Faith and Thought

A Journal devoted to the study of the inter-relation
of the Christian revelation and modern research

Vol. 90 Number 3 Winter 1958

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The Concepts of Randomness and Progress in Evolution

A survey of the history of biological thought reveals that certain philosophical ideas, found in current literature on evolution, have been derived from classical Greek philosophy rather than biological theory. These ideas are (1) the metaphysical notion that the randomness of evolution is incompatible with a creatorial plan or purpose, and (2) the ethical notion that evolution manifests some sort of progress.

These two ideas are discussed in relation to pre-human evolution, and it is argued that the first results from a failure to differentiate between two distinct concepts of randomness, physical and metaphysical; while the second results from the unwarranted imputation of values to objective biological features.

Human social history is then discussed; and it is concluded that no grounds exist, in the facts of evolution, either for predicting future progress, or for determining ethical principles to ensure it.

Thus evolution is considered to be metaphysically and ethically neutral.

Introduction

The theory of evolution is a typical scientific theory, in that its postulates are, in principle, open to test by empirical methods. But it has gained a number of accretions which cannot be tested empirically, and which must, therefore, be regarded as philosophical rather than scientific.

These philosophical concepts and theories are very frequently incorporated into the scientific writings (both technical and popular) of some who are undoubted authorities on the scientific theories of organic and psycho-social evolution. This may be both valuable and dangerous: valuable, because it serves to stimulate thought and discussion amongst professional scientists and philosophers; dangerous, because it misleads students and laymen into believing that the particular philosophical view of the writer is logically implied by the scientific evidence. The danger could, of course, be very largely avoided if the writer were to make it clear when he is stepping across the boundary between scientific and philosophical territory. Unfortunately the boundary is seldom indicated.

The importance of making this distinction between science and philosophy has been stressed in two papers previously delivered to the

Victoria Institute. In one, Barclay [1] discussed the many meanings of the word 'Evolution', and made the plea that the word should, in the interests of clear thinking, be limited to a scientific connotation, and divorced from its philosophical overtones. In the other, I [2] surveyed the logical apparatus that characterised the scientific method, and distinguished it from philosophy; and urged the importance of differentiating between scientific and philosophical concepts in the communication of scientific knowledge.

This paper may be regarded as a sequel to those two papers. Its object is not to discuss the truth of scientific theories of biological evolution (as generally accepted by the majority of biologists), but to demonstrate that, given their truth, certain arguments commonly found in current scientific literature do not follow. The arguments fail because they require various philosophical assumptions, which are usually not explicitly stated. The theories to which the arguments lead are, then, themselves philosophical: they cannot be verified by the scientific method, but must be tested against the philosophical and theological criteria of truth, viz., logical self-consistency, and consistency with revelation, respectively.

The History of the Concepts of Randomness and Progress in Evolution

In order to trace the origins of the concepts of randomness and progress in the history of life, one needs to go back as far as the ancient Greek philosophers.

One of the earliest, the Ionian philosopher, Anaximander (sixth century B.C.), pictured the universe as originating in a chaotic fusion of hot, cold, wet, and dry (the *apeiron*), which gradually resolved itself into an orderly arrangement of its separate elements, as seen in the *cosmos*.[3] He not only propounded a progressive cosmogony, but also postulated that life arose in warm mud in the sea, and later gave rise to terrestrial organisms, including man.[4]

The pluralist philosopher, Empedocles (fifth century B.C.), taught that the earliest organisms were formed by the random association of

[1] O. R. Barclay, 'The meanings of the word Evolution in biology and their bearing on the Christian faith', *J. Trans. Vict. Inst.*, **78** (1946), 91-101.

[2] G. E. Barnes, 'Philosophical principles in the teaching of science and religion', *J. Trans. Vict. Inst.*, **88** (1956), 79-98.

[3] W. K. C. Guthrie, *The Greek Philosophers* (Methuen, 1950).

[4] G. Sarton, *History of Science* (O.U.P., 1953).

organs, of both plants and animals, but only those adapted to their environment, and therefore able to survive and reproduce, had persisted. Thus there had been a progressive replacement of imperfect forms by perfect forms as a result of the selection of suitable random combinations.[1]

A younger contemporary of Empedocles was Democritus (fifth and fourth centuries B.C.), a materialist, and father of the atomic theory. To him, gross structure and change were merely the manifestations of the combination and movements of atoms, of infinite number and variety of shape. All things, including life and mind, were properties of particular changing configurations of atoms, and were therefore the effects of materialistic causes. If purpose, plan, or will existed, they were effects and not causes of matter. There was thus no mind at work in the universe, and natural events could be regarded, therefore, as neither intentional nor accidental, but just necessary.[2]

Although Aristotle (third century B.C.) held Democritus in very high esteem, his own teleological views, derived from Plato, prevented him from accepting the materialistic metaphysics of Democritus. Whereas the 'material cause' of Democritus was the adequate and only cause, Aristotle's 'material cause' represented merely a potentiality which could be actualised only by the operation of three other causes, the formal, the efficient, and the final causes. Thus Aristotle rejected the concept of purely materialistic causation.

Aristotle's doctrine of the four causes logically required a divine plan to which the whole universe conformed. He therefore rejected the concept of randomness, held by Empedocles. Furthermore, as the 'forms' of organisms were eternally constant, there could be no transition from one to another. So he also rejected the evolutionary ideas of his predecessors.[3] Nevertheless, he constructed a scale of life, along which he arranged natural 'forms' from the least to the most perfect. It included, in order, inanimate objects, plants, sponges, sea anemones, bloodless animals (i.e. invertebrates), fishes, birds, oviparous quadrupeds (i.e. reptiles), viviparous quadrupeds (i.e. mammals), monkeys, and men.[4]

[1] H. S. Williams, *A History of Science*, vol. I (Harper, 1904).

