Is There 'Purpose' in Modern Biology?

by Andrew Robinson

The prevailing dogma of mechanistic theory ascribes not only the complex organization of living things, but the very appearance of life itself, to sheer chance and necessity. With some biologists there is an undercurrent of "holy discontent" with the Synthetic Theory of Evolution, but the conventional view is that evolution depends upon random mutations and natural selection and nothing else.[1]

Does nature, then, have no purpose? Is purpose no more evident in living systems than it is in the inanimate world? In a clear statement of the mechanistic thesis, French biologist and Nobel Laureate Jacques Monod had denied that there is design anywhere in the universe. In his book *Chance and Necessity,* Monod claims that chance alone is creative, and the necessity of natural selection its only offspring. Only random perturbations of the genetic code introduce novelty into the invariant stability of established species. There is neither room nor need for purpose or plan in the blind movements of nature and its evolution. He says:

> Chance alone is at the source of all novelty, of all creation in the biosphere. Pure chance, only chance, absolute but blind liberty, is at the very root of the prodigious edifice of evolution: this central notion of modern biology today is no longer an hypothesis among other possible or even conceivable ones. It is the only conceivable one, as being the only one compatible with the facts of observation and experience. And nothing permits us to suppose (or to hope) that our ideas on this point need to be or even could be revised.[2]

Thus, according to Monod, alterations in the genetic code are accidental. They constitute the only possible source of modifications of the genetic text. These modifications become a new depository of hereditary structures. Therefore, evolution and any "progress" that it seemingly displays is not intended in advance: it is an accidental outcome of blind materials and the forces that operate blindly upon them. Even with respect to man, Monod makes no exceptions. Man too has emerged by chance. Both his destiny and his duty are arbitrary. Monod writes: "Our number came up at a Monte Carlo game, and like someone who just made a million at the tables, this realization makes us feel strange and unreal . . ." And further:

> Man knows at last that he is alone in the indifferent immensity of the universe whence he has emerged by chance. No more than his destiny,

his duty is not anywhere written down. It is for him to choose between the kingdom and the darkness.[3]

If the mechanist's claim that there is no purpose in the universe actually was correct, it is hard to understand what on earth might suggest the idea in the first place. However, the anti-teleological thesis of mechanism is dominant today. Let us discuss this thesis in terms of its philosophical implications. The question that I raise in the title of this paper and that Monod and others answer so emphatically in the negative is by no means an easy one. I hope that my remarks may suggest a new approach to its clarification and solution. Finally, I will indicate why I think modern biology contains evidence for conclusions very different from the ones we have just heard by Monod.

To begin, we need a brief summary of what is at issue on the biological level. Recent discoveries in biology show that any new organism, whether in the normal line of specific reproduction or in the rare case of a mutation, begins from a quite definite configuration of atoms arranged in an exact sequence of parts. These are connected by chemical bonds and together constitute a long and large molecule in the geometrical form of a double helix. This structure is like a spiral staircase made out of sugars and phosphates with each banister one helix, and the steps between the banisters and holding them together made out of chemical bases joined in the middle by hydrogen atoms.

Inside the two banisters of the "double" molecule are arranged the four compounds that determine the pattern or code of the large molecule which includes them. This large molecule is now commonly known as deoxyribonucleic acid, or DNA. These four compounds, thymine, adenine, guanine, and cytosine, are symbolized by the letters T, A, G, and C. These letters in the proper sequence are the information of a given DNA molecule. They are the letters that give the directions needed for the formation of the other molecules and for the formation of the proteins that go into the cells and organism as it develops into a finished individual of the species.

