Progress is a major fact of past evolution; but it is limited to a few selected stocks. It may continue in the future, but it is not inevitable; man, by now become the trustee of evolution, must work and plan if he is to achieve further progress for himself and so for life.

This limited and contingent progress is very different from the *deus ex machina* of nineteenth-century thought, and our optimism may well be tempered by reflection on the difficulties to be overcome. None the less, the demonstration of the existence of a general trend which can legitimately be called progress, and the definition of its limitations, will remain as a fundamental contribution of evolutionary biology to human thought.

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