[2] W. T. Sedgwick and H. W. Tyler, *A Short History of Science* (Macmillan, 1919).

[3] M. Clagett, *Greek Science in Antiquity* (Abelard-Schuman, 1957).

[4] Aristotle, *De Partibus Animalium*, English translation by W. Ogle (O.U.P., 1912).

Aristotle's philosophy of nature proved not only popular in his own times, but also very congenial to later Christian thought, and it eventually became incorporated, with modifications, into the official Thomist philosophy of the Roman Catholic church. Thus it retained its position of influence for two thousand years.

In particular, Aristotle bequeathed to western culture (*a*) an antipathy to purely materialistic causation, (*b*) the idea that randomness is incompatible with a divine plan, (*c*) an opposition to evolutionary theories, and (*d*) the concept of a scale of values in organisms, the *scala naturae*.[1]

Of these four attitudes, the first succumbed to the Renaissance, with its overthrow of authority, and development of the experimental approach. The success of Galileo in astronomy, Harvey,[2] Borelli,[3] and Perrault [4] in biology, and Newton in physics, finally established the value of the mechanistic attitude to causation, while the philosophical writings of Leibniz [5] demonstrated the compatibility of this attitude with the theism of Christianity.

The third of the above attitudes, opposition to evolutionary theories, began to wane a century ago, after the publication in 1859 of Darwin's book, *The Origin of Species*. Ideas of organic evolution had, of course, been in the air for a century before this, but most scientists, as well as philosophers and theologians, had not accepted them. Darwin, however, presented, not only a vast array of evidence for the fact of evolution, but also a satisfactory mechanistic hypothesis for its cause; and most scientists were within a few years won over to the support of his theory. Today, evolutionary theories have little opposition.

The other two attitudes derived from Aristotle have persisted until the present day. The antithesis of randomness and plan, or purpose, has been repeatedly invoked by both sides in the evolution controversy. At first, it was the theologians and metaphysicians who used it to whip the scientists; now, more often, it is the scientists who use it against Christian theology. Carter [6] quotes Annan as saying: 'The real signifi-

[1] A. Rey, *L'Apogeé de la Science Technique Grecque*, livre iv (Michel, 1946).

[2] W. Harvey, *De Motu Cordis et Sanguinis*, 1628, English translation by R. Willis (Dent, 1923). [3] G. A. Borelli, *De Motu Animalium*, 1679.

[4] C. Perrault, *Essais de la Physique*, 1680.

[5] G. W. Leibniz, *Philosophical Writings of Leibniz*, English translation by M. Morris (Dent, 1934).

[6] G. S. Carter, *A Hundred Years of Evolution* (Sidgwick and Jackson, 1958), pp. 65-66.

cance of *The Origin of Species* lay in its apparent contradiction of orthodox metaphysics. Darwin introduced the idea that *chance* begets order. Fortuitous events, not planned or rational but fortuitous, result in a physical law; the process of natural selection achieved by minute accidental variations in the species, breaks the principle of internal determinism. . . . *The Origin of Species* made the world seem less, not more, rational, and the universe a creation of blind chance, not a " block-world" (in William James's phrase) created by an other-worldly Master Mind.'[1] Simpson provides a modern example of this antithesis, when he writes : 'Man is the result of a purposeless and materialistic process that did not have him in mind. He was not planned.'[2]

The fourth of the above Aristotelian ideas, that of a scale of values, when combined with transmutationist[3] theories, gave rise to the concept of progress. There was no scientific evidence for believing that the evolutionary changes postulated were always from 'lower' to 'higher' forms, but what science could not supply speculative theology did. Bonnet (1720-93) was probably the earliest writer to make much of the idea of biological progress; and of him Nordenskiöld writes: 'One idea that occupies his mind . . . is the thought of the progressive development going on in nature. His firm conviction as to the wisdom of the Creator has made of him an incorrigible optimist; he is absolutely convinced that nature is advancing towards a high goal.'[4] Thus the *scala naturae* of Aristotle, a series of static forms, developed into Bonnet's *échelle des êtres naturels*, a dynamic series progressive with time.

Bonnet, of course, had no idea of a continuous evolutionary development—he was a catastrophist—and it was left to Lamarck (1744-1829), who quoted Bonnet,[5] to wed the concept of the *échelle des êtres* to that of a continuous and gradual evolution of organisms. The latter still conceived of evolution as following a single line (represented by the *échelle*), and it has been said that 'this unfortunate mistake was largely responsible for the rejection of Lamarck's whole theory'[6] of evolution.

[1] N. G. Annan, *Leslie Stephen* (1951).

[2] G. G. Simpson, *The Meaning of Evolution* (O.U.P., 1950), p. 334.

[3] Transmutationist, as defined by R. Hooykaas, 'The principle of uniformity in geology, biology, and theology', *J. Trans. Vict. Inst.*, **88** (1956), 105.

[4] E. Nordenskiöld, *The History of Biology* (Tudor Publishing Co., 1927).

[5] J. B. P. A. de M. de Lamarck, *Recherches sur l'Organisation des Corps Vivants*, 1802.

[6] T. Dobzhansky, *Evolution, Genetics, and Man* (Wiley, 1955).

At the end of Lamarck's life, Comte (1798-1857) was beginning to make known his *philosophie positive* [1] in which he developed the idea of 'social dynamics', a progressive evolution of human social systems. Comte's sociology laid the foundation of nineteenth-century liberalism, associated particularly with the names of Bentham, Buckle, J. S. Mill, and Spencer, all practical social reformers, so that the idea of progress ceased to be just an interesting speculation of the philosophers, and became a live and influential ideology amongst educated people. So the idea of progress was very much in the wind when Darwin's *Origin of Species* was published.