The key to how the DNA molecules do indeed direct the formation and development of new organisms lies in their capacity to make copies of themselves and to transmit the same directions over and over again for the generations of new proteins, cells, and organisms. This constant reproduction in each new generation of the same written code, a certain sequence of nucleotides in the DNA molecule is responsible for the stability of a given species. However, no microscopic entity (or macroscopic one, for that matter) is immune to physical disturbances which, if ever so slight, may nevertheless accumulate sufficiently to alter the macroscopic structure of DNA itself or the transmission of its effect upon its various dependents. These "accidental" alterations (can we call them errors?) will then become

as firmly established in the products as the unaltered code was originally. Examples of such "accidents" are the following: the substitution of one pair of nucleotides for another; or the insertion of an extra nucleotide, an A (adenine) between another A and the T that followed it in the original master DNA. Such accidents change the code in some detail and can bring about a significant departure from the norm in the final organism that is developed. Such departures from the norm, from the exact and stable reproduction originally prescribed, are called mutations.

Regardless of whether we think of these mutations as advantageous or not, mechanistic theory ascribes every single one to chance. According to the mechanist, after the occurrence of such mutations, natural selection takes over. It weeds out the disadvantageous forms (though whether they are called disadvantageous before or after the fact is a thorny question) and preserves in continuous and stable reproduction the advantageous ones. Neither the mtutation nor what precedes or follows it calls for any purposeful agent or activity. The one is the result of blind chance; the others of sheer prior necessity.

Here we are confronted with a contradiction. The mechanist argues that singular and unpredictable accidents come about by pure chance and are then installed in the domain of necessity and governed by the absolute certitude that characterizes natural selection.[4] Such necessity, once established, would leave no room for further chance. A chance occurrence cannot be an exception to what is necessary, for the necessary by definition admits of no exception. Let us investigate the antecedents of this contradiction.

To begin with, to say that nature acts for an end does not mean, of course, that nature deliberates. To ask if there is purpose in living systems is not to ask if they are conscious. It is to ask if biological materials and the forces that act upon them frequently produce a result that is beneficial, a successful outcome as, for example, measured by the capacity for survival.

Furthermore, the event of chance is the rare and unintended outcome of purposeful activity. Chance cannot even be defined without a reference to purpose. But the purpose that is implicit in defining chance is that kind which is typical of nature and not consciousness. Thus, even when the mechanist speaks of chance he necessarily implies purpose.

These distinctions enable us to launch the arguments in favor of teleology and to dispose of the contradiction that arises from the mechanistic denial of it. First, let us consider the three meanings which chance can have when used by a mechanist:

(1) A condition of our knowledge but not of reality. This is the meaning which it has in a Laplacian, deterministic universe where everything actually happens with necessity, but our knowledge of the causual factors at

work is said to be incomplete. An event is "by chance" not because it is so in fact but because we are ignorant of the necessary causes which produce it. Some mechanists speak of random mutations in this way. The randomness they attribute to mutations is taken to mean, not that these rare occurrences are in themselves accidents, but that we are thus far ignorant of the physical and chemical laws that necessitate them. However, this meaning is not the more commonly accepted one today, and the leading proponents of mechanistic theory reject it as incompatible with the solidly established interderminacy principle of modern physics.[5]

(2) A statistic. This is the meaning the term "chance" has when it is used in expressions such as "laws of chance." It is taken to refer, not to an essential uncertainty, but to an operational one. There is no question of an accident in the sense of a departure from some intended result that frequently occurs in a given set of circumstances. The event of chance has an exactly defined probability. Thus, if a die is cast a number of times, the "chance" of any one side turning up on a given throw has a definite and circumscribed probability. As the number of throws is increased, there tends increasingly to be an equal distribution of the faces that turn up. This distribution is like the entropy of a physical system rather than like the negative entropy of a developing organism or of evolution.[6] If the randomness of a mutation is regarded by the mechanist as one face of a multifaceted die, he holds out the possibility, at least theoretically, of being able to circumscribe the chances that it will occur before it does. No biologist should be willing to commit his science to such an a priori and gratuitous hypothesis that has no chance of being tested. This second meaning of "chance" does not, of itself, make a reference to purpose. But, like the first meaning, this is not the one the mechanist has in mind when he speaks of random mutations caused by chance.

