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LAMARCK AND THE EVOLUTION THEORY

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FEW of the recent articles on evolution mention any name older than Darwin. Perhaps this is well: we have enough to regret in the present controversy. The omission is evidence, just the same, of a general belief that the modern evolution theory began with Darwin, and that all earlier writers possess only historical interest.

There is indeed a sharp distinction between the modern theory and those proposed before it. The line should be drawn, however, not when the "Origin of Species" appeared, but just fifty years earlier, when Lamarck published his "Zoological Philosophy."

Lamarck approached the evolution question near the close of a singularly fruitful scientific career. Up to the age of fifty, he occupied himself exclusively with botany. Then, in 1793, the Museum of Natural History in Paris was reorganized. Lamarck was transferred to an utterly new field and appointed "professor of zoology, insects, worms and microscopic animals." At a time of life when most scientists are content to glean the stubble of more fruitful years, Lamarck began the study of the least known part of the animal world. He determined the position and affinities of thousands of forms, improved the existing classification of Linnaeus and Cuvier and laid the foundation for invertebrate paleontology.

With the growth of his knowledge of vegetable and animal life, Lamarck reached the point when he could no longer harmonize the facts with the prevailing doctrine of the fixity of species. In spite of opposition and ridicule, he became an evolutionist. His beliefs are set forth in several works, but perhaps most fully in his "Zoological Philosophy," published in 1809. In this work Lamarck attacks the problem that Darwin attempted to solve a half century later.

The "Zoological Philosophy" is generally considered a classic work. Like most classics it is seldom read. For this the modern student can plead some excuse. The book contains considerable superfluous matter — at least when judged by modern standards—so much so that the reading of it in the original French is an exhausting undertaking for the average doctor of philosophy. In addition Lamarck's style of presentation belongs to a past era in scientific literature. For those who wish to know more of the book than the stock quotations afford, the language obstacle has been cleared away by an excellent and very readable translation made by Hugh Elliott.[1] The following abstract of Lamarck's argument, given as far as possible in extracts from his work, but rearranged in a modern order, will show the nature of his theory of evolution and its place in scientific thought. Since Elliot's translation is more accessible than the original and his rendering of Lamarck's words better than any I can offer, I will quote from the translation.

To begin with, Lamarck had a clear conception of the uniformitarian principle. He believed, as we do to-day, that all events in past world history can

[1] "Zoological Philosophy," by J. B. Lamarck; translated, with an introduction, by Hugh Elliot, Macmillan and Co. 1914.

be explained best as the result of the operation of present-day forces of nature. The prevailing view in Lamarck's time was very different. The school of Werner, then at the height of its popularity, solved all geological puzzles by an appeal to floods that might have staggered the imagination of the writers of Genesis, and by calling in a chemistry as fantastic as medieval alchemy. Quite as popular were the Catastrophists, who laid the destruction of fossil forms to great disasters which at one time overwhelmed the world, utterly destroying every living thing. Lamarck, however, took his stand with Hutton and Demarest, and postulated the uniformitarian principle as the foundation for his evolution theory.

> Every qualified observer [Lamarck writes] knows that nothing on the surface of the earth remains permanently in the same state (p. 45).
>
> Naturalists who did not perceive the changes undergone by most animals in the course of time tried to explain the facts connected with fossils, as well as the commotions known to have occurred in different parts of the earth's surface, by the supposition of a universal catastrophe which took place on our globe. . . .
>
> But why are we to assume without proof a universal catastrophe, when the better known procedure of nature suffices to account for all the facts which we can observe?
>
> Consider on one hand that in all nature's works nothing is done abruptly, but that she acts everywhere slowly and by successive stages; and on the other hand that the special or local causes of disorders, commotions, displacements, etc., can account for everything that we observe on the surface of the earth, while still remaining subject to nature's laws and general procedure . . . (p. 46).

Darwin warmly acknowledged that it was Lyell who taught him to look for the cause of past changes among causes for change in the present, and thus started him on the road that led to evolution. Under far less favorable conditions Lamarck attained a thorough grasp of the same principle, without which no evolution theory is possible.

With Lamarck it is especially necessary to distinguish his evolution theory in the narrower sense; *i.e.*, his concept of the fact or law of evolution, from the causes or factors which he thought brought about the process of evolution. Lamarck does not separate the two very well, and subordinates the first to the second throughout his book.

Lamarck's conception of the law of evolution he gives in the following paragraphs:

> Nature has produced all the species of animals in succession, beginning with the most imperfect or simplest, and ending her work with the most perfect, so as to create a gradually increasing complexity in their organization: these animals have spread at large throughout all the habitable regions of the globe, and every species has derived from its environment the habits that we find in it and the structural modifications which observation shows us (p. 126).
>
> We must first recognize that the general series of animals arranged according to their natural affinities is a series of special groups which result from the different systems of organization employed by nature; and that these groups are themselves arranged according to the decreasing complexity of organization, so to form a real chain (p. 68).