Darwin's work not only made the theory of evolution scientifically tenable, but it also provided the contemporary philosophy of progress with an apparent basis in scientific fact. In the theory of organic evolution, starting with the 'lowest' forms and leading to man, Herbert Spencer (1820-1903) saw a historical process which, by extrapolation, promised continuous human progress in the future. In Darwin's theory of natural selection he found, furthermore, a mechanistic explanation of biological progress. As a result of the 'survival of the fittest' (Spencer's own phrase), progress was not only possible but also inevitable. 'Progress', he declared, 'is not an accident, but a necessity'.[2] It was also universal, operating throughout the cosmic, organic, and social spheres. 'The law of organic progress', he wrote, 'is the law of all progress. Whether it be in the development of the Earth, in the development of Life upon its surface, in the development of Society, of Government, of Manufacture, of Commerce, of Language, Literature, Science, Art, this same evolution of the simple into the complex through successive differentiations holds throughout. From the earliest traceable cosmical changes down to the latest results of civilization, we shall find that the transformation of the homogeneous into the heterogeneous is that in which progress essentially consists.' [3] Thus, with Spencer, the idea of progress reached its zenith.

Since his time, the concept has been repeatedly attacked by both philosophers and scientists, and no biologist today could hold the naïve view that Spencer held of the inevitability and universality of progress. Nevertheless, the concept still persists, in various forms, in the works of contemporary biologists. Sometimes it is presented

[1] I. A. M. F. X. Comte, *Cours de Philosophie Positive* (Paris, 1830-42).
[2] H. Spencer, *Social Statics*, revised edn. 1892, p. 30.
[3] H. Spencer, *Progress, Its Law and Cause*, Essays, vol. 1, p. 10.

rather cautiously as a tentative interpretation of evolutionary history:[1] at other times it is stated as an objective fact, with ethical implications.[2] Sir Julian Huxley would even have us make it the basis of a new religion, Evolutionary Humanism.[3]

This has been a very rapid survey of two and a half millennia of biological thought; but I think sufficient has been said to show that two ideas, current in modern biological literature, (*a*) that the random features of evolution are incompatible with plan or purpose, and (*b*) that, despite this, organic evolution exhibits progress, have been derived historically, not from science, but from philosophical speculation. This, of course, does not necessarily invalidate them—other philosophical theories (e.g. the atomic theory) have later become incorporated as scientific truth—but it should cause us to enquire whether they are valid inductions from objective facts, and therefore justifiably included in scientific theory, or merely philosophical interpretations in terms of inadequate thought-forms of the past. It is to this enquiry that I now turn.

Randomness in Evolution

The word 'randomness' has two distinct connotations, a popular one and a technical scientific one. The former denies the *existence* of a plan; the latter denies the *appearance* of a plan: and it is important to differentiate between the two. They are logically independent.

Certain events may occur with such regularity that they look as if they are planned, and yet the circumstances may be such as to reveal to a knowledgeable observer that they are, in fact, unplanned. For example, a leaky joint in a piece of machinery may yield drips of oil just as regularly as the pistons of the machine turn a wheel. Yet the rotation of the wheel is planned, but the dripping of the oil obviously is not. On the other hand, things which appear to be unplanned may sometimes be discovered to be the result of design. There is, in fact, such a thing as planned randomness. A good example is afforded by some of Professor Graham Cannon's anatomical drawings. If one were to examine them with a hand lens, one would discover in certain areas a random distribution of ink dots. Yet Professor Cannon

[1] E.g. J. Z. Young, *The Life of Vertebrates* (O.U.P., 1950).

[2] E.g. J. S. Huxley, *Evolution, the Modern Synthesis* (Allen and Unwin, 1942); G. G. Simpson, *The Meaning of Evolution* (O.U.P., 1950).

[3] J. S. Huxley, *Evolution in Action* (Chatto and Windus, 1953), pp. 149–150.

has revealed [1] that he carefully places each dot in position so as to avoid all regularities, such as straight lines, that would break up the continuity of the area. So, whether events appear to be planned or unplanned is not, in itself, evidence for or against an actual plan.

Thus there are two types of randomness, for which two different types of evidence must be adduced. The popular concept can be arrived at only by some sort of metaphysical insight. Either one must know, from the circumstances, that there is no mind which could possibly plan or control, or else one must know that a potential controlling mind did not, in fact, do so. The latter knowledge could be gained in two ways: that mind could reveal that it played no part in the planning, or else one could discover that the objects or events under consideration did not conform with a plan which that mind has revealed as its own. But in either case there must be a self-revelation. So, before one can assert that certain events are random (in the popular sense), one must either be in a position to deny the existence of a planning mind or else have received a self-revelation of that mind. In both cases, the assertion will be a metaphysical one.

In contrast to this, the technical concept is based purely upon objective features. Thus, a series of events would be regarded as random if the study of a large number of them did not enable an observer to predict the characteristics of the next one.[2] Tossing a penny, for example, a thousand times would not enable an experimenter to predict which way the 1001st toss will fall—unless, of course, it happened to be a double-headed penny, which would remove the element of randomness entirely. The technical criterion of randomness is then a physical (i.e. objective) one, and it is without metaphysical implications. In fact, it would be very easy for a statistician to write down on paper a series of 'heads' and 'tails' in such an order that another statistician could not tell whether the series had been planned,

[1] H. G. Cannon, *A Method of Illustration for Zoological Papers* (Association of British Zoologists, 1936), pp. 14-16.