(3) An essential reality.[7] This is the "pure chance" from which all novelty in living systems is said to arise. This is the chance which supposedly gives birth to an implacable necessity. Let us consider Monod's definition of it:

> The notion of chance has an essential and not just an operational meaning. This is the case, for example, of what one calls "absolute coincidences," that is to say, those which result from the intersection of two causal chains totally independent of one another. Suppose for example that Dr. Dupont is urgently called to visit someone who has just fallen ill, while Dubois the plumber works urgently to repair the roof of a neighboring house. When Dr. Dupont passes in front of the house, the plumber inadvertently drops his hammer, whose deterministic trajectory intercepts that of the Doctor, who then dies of a fractured skull. We say that he did not have a chance. What other term

> is to be used for such an event, unpredictable by its very nature? This chance must evidently be considered as essential, inherent in the total independence of the two series of events whose meeting produces the accident.[8]

The pure chance that causes random mutations, we are told, is therefore an effect of the intersection of two totally independent causal lines that were going their own way, presumably toward the production of some other effects. Or were they? Is their intersection an accident? If it is, what causes it? In such an analysis, chance either disappears or is itself an effect and not a cause. Let us look at this more closely.

We may begin by dismissing the notion of two totally independent causal series because the hypothesis of a closed system is merely an hypothesis, and an untestable one at that. However small the effect of one thing upon another in the universe, the only truly closed system is the universe itself, and even that contains the openness of unrealized potentialities. However, the absolute assumption of a closed system, erroneous though it is, is not the crux of the matter.

Let us suppose that the two causal chains are going about their own business independently of one another and of everything else. Are they doing so with necessity? If so, they can neither be interfered with by any other causes nor can they interfere with one another. Their interference or intersection is either an accident or a necessity (or intended, of course, but that cannot be an alternative for a mechanist). If it is a necessity, then the event that it produces is not by chance; if it is an accident, then their respective trajectories were not deterministic. There is no middle ground here. If a cause or a series of causes is necessarily determined to produce an effect, then that effect will inevitably ensue; if not, then not. It is precisely because the so-called independent causal chains are contingent and not absolutely necessary in their trajectories that they leave room for an accidental occurrence, a departure from the norm which they frequently bring about. Chance is not a partner of necessity; it is a partner of contingency. There can be no chance if there are not causes operating contingently to produce the rule rather than the exception to it. Chance is a cause, not an effect. It is the cause of the exceptional effect, the mutation that was unpredictable because it was not determined in advance in the immediate cause. This is not to say, however, that the event that is caused by chance was not intended at all.

This brings us to the question of the final cause and the impossibility of eliminating it if we are to make any sense out of either random mutations or natural selection.

Once the mechanist denies final causality, there is nothing left to which chance can be an exception; there is nothing left of the somehow "de-

termined in advance" from which the random mutation can be distinguished. Surely the random occurrence of a chance event cannot be an exception to what is necessary. It can be a departure only from a norm that was not necessary, which is the way the random mutation is itself defined — a change that was not necessary and not intended. According to this definition, it is indistinguishable from the non-mutated reproductions coded in the DNA molecule and brought about by the transmission of the information contained therein. For they too must not be necessary unless for an end, and the mechanist denies that they have any end in the sense of purpose. This would leave the distinction in the hands of mere statistics, and in the global sense how could we assign the probabilities, much more account for them?

The fact that mutations can and do occur is because the genetic materials and the physical and chemical forces that operate upon them are not uniquely and necessarily determined to their effects. If they were, there would be no room for any exceptions, and this universe would contain no chance at all. But the fact that natural causes do not necessitate their effects in advance doesn't mean that they are not at all determined to produce them, or that they are indifferent to what in fact does come about. The stability and frequency of specific reproduction, the invariance in the midst of perturbations, bears striking witness to a natural determination to produce certain effects rather than others. Changes do occur, and indeed some are useful, even crucial for the survival of a given species.