The chain series concept was, of course, not new with Lamarck, but the following modification is:

> I do not mean that existing animals form a very simple series, regularly graded throughout; but I do mean that they form a branching series, irregularly graded and free from discontinuity, or at least once free from it. . . . It follows that the species terminating each branch of the general series are connected on one side at least with other neighboring species which merge into them (p. 37).

Lamarck thought of the animal kingdom as a great family-tree; indeed he illustrates his idea with a crude tree. Now it is precisely this concept of a branching series that distinguishes the modern theory of evolution from all that precede it. To Lamarck falls the honor of adding this essential feature.

The proofs for the law of evolution are usually assembled into three groups.

to form the arguments from comparative anatomy, from embryology and from paleontology, respectively — somewhat after the fashion of books on theism. Most of the evidence given by Lamarck falls into the first group.

The mutability of species suggested itself to Lamarck as an explanation for the difficulties he encountered in his systematic work. It should be noted that Lamarck, like Darwin, speaks of the evolution of species and genera. Modern writers seldom descend below the larger systematic groups in their discussion of the evolutionary process.

> The almost universally received belief [Lamarck writes] is that living bodies constitute species distinguished from one another by unchangeable characteristics, and that the existence of these species is as old as nature herself (p. 31).
>
> Meanwhile, the farther we advance in our knowledge of the various organized bodies . . . the greater becomes our difficulty in determining what should be regarded as a species, and still more in finding the boundaries and distinctions of genera.
>
> According as the productions of nature are collected and our museums grow richer, we see nearly all the gaps filled up and the lines of demarcation effaced (p. 37).
>
> How many genera there are, both among plants and animals among which the number of species referred to them is so great that the study and determination of these species are well nigh impracticable! The species of these genera, arranged in series according to their natural affinities, exhibit such slight differences from those next to them as to coalesce with them. These species merge more or less into one another . . . so that there is no means of stating the small differences that distinguish them (p. 37).

Darwin records a similar experience in the "Voyage of the Beagle." As he sailed southward along the South American coast he noted the gradual replacement of species by others closely allied to them. Later at the Galapagos Islands he was struck by the slight differences that separated the birds of the several islands from each other and from their relatives on the adjacent mainland. The likenesses and differences were those found in the individuals of a human family, which everyone attributes to descent from a common ancestor.

The other evidence given by Lamarck for the mutation of species is adaptation. Lamarck found that everywhere in nature animals seemed specially fitted to live where they were found. He could not help but think that species had suffered modification to fit them for their particular environment.

The evidence that Lamarck assembled to justify his belief in evolution would all be included to-day in the argument from comparative anatomy. He cites the foetal teeth found in some whales and interprets them in accordance with his theory, but otherwise embryological evidence is lacking, as one might expect from the state of that science before von Baer. Lamarck could lean even less than Darwin on the infant science of paleontology. He seems to have doubted that any species was really extinct, especially of higher vertebrates. The explanation for this may be that Lamarck was best acquainted with the then recent and sensational discoveries of Cuvier in the Paris basin. The rocks of this region are of comparatively recent date geologically, and afford fossil vertebrates closely allied to living forms.

The differences between fossil and living invertebrates, however, did not wholly escape him. He suggests as an explanation:

> May it not be possible on the other hand that the fossils in question belong to species still existing, but which have changed since that time, and become converted into similar species that we now actually find (p. 45).

So much for Lamarck's conception of the fact or law of evolution, and the evidence he brought forward for it. As has been said, he devoted but a small part of the discussion to this part of his

theory and was chiefly concerned to suggest and establish the causes or factors by the operation of which the evolutionary process was brought about. These causes or factors are Lamarck's best known contribution to the general evolution theory, and are linked with his name, as natural selection is with that of Darwin.

The primary factor Lamarck thought to be some unknown cause which impelled living matter to become more complex in structure and function. To this cause he refers only vaguely and indirectly. The clearest reference is in the following sentences:

> If the factor which is incessantly working towards complicating organization were the only one which had any influence on the shape and organs of animals, the growing complexity of organization would everywhere be regular. But it is not; nature is forced to submit her works to the influence of environment, and this environment everywhere produces variations in them (p. 69).

The paragraph just quoted is worth emphasis, for it has been overlooked by the majority of writers on Lamarck's theory. Exactly what Lamarck had in mind is hard to say. Osborn thinks that Lamarck did not contemplate a "perfecting tendency," and nothing elsewhere in the text suggests that he did. Perhaps Lamarck thought that the effect of environment would not be more than to produce lesser adaptations in preexisting forms, and that the production of radically different types, such as amphibia from fishes, would require a cause quite independent of environment.