[2] D. Lack (*Evolutionary Theory and Christian Belief*, (Methuen, 1957) appears to use the word 'random' in contradistinction to either 'rigidly determined' (p. 67) or 'the result of natural laws' (p. 71). This seems to me a false antithesis. The series of letters, *otdwttwpnaddf*, is an objectively random series, yet it is rigidly determined by taking the first letters of successive paragraphs in a recent *Reader's Digest* article. Similarly, the successive flights of a repeatedly tossed coin produce random 'heads' and 'tails', yet they are the result of natural laws. Science assumes as a prerequisite working hypothesis that all observable phenomena are the results of natural laws; yet it still recognises randomness.

or was a record of a series of tosses. To distinguish, therefore, between the two types of randomness I shall subsequently refer to them as 'metaphysical' and 'physical' randomness, respectively.

A study of evolution reveals several physically random features, among both the causes and the course of descent with modification. Hurst has summarised the random factors in the mechanism of evolution, as follows: 'the course of creative evolution in living nature has been shaped and guided in the higher organisms by at least four different vital processes, all of which in their action are random variables, namely, Mutation, Transmutation, Sex, and Natural Selection. The random mutations of genes and the chance transmutations of chromosomes appear, on experimental evidence, to be caused by atomic or other disturbances due to short wave radiations and other causes, producing at random every possible kind of hereditary variation. The function of sex, in the higher organisms, serves to combine and recombine at random and to fix these mutations and transmutations in different individual organisms, while the constant action of natural selection determines their survival and consequently the progressive adaptation of the mutants and transmutants to the changing conditions of life. Natural selection, being contingent, is locally random in its action according to the particular conditions of environment which happen to be present during the fertile life of the surviving organism, whether it be a gene, a protist, a plant, or an animal. Of the four prime factors concerned with the processes of creative evolution, natural selection has been the final arbiter, and though locally random and contingent in its action it has inevitably made for general progress in creative evolution.'[1]

These physically random factors in the mechanism of evolution lead to physically random features in the course of evolution.[2] Natural selection by continually changing environments leads to many random lines of adaptive radiation. Of these, only very few persist so as to take part in a trend towards a new phylogenetic group. Similarly, trends are themselves physically random in that a knowledge of the trends of several related groups does not enable one to predict the trend of yet another related group: neither does a knowledge of the trend of one group over a certain period of time enable one to predict the trend of the same group during a subsequent period of time.

[1] C. C. Hurst, *The Mechanism of Creative Evolution*, 2nd edn. (C.U.P., 1933), pp. 328-329.

[2] G. G. Simpson, *The Meaning of Evolution* (O.U.P., 1950), chap. xi.

These are all examples of physical randomness, but are they in any way evidence of metaphysical randomness? The atheist, the pantheist, or the deist could regard them as such, but then metaphysical randomness is already implied anyway by his own metaphysical presuppositions; and the facts of the history of life are irrelevant. The theist could, too, if he had any grounds for believing that the facts of evolution are incompatible with the character and will of God. This has, in fact, often been the basis of argument of many who have denied that evolution could be the result of the activity of the God of the Bible. Several incompatibilities have been alleged, but they fall into two categories, very clearly indicated by J. B. S. Haldane. He writes: 'There are two objections to this hypothesis' (that evolution has been guided by divine power). 'Most lines of descent end in extinction, and commonly the end is reached by a number of different lines evolving in parallel. This does not suggest the work of an intelligent designer, still less of an almighty one. But the moral objection is perhaps more serious. A very large number of originally free-living crustacea, worms, and so on, have evolved into parasites. In so doing they have lost, to a greater or less extent, their legs, eyes, and brains, and have become in many cases the source of considerable and prolonged pain to other animals and to man. If we are going to take an ethical point of view at all (and we must do so when discussing theological questions), we are, I think, bound to place the loss of faculties coupled with increased affliction of suffering in the same class as moral breakdown in a human being, which can often be traced to genetical causes. To put the matter in a more concrete way, Blake expressed some doubt whether God had made the tiger. But the tiger is in many ways an admirable animal. We have to ask whether God made the tapeworm. And it is questionable whether an affirmative answer fits in either with what we know about the process of evolution or what many of us believe about the moral perfection of God.' [1]

Now it may well be that the extinction of most evolutionary lines, or the evolution of the tapeworm, does not fit in with what many of us believe about God. But then it is so easy for 'man to create God in his own image', to use Voltaire's expression. To the Christian theist, however, the test is not 'what many of us believe', but what God has revealed in the Bible; and before physical randomness in evolution can be used as evidence of metaphysical randomness it must be shown

[1] J. B. S. Haldane, *The Causes of Evolution* (Longmans, Green and Co., 1932), p. 159.

that the facts of evolutionary history are incompatible with the intelligence and moral perfection of the omnipotent God of that Book.

To discuss this adequately would require two further papers, one on the Biblical teaching of God's immanence in His creation, and the other on the two distinct problems of pain and moral evil. But a few brief points may be made here. Firstly, the God of the Bible is Master of physical randomness. 'The lot is cast into the lap; but the whole disposing thereof is of the Lord.'[1] The apostles 'prayed, and said, Thou, Lord, which knowest the hearts of all men, show whether of these two Thou hast chosen. . . . And they gave forth their lots; and the lot fell upon Matthias.'[2] Many random events recorded in Holy Writ are regarded as miracles only because they occurred at highly significant moments when they obviously subserved the Divine will. Secondly, God's wisdom is such that His plans and purposes are normally incomprehensible to man, so that if the facts of evolutionary history do 'not suggest the work of an intelligent designer, still less of an almighty one', the lack is on man's side and not God's. 'For my thoughts are not your thoughts, neither are your ways my ways, saith the Lord. For as the heavens are higher than the earth, so are my ways higher than your ways, and my thoughts than your thoughts.'[3] And the believer who has learned to appreciate God's plan, albeit in a very limited measure, can only exclaim 'O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are His judgments, and His ways past finding out!'[4] Thirdly, it may well be true, as Haldane suggests, that the consequences of parasitic infection fall into the same class as the consequences of human moral breakdown, but it is also true that the God of the Bible accepts responsibility Himself for just those same consequences;[5] and if He is responsible for human moral failure, I see no reason why He should not be responsible for the tapeworm's amoral activities. In fact, 'the noisome beast' and 'the pestilence' are two of God's 'four sore judgments' which he sends upon mankind.[6]