Mechanism might argue that the utility of a particular characteristic caused by a mutation or maintained by stable reproduction is simply a fact, accidental and unintended. It just is. Thus utility (say for survival) is just another word to describe the fact of the matter. It does not call for any final cause which was being aimed at. If you call the elephant's trunk useful or a good thing, you simply mean, according to the mechanist, that it enables him to survive; you do not mean or imply that survival is a good thing, something intended, except by reference to human patterns of thinking. Incontestably of course, it is human patterns of thinking that we are also talking about; elephants have nothing to say on the matter. But if we deny that anything is either good or bad for an elephant, including his survival, we should have to say, for the same fundamental reasons, that our own survival is, in the final analysis, equally a matter of indifference. And so it would be if there were no reason to explain it other than blind materials and equally blind physical and chemical forces with no reason for being other than themselves. Indeed, there would be no reason even to try, to seek explanations, and science would lose it own raison d'être.

Recent discoveries in biology reveal that there is a clear proportion between the genetic materials from which living things are coded and

produced, and the complete organism that arises from them. These materials and forces are inherently apt to produce, and frequently do produce, an organism that is frequently able to survive. The organic equipment which the organism is coded to have makes this possible. Of all the phyla none is extinct, although in the course of evolution many individual species have failed to survive. Yet the stability of species is as much a fact as the mutations (good or bad) which occur in the course of an evolution which can only be described as ascendant and progressive. As von Bertalanffy has pointed out, "A general progression of evolution towards higher organization (comparable to a similar trend in individual development) is a phenomenological fact, that is, a matter of the paleontological record."[9] To associate this progress with a purpose is, of course, another question, but it would be absurd to attribute it to chance. Yet Monod proclaims:

> The mechanism and transmission of the genetically coded information is strictly irreversible . . . . This system, by its very structure, must oppose itself to all change, to all evolution. There is no doubt that such is indeed the case, and we have in this the explanation of a fact that is truly more paradoxical than evolution itself, namely the prodigious stability of certain species, which are known to reproduce themselves without appreciable modifications in hundreds of millions of years.[10]

The stability of species is paradoxical only in the mechanistic framework of no purpose; when viewed in the light of a long and progressive movement of nature toward a goal, both the prodigious stability of species and also the rare and strikingly successful mutations that propel the biosphere forward to higher forms of life becomes intelligible. Paradox gives way to reason, but to a reason admittedly shrouded in mystery.

It cannot be chance which causes the inherent aptitude of genetic materials for the organism they code in advance. The organism is invariably the outcome of the successful transmission of this prior code. Yet the process in not one that necessitates the outcome; there can be and are exceptions to the successful fulfillment of the prior genetic determination. It is absurd to say that there is no connection between the DNA of a given species, and the characteristics of that species, and individual instances of it. As Sinnott remarks: "The whole seems somehow immanent in all its parts."[11]

What are we left with if we say that pure chance and necessity are not enough to explain replication, mutation, and selection in the biosphere? We are left with, or rather should begin with, natural causes having an ordination to the origin and development of living systems superior to their predecessors and better able to survive and progress. As Polanyi asserts in the *Tacit Dimension,* "The . . . thrust of evolutionary ascent is as clearly

manifest as the growth of an individual from a germ cell."[12] The prior aptitude in such causes, in the genetic materials, is precisely what is meant by nature's intention of an end. And this aptitude is clearly for a determined outcome that is successful, one that can survive. The intention of such an end is already present in the materials before the end comes about in fact. Thus, the final cause is the reason for the activity of the agents and materials that precede it in existence. It does not cause the existence of these agents and materials as such, but it causes them to operate. The ultimate source of the aptitude which genetic materials display for results that are good and more successful than not, may be mysterious. But the aptitude itself is no mystery; it is a matter of fact.

It is hard to see how that which does not yet exist in itself can be a cause of anything and a source of intelligibility. But if evolutionary replication, mutation, and selection confer an advantage on macromolecules that are more apt to replicate spontaneously than those which cannot do so, there must be a reason why such replication exists and is an advantage. Mechanical causes alone do not cause advantages; there must be a cause not only for the outcome, but also for its utility. The utility that DNA activity produces is as frequent as the sheer material effect that it orders up. The two are conjoined. To take an example given elsewhere in a similar context:

> Shall we say that our front teeth are sharp, fitted for tearing, and the molars broad, and useful for grinding down food because they came up in such a fashion of necessity; and it is by chance that this arrangement is useful? Must we insist that these teeth did not arise so for any end? It would then be a mere coincidence that this structure of teeth should turn out to be useful. And in other organisms whose parts are arranged as if they were for a purpose, the organism would survive only because it is organized in a fitting way by chance.[13]

This is the irrational picture of living systems that is painted by mechanistic theory today. Could we make any sense of the science of biology if this were true? The scientific effort would be no more intelligible than its subject.