A far more important cause of evolution, to Lamarck, was the interaction of the species and its environment. This factor he explains and illustrates in considerable detail, and formulates into his well-known laws. In the "Zoological Philosophy," these are two in number.

> First law. In every animal which has not passed the limit of its development, a more frequent and continuous use of any organ gradually strengthens, develops and enlarges that organ, and gives it a power proportional to the length of time it has been so used; while the permanent disuse of any organ imperceptibly weakens and deteriorates it, and progressively diminishes its functional capacity, until it finally disappears.
>
> Second law. All the acquisitions or losses wrought by nature on individuals through the influence of the environment in which their race has long been placed, and hence through the influence of the predominant use or permanent disuse of any organ: all these are preserved by reproduction to the new individuals which arise, provided that the acquired modifications are common to both sexes, or at least to the individuals which produce the young (p. 113).

The evidence, or lack of it, for these laws need not be discussed here. It should be noted that the laws as they read in the "Zoological Philosophy" make no provision for the origin of absolutely new organs. In a later work Lamarck expands his two laws into four, the second of which provides for this omission, and, as given by Osborn, reads:

> The production of a new organ or part results from a new need or want, which continues to be felt, and from the new movement which this need initiates and causes to continue.

One can not rise from the reading of the "Zoological Philosophy" without wondering why it failed to impress the generation to which it was addressed and has been imperfectly understood ever since.

The contemporaries of Lamarck were dominated by catastrophic geology on one hand, and by the fag end of the Linnean era on the other. A modern evolution theory and eighteenth century geology are utterly incompatible. Neither would enthusiasts for classification welcome such slippery things as mutable species. Lamarck's first task should have been the methodical accumulation of evidence to prove that evolution really has taken place. Instead he did little more than summarize his personal im-

pressions. Then, taking the law of evolution for granted, he devoted his time to the discussion of the causes which might bring evolution about. His readers, decidedly not convinced of the reality of evolution, would not seriously entertain arguments for its causes. To make matters worse, most of the arguments that Lamarck advances for his causes of evolution are really illustrations and hence only concrete restatements of his thesis. A rigid proof of his laws transcended the knowledge of his day, as it still does ours.

To-day Lamarck is recognized as a scientific genius of the first order, the greatest figure between Aristotle and Darwin. Yet he is continually damned with faint praise. Eulogies are nearly always mixed with detractions. The credit for the uniformitarian concept has properly gone to Hutton and Lyell who gathered the evidence to prove it. For the same reason the glory for establishing the law of evolution has gone to the generation that followed Lamarck. Attempts have been made repeatedly to withhold credit from Lamarck for the laws or factors which are his chief contribution to biological thought. As is well known, Erasmus Darwin expressed substantially the same ideas a few years before Lamarck published. Darwin's statements are scattered here and there through the "Temple of Nature" and two other poems, and are vaguely sketched in a medical treatise entitled "Zoonomia." Despite any direct evidence, it has been insinuated more than once that Lamarck borrowed from Darwin without giving credit. Darwin's conception can be reconstructed only after a laborious plodding through a mass of doggerel, and by picking out a sentence here and there in the chapter on Generation in the "Zoonomia." After giving fullest credit to Erasmus Darwin's stimulating originality, surely some ought to be left for an independent thinker who worked out the same position and, in addition, formulated it in clear, definite and intelligible fashion.

No small part of the hostility to Lamarck among present-day scientists arises from *a priori* objections; different of course from those that closed minds to him a century and a quarter ago, but perhaps just as unreal. Evolution was to Lamarck, as it was to Charles Darwin and Huxley, not so much a progress upward as an adaptation to a changing environment. The three differed as to what part environment played, but all could agree that without a changing environment there would have been no evolution. Now present-day zoological thought is dominated by experimental physiology and genetics. The undoubted success of the experimental method in both fields has led many to prefer an evolution theory that will work *in vacuo*, or better *in vitro*, one that will operate without regard to environment. Accordingly the evidence for adaptation in nature is ignored or denied, and evolution theories that include adaptation as an essential part are opposed. Surely, the evidence of paleontology and of animal and plant distribution can not be ignored, even if it is not amenable to present-day experimental methods. When this is recognized a greater interest in Lamarck's theory can be expected.

The proof of Lamarck's factors, like the proof of other proposed causes for evolution, is likely to be a long and arduous affair. Those who believe that Weismann has disproved or that Guyer has proved the essential part of Lamarck's laws alike overlook the inherent difficulty of paralleling in a laboratory what is, by hypothesis, a secular process.