In conclusion, I would summarise this section, then, by saying that, although physical randomness is a very conspicuous feature of evolutionary history, this in itself is evidence neither for nor against a

[1] Proverbs xvi. 33.
[2] Acts i. 24-26.
[3] Isaiah lv. 8-9.
[4] Romans xi. 33.
[5] See, e.g. Exodus vii. 3, Judges ix. 23, 2 Samuel xxiv. 1 (cf. verse 10), Isaiah xlv. 7, and my comment, *J. Trans. Vict. Inst.*, 88 (1956), p. 183.
[6] Ezekiel xix. 21.

creatorial plan. Furthermore, although some random features in evolution are incompatible with some popular conceptions of divine activity, there appears to be no incompatibility between them and the activity of the God revealed in Scripture.

Progress in Evolution

The word 'progress' is commonly used in two different senses in the literature on evolution, sometimes, one suspects, without the writer's awareness of the difference. The word often means 'progression', or 'movement', or 'extent of change' (just as one might speak of the 'progress' of a chemical reaction), but to use it in this sense is merely to single out for description one aspect which is necessarily implied in the biological concept of evolution, viz. that it is a process in time. The word, on the other hand, may be used of a movement of a particular type; a change from a worse to a better condition, a progression from a lower to a higher form; in other words, some sort of improvement. This is a feature which is not necessarily implied in the biological concept of descent with modification, nor obvious in the history of the course of evolution; and we must enquire what justification there is for arguing from 'progression' to 'progress' (in this latter sense). A number of different answers have been given.

Herbert Spencer argued that, as natural selection ensured the survival of the fittest, the only trend that organic and social evolution could exhibit is one of gradual progress towards perfection.[1] He regarded human social progress as the extension of the Lamarckian *échelle des êtres*, so the total process acquired an ethical significance. In fact, he regarded evolution as synonymous with progress.

This view could result only from faulty logic and inadequate knowledge of biological facts. Firstly, his logic failed him in his deduction from the 'survival of the fittest'. If we ask, in this context, 'what are the fittest?', the only answer that can be given is 'those that survive'. So his phrase 'survival of the fittest' becomes a tautology, 'survival of the survivors', and tells us nothing about the nature of those survivors. Secondly, he had no appreciation of the many types of evolutionary change that had occurred, and he thought that increasing complexity (i.e. increasing heterogeneity and increasing coherence) and increasing adaptation to environment comprised them

[1] H. Spencer, *Autobiography*, vol. 2 (1904), summarises the argument.

all. But, as T. H. Huxley [1] pointed out, the multiformity of evolutionary change is such that it would be impossible to find any one feature that was common to all evolutionary lines, and which could be regarded as the criterion of progress. If there has been increasing complexity in some groups, there has also been simplification in others; if there has been adaptive change, there has also been age-long stability; indeed almost every conceivable type of change has taken place, and no one today could identify evolution with progress, as did Spencer.

But, if evolution is not inevitably and universally progressive, are there any general trends, or even intra-phyletic trends manifest here and there, which may be regarded as progressive? Simpson [2] has surveyed the various affirmative answers that have been given to this question, and upon his survey I base the succeeding discussion.

There appears to be only one general trend that could be regarded as progressive. That is, to quote Simpson, '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 been points where it has 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. It involves all three, and increase in any one is an aspect of progress in this broadest sense.' [3]

Although this statement begs two very interesting questions,[4] firstly as to what is a 'livable environment', and secondly as to what it means to 'fill' the available spaces in that environment, it is nevertheless a fair statement of this general trend in evolution. If, however, one applies this criterion of expansion to individual phyletic groups (as distinct from life as a whole), one finds that progress has been very variable in the past, although man at the present time is a very progressive animal. But is expansion a valid criterion of progress? Is it

[1] T. H. Huxley, *Evolution and Ethics*, Romanes Lecture, 1893. Essays, vol. ix: *Criticisms on the Origin of Species*, 1864; Essays, vol ii: Macmillan.

[2] G. G. Simpson, *The Meaning of Evolution* chap. 15.

[3] G. G. Simpson, *The Meaning of Evolution*, pp. 243–244.

[4] One cannot say whether an environment is inhabitable until something inhabits it. Similarly, one cannot say whether an environment is fully occupied until it gains more occupants.

better to belong to a species or group which is numerous, or has a high rate of metabolism, than to one which is rare or metabolises slowly? If it is, then a few species of soil bacteria must be, by far, the best organisms in existence, for they are exceedingly numerous and are responsible for as much metabolic turnover as all the rest of the animals and plants put together. They thus satisfy two of Simpson's three criteria of expansion, and therefore ought to be highly progressive organisms. But I think a few moments' reflection will reveal that there is no scientific reason for regarding expansion as a good thing—it is ethically neutral.