In the context of such a purposeless biology, the stability of a species or the successful consequences of mutation that produce new species with enhanced chances for survival would have no explanation. To assign chance as their root cause is merely to admit that they have no explanation. Yet chance is compared to reason for its own meaning and definition: it is the cause of what is rare and unintended and not absolutely necessitated in advance. What it causes in nature can be called necessary only on the hypothesis of an end to be achieved, and then only in light of a purpose that goes beyond the more limited one of stable generations. Reason cannot get rid of itself and purpose intrudes upon every attempt to deny it.

What is frequent is no coincidence. Polanyi reminds us that, "No level can gain control over its own boundary conditions and hence cannot bring into existence a higher level . . . . A higher level can come into existence only through a process not manifest in the lower level."[14]

Biology gains no advantage from a denial of purpose. On the contrary, mechanism's dogmatic denial of it is an impediment to progress. On the other hand, there is no reason why a scientist should not shun problems that his method can approach only remotely, if at all. If the exact experimental techniques used by the molecular biologist fail to inform him about the purposes of the objects which he studies, these techniques are nevertheless astonishingly successful in bringing to light the materials that nature works with and the mechanics of their interaction. Without this knowledge, the larger and more important questions can never clearly be grasped or the scope of their implications even guessed.

Edmund Sinnott tells us:

> Each tiny living unit is a much more complex thing than it appears to be, for it bears within itself an image of the whole organism, the "goal" toward which its development persistently will move.[15]

This image of the end is like the effect of an art implanted in things by which they are moved to a determined end. Nature does not possess a conscious reason, but it shares in a Reason that is above chance and necessity and employs both for a purpose which we continue to explore — a purpose that gives meaning to living systems and to our exploration of the biosphere of which we are also a part.

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[1]See C. H. Waddington, "The Theory of Evolution Today," in *Beyond Reductionism* The Alpbach Symposium, edited by Koestler and Smythies (Boston: Beacon Press, 1971).

[2]Jacques Monod, *Le Hasard et la Nécessité* (Paris: 1970), p. 127. (My translation. A translation by Austryn Wainhouse, published by Alfred A. Knopf, New York, is now available).

[3]Monod, *Op. cit.*, p. 161; p. 195.

[4]Monod, *Op. cit.*, p. 135.

[5]Monod, *Op. cit.*, p. 129.

[6]Monod, *Op. cit.*, pp. 72- , 211-213.

[7]This use of the word "essential" is Monod's; inasmuch as chance is an accidental cause, I take such usage to be equivocal.

[8]Monod, *Op. cit.*, p. 128.

[9]In *Beyond Reductionism*, "Chance or Law," pp. 66-67.

[10]*Op. cit.*, p. 125.

[11]Edmund W. Sinnott, *The Biology of the Spirit* (New York: Viking Press, 1957), p. 16.

[12]Michael Polanyi, *The Tacit Dimension* (Garden City, New York: Doubleday, 1967), p. 48.

[13]Aristotle, *Physics*, Book II, Ch. 8, from *The Basic Works of Aristotle*, edited by Richard McKeon (New York: Random House, 1941).

[14]*Op. cit.*, p. 45.

[15]*Op. cit.*, p. 36; "It is not only legitimate but necessary for (the biologist) to include in his explanatory schemes factors which are unnecessary for the explanatory schemes of the physicist — namely, such concepts as memory, anticipation, purpose, final causation . . .. " From W. E. Agar, *A Contribution to the Theory of Living Organisms* (Melbourne, Australia, 1951), as quoted by Sinnott, *Op. cit.*, p. 14.