

CLASSICS OF SCIENCE: Inheritance of Acquired Characteristics

Biology

Lamarck's laws set forth one of the early forms of the theory of evolution, a generation before Darwin. Their weakness is apparent now, but they were a long step in advance of the ideas of a static world then widely held. Lamarck's researches were done upon invertebrates, which is well illustrated by his constant distinction between generation and reproduction. In this connection it must be remembered that the mechanism of reproduction and transmission of heredity was practically unknown in Lamarck's day.

NATURAL HISTORY OF THE INVERTEBRATE ANIMALS, presenting the general and particular characters of these animals, their distribution, their classes, their families, their genera, and a list of the principal species into which they fall; preceded by an Introduction presenting the determination of the essential characteristics of animals, their distinction from plants and other natural bodies, and finally, the explanation of the fundamental Principles of Zoology. By M. De Lamarck. Paris, 1815. Translated for the SCIENCE NEWS-LETTER, by Helen M. Davis.

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The Four Laws

After the smoothing away of the first difficulty which spontaneous generation offers us at the beginning of every organic kingdom, as well as to that of certain branches of these kingdoms, everything else relative to the composition of the organization in these animals, and to the formation of the different special organs which are