Sir Julian Huxley has made much of the sequence of dominant groups as a means of establishing the concept of biological progress. His arguments have been presented in a large number of books, essays, and articles, both scientific and popular, over a period of many years.[1] He points out that the palaeontological record shows that there has been a succession of groups which biologists would agree were dominant. It is not easy to define 'dominant groups', but Simpson says that they are 'much more varied and abundant than others' at the time, while Huxley adds that they are characterised 'by a high degree of complexity for the epoch in which they lived'. Now if we compare dominant with non-dominant groups, or later dominant groups with earlier ones, we should find in both cases, Huxley argues, that the former show improvements over the latter, and these could be taken as criteria of progress. He says, 'the distinguishing characteristics of dominant groups all fall into one or other of two types—those making for greater control over the environment and those making for greater independence of changes in the environment. Thus advance in these respects may provisionally be taken as the criterion of biological progress.'[2]

In illustration of his argument, Huxley quotes the dominance sequence: trilobites, eurypterids, ostracoderms, placoderms, fishes, amphibians, reptiles, and, simultaneously, birds and mammals. In so doing, he is being highly selective, and, as Simpson points out, is bringing in other criteria, which are not wholly objective, in addition to that of dominance. To be completely objective one would have to include protozoa, molluscs, insects and teleost fishes, as well as birds and mammals, in the category of present-day dominant groups.

[1] E.g. J. S. Huxley, *Progress, Biological and Other*, in *Essays of a Biologist* (1923); *Evolution, the Modern Synthesis*, chap. 10.

[2] J. S. Huxley, *Evolution, the Modern Synthesis*, p. 562.

But even if one agrees to the use of selection (upon valid principles, of course), so as to produce a convincing dominance sequence, one must still raise a much more fundamental problem, and that is the validity of using dominance as a criterion of progress. To put the problem in the form of a question, why is it better to belong to a dominant group rather than to a non-dominant one, or to a later dominant group than an earlier one? I suggest that science provides no answer.

Several other criteria of progress have been postulated from time to time, and to deal with them all would extend this paper beyond reasonable limits, but I will briefly mention those which Simpson regards as having some validity and usefulness. They are (*a*) the successive development of new modes of life, (*b*) successive replacement of types within a given ecological niche, (*c*) improvement in adaptation, or increasing biological efficiency, in a given environment, (*d*) increasing adaptability, and (*e*) increasing control over the environment. These all require for their validation some sort of value judment, for which there is no scientific justification. Criterion (*a*) assumes that it is better to follow a newer mode of life than an older one, (*b*) assumes that it is better to be a later occupant of an ecological niche than an earlier one. It is often argued that replacement of one type by another is evidence of the greater efficiency of the newcomer. This is not necessarily true, but if it were the case, it would lead to criterion (*c*). This raises the difficult problem of the assessment of biological efficiency, which presumably would have to be based upon such data as numbers, length of life, or metabolic rate, of individual organisms; and these, in turn, suggest further value judgments, e.g. that it is better for an organism to be one of many rather than one of a few, or that it is better to live for a longer than for a shorter while. Adaptability, involved in criterion (*d*), is of no value to an organism in a constant environment, but, should the environment change, it may permit survival which would otherwise be impossible. So criterion (*d*) assumes that survival of a group or individual is better than extinction. Lastly, criterion (*e*) is quite obviously ethically neutral. Control over the environment is of ethical significance only in relation to the use to which it is put. So unless one is prepared to see moral significance in animal behaviour, this also fails as a criterion of progress. Now we may feel very much in sympathy with some of the above value judgments, particularly when they are applied to human life, but that does not alter the fact that they are not scientifically determined.

I therefore conclude that the concept of progress is not a valid scientific induction from the facts of evolutionary history.

Huxley writes, 'It is, curiously enough, among the professional biologists that objectors to the notion of biological progress and to its corollary, the distinction of higher and lower forms of life, have chiefly been found. I say curiously enough, and yet to a dispassionate observer it is perhaps not so curious, but only one further instance of that common human failing, the inability to see woods because of the trees that compose them.'[1] There is another explanation, I suggest. May it not be that the professional biologist is more aware than the layman of the limitations of his own science?

Philosophers, of course, are agreed, and have repeatedly asserted, that ethical values cannot logically be derived from the objective data, or inductive inferences, of science; and, if they are right, the concept of biological progress is non-scientific. The foregoing arguments, then, merely exemplify this philosophical principle, but I think they still need stating in detail, when eminent biologists teach, as scientific facts, concepts which have no more scientific justification than had the older *scala naturae*, from which, historically, they have been derived.

Randomness and Progress in Human Evolution

By extrapolation from the past into the future, attempts have been made, either to predict progress in the human race, or to lay down principles of conduct for ensuring it. The former is now a matter of past history; the latter a current intellectual exercise.

Spencer was, as has been mentioned, the major prophet of the inevitability of progress. In his view, man, as a species, would always continue to rise, despite anything that individual men or societies might do. Progress, he wrote, 'is not a thing within human control, but a beneficent necessity'.[2] Although he held this view before the publication of Darwin's *Origin of Species*—so it was not a deduction from the theory of natural selection—he nevertheless regarded that theory as affording valuable biological support for his view. Human social evolution was merely the extension of animal evolution.

[1] J. S. Huxley, *Progress, Biological and Other*, in *Essays of a Biologist* (Pelican Books), p. 22.

[2] H. Spencer, *Progress, Its Law and Cause*, Essays, vol. 1.

His prediction of human progress, however, falls down for two reasons: firstly, because trends in animal evolution have been random, so that it is impossible to predict the future of any given group; and, secondly, because, even if progress had been a universal feature in the past, the mechanisms now operating most effectively in human social change are completely new ones, which, because of their speed, relegate the older factors to relative insignificance. T. H. Huxley realised this, when he said the oft-quoted words, 'ethical progress of society depends not on imitating the cosmic process, still less in running away from it, but in combating it'.[1] He probably over-stated his case in uttering these words (inasmuch as it may be argued that human ethics are themselves a late product of evolution), but I think none today would deny that those characters which ensured the survival of animals in the past are very different from those which are influencing human societies today. It is therefore impossible to predict human progress by extrapolation from the facts of animal evolution.

With the advent of man, a new type of evolution has commenced. This psycho-social evolution, to use Huxley's phrase,[2] depends upon the acquisition and communication of knowledge and skills, and it is so rapid a process that it has virtually superseded organic evolution in human history. So it could be that the new mechanism of change did, in fact, produce only one sort of trend, or alternatively one major trend; and if this had been maintained for sufficiently long, there would have been grounds for predicting the human future. I have, however, now moved into the province of the anthropologist, the archaeologist, and the historian, and here I am not qualified to judge; but I hazard the guess, from what little I know of the way in which civilisations have arisen and declined at different times and in different ethnic groups, that randomness is just as marked a feature in human history as it is in biological history.

This is not to deny the obvious fact that there has been a great increase in knowledge and its application (technology), particularly in the last three or four centuries, when it has become a major trend. Although this could be described as 'technological progress', it is progress only in the non-ethical sense of increase or development. In itself it is of no ethical value; only the purpose to which it is put

[1] T. H. Huxley, *Evolution and Ethics*, Romanes Lecture, 1893.

[2] J. S. Huxley, *The Emergence of Darwinism*, Darwin-Wallace Commemoration Lecture, 1958 (J. Linn. Soc., 1958, 1).

determines whether it is progress; and human purposes appear to be as random as human history.

Now if technological progress is to be transmuted into ethical progress, it is necessary that human purposes should cease to be random, and should be directed into good channels. The determination of these good channels has traditionally been a task of religion and philosophy; but some present-day biologists of repute, notably Huxley, Simpson, and Waddington, apparently discontented with what they call 'intuitive ethics', have attempted to establish ethical principles upon a scientific foundation. Waddington, for example, argues that 'ethical judgments are statements of the same kind—having, as the logisticians would say, the same grammatical structure—as scientific statements'.[1] All three writers regard evolution as providing the necessary factual basis.

The various systems of 'evolutionary ethics' have been criticised by Lack,[2] and other criticisms of Waddington's arguments are to be found in the discussion in his own book.[3] Simpson,[4] too, criticises the systems of evolutionary ethics other than his own. So a few brief comments only must suffice here, in order to complete this survey of the concept of progress.

Huxley's ethics are well summarised in the following passage: 'When we look at evolution as a whole, we find, among the many directions which it has taken, one which is characterised by introducing the evolving world-stuff to progressively higher levels of organization and so to new possibilities of being, action, and experience. This direction has culminated in the attainment of a state where the world-stuff (now moulded into human shape) finds that it experiences some of the new possibilities as having value in and for themselves; and further that among these it assigns higher and lower degrees of value, the higher values being those which are more intrinsically or more permanently satisfying, or involve a greater degree of perfection. . . . We can say that this is the *most desirable* direction of evolution, and accordingly that our ethical standards must fit into its dynamic framework. In other words, it is ethically right to aim at whatever will promote the increasingly full realization of increasingly higher values.'[5]

[1] C. H. Waddington, *Science and Ethics* (Allen and Unwin, 1942), p. 10.

[2] D. Lack, *Evolutionary Theory and Christian Belief* (Methuen, 1957), chap. 9.

[3] Particularly relevant here is H. Dingle's contribution to the debate in *Science and Ethics*.

[4] G. G. Simpson, *The Meaning of Evolution*, chap. 18.

[5] J. S. Huxley, *Evolutionary Ethics*, Romanes Lecture, 1943, in T. H. and J. S. Huxley, *Evolution and Ethics*, 1893-1943 (Pilot Press Ltd., 1947).

This means, in simple language, that man must decide what possibilities of life are more perfect (thus begging one ethical question), or more satisfying (an emotional criterion); and then decide which of many evolutionary trends lead to these possibilities; and then, finding these trends most desirable (on what grounds? emotional?), decide to behave in a manner conducive to these trends. Surely it is not necessary at all to bring evolution into this ethic: the whole argument is a circuitous way of saying that man must decide what he likes, and act accordingly. Quite evidently, this is not a scientific argument.

Simpson, unlike Huxley, sees, not similarity, but contrast between pre-human and human evolution, with reference to ethical values. 'The old evolution', he writes, 'was and is essentially amoral.[1] The new evolution involves knowledge, including the knowledge of good and evil.'[2] So pre-human evolution is irrelevant to human ethics, which must therefore be based upon human evolution. Apart from this, his argument is similar in form to Huxley's. 'Man has risen', he says, 'not fallen. He can choose to develop his capacities as the highest animal and try to rise still farther, or he can choose otherwise. The choice is his responsibility, and his alone.'[3] This argument prompts a number of questions. Firstly, in what sense is man the highest animal? If he really means 'the highest animal', he is considering man in relation to pre-human evolution,[4] which he tells us in the same paragraph is amoral. But perhaps he means 'higher than the animals', because man alone knows good and evil; in which case he is making the *a priori* value judgment that it is better to know good and evil than to be amoral. Secondly, what does it mean for man to 'rise still farther'? How does he determine which direction of evolution is correctly described as 'rising', without making another *a priori* value judgment? Thirdly, what does it mean to speak of human 'responsibility', a word which he frequently uses without defining? 'Responsibility' surely implies an allegiance to some superordinate mind, code, or purpose; and yet in the same paragraph Simpson writes, 'Evolution

[1] It is difficult to reconcile this statement with his insistence on progress in animal evolution. He defines 'progress' as 'movement in a direction from (in some sense) worse to better, lower to higher, or imperfect to more nearly perfect' (op. cit. p. 241). To speak of worse and better implies a good, an ethical value.

[2] G. G. Simpson, *The Meaning of Evolution*, p. 311.

[3] G. G. Simpson, *The Meaning of Evolution*, p. 310.

[4] His argument earlier in his book (chap. 15) for regarding man as the highest animal is certainly based upon pre-human evolution.

has no purpose; man must supply this for himself'. So the essence of his argument is that man must decide in which direction he desires to develop, and then choose his behaviour accordingly. This is no more scientific, or based upon evolutionary fact, than Huxley's argument.

Lastly, Waddington repudiates any criteria external to the process of evolution, and maintains that that process itself affords the only possible ethic. He writes, 'we must accept the direction of evolution as good simply because it *is* good according to any realist definition of that concept. We defined ethical principles as actual psychological compulsions derived from the experience of the nature of society; we stated that the nature of society is such that, in general, it develops in a certain direction; then the ethical principles which mediate the motion in that direction are in fact those adopted by that society. Of course, the good is, as the anthropologists pointed out, different in different societies, and particular cultures which regress may be actuated by principles at variance with the cosmic process. But in the world as a whole, the real good cannot be other than that which has been effective, namely that which is exemplified in the course of evolution.'[1] So the function of science then, he argues, is 'the revelation of the nature, the character, and direction of the evolutionary process in the world as a whole, and the elucidation of the consequences, in relation to that direction, of various courses of human action'.[2]

One difficulty with Waddington's ethical principle is the problem of deciding just what is the 'direction of the evolutionary process in the world as a whole'. A further difficulty would be to demonstrate that the development of the Waddington type of ethics is a feature of that direction (it might well be a local and temporary aberration, like the regressive cultures that he mentions); and, until this is demonstrated, Waddington's system is logically self-destructive.

The various systems of evolutionary ethics are all concerned with *knowing* the good: there yet remains the problem of *choosing to do* the good. Until this problem is solved in the life of both individuals and society, I suggest that randomness of purpose will continue to be a very evident feature of human social development.

I conclude, therefore, that the theories of biological and psychosocial evolution offer no satisfactory grounds, either for the prediction of, or for the prescription for, human progress.

[1] C. H. Waddington, *Science and Ethics*, p. 18.
[2] C. H. Waddington, *Science and Ethics*, p. 19.

Conclusions

We have seen that physical randomness is a prominent feature of both the mechanism and direction of evolution, but also that this physical randomness is not, as some would argue, evidence of metaphysical randomness. It *is* possible to believe (on non-scientific grounds, of course) that evolution is the outworking of purpose.

Owing to natural selection, those random mutations which are of adaptive significance accumulate to produce adaptive trends. These trends cannot, on scientific grounds alone, be regarded as progressive. Nevertheless, Huxley and Simpson have given an ethical value to such objective features as increasing complexity, increasing independence of changing environments, etc., with the result that they see evolution as, in parts, a progressive process.

It is difficult to know how Huxley and Simpson derive their values. They could be reading into the evolutionary record their own human values, as J. B. S. Haldane asserts. 'We must remember', he says, 'that when we speak of progress in Evolution we are already leaving the relatively firm ground of scientific objectivity for the shifting morass of human values'.[1] But both Huxley [2] and Simpson [3] deny this.

Huxley, furthermore, writes: 'there was progress before man ever appeared on the earth, and its reality would have been in no way impaired even if he had never come into being.' [4] Now progress involves a value judgment, as both Huxley and Simpson admit. But values (other than the ultimate abstractions: goodness, truth, and beauty, of certain ethical systems; or the will of God, of various religions) cannot exist apart from purpose: a thing is good only if it subserves the purpose for which it is intended.[5] So the concept of progress logically leads to the concept of purpose in evolution. Yet

[1] J. B. S. Haldane, *The Causes of Evolution*, p. 154.

[2] J. S. Huxley, *Evolution, the Modern Synthesis*, pp. 565-566.

[3] G. G. Simpson, *The Meaning of Evolution*, p. 242.

[4] J. S. Huxley, *Progress, Biological and Other*, in *Essays of a Biologist* (Pelican Books), p. 43.

[5] I find it difficult to understand what Huxley means when he speaks of 'possibilities as having value in and for themselves' in the passage quoted earlier in this paper. But I notice that he relates this to the human stage of evolution in contrast to the earlier stages. Nevertheless, I still wonder how man recognises possibilities as having value, apart from purpose.

the concept of purpose, apart from human purposes, both of these biologists repudiate.[1]

Thus, one can only conclude that these writers have constructed on the basis of the theory of evolution two philosophical theories which are mutually exclusive. The ethical theory of biological progress logically refutes the metaphysical theory of the absence of mind or purpose.

Waddington's ethics, if tenable, would avoid this difficulty. He argues that evolution is good, not because it conforms to external ethical standards, but because evolution itself has produced, by the interaction of society and the individual's Super-ego, the concept of the good. Without evolution of this sort, presumably there would be no 'good'.[2] Therefore evolution is good, although it has no purpose. But it could be equally well argued that evolution is bad or amoral, because, through the same interaction, it has also produced the concepts of the bad and the amoral, with no logical means of distinguishing between the categories so designated.

The thesis of this paper, however, is that, in reality, evolution, as studied by the method of empirical science, neither implies nor denies the existence of a controlling mind, and that in itself it is neither good nor bad, but amoral. In short, evolution is both metaphysically and ethically neutral.[3]

[1] J. S. Huxley, *Evolution, the Modern Synthesis*, pp. 576-577. G. G. Simpson, *The Meaning of Evolution*, pp. 344-345.

[2] This assumption appears to be implicit in Waddington's argument, but it cannot be substantiated. Quite obviously, it is impossible to perform a control experiment to test it. The Christian could argue that man's knowledge of the good is independent of the mechanism of his origin, but dependent upon his *spiritual* relation to his Creator.

[3] If this thesis can be maintained, it would be a good thing if biologists were to reconsider their use of such ethically-overtoned words as 'higher', 'lower', 'advanced', and 'degenerate', which appear to be a cover for much vague thinking. I suspect that these words mean different things to different people, and different things in relation to different phyla: and they could well be replaced by words which relate to purely objective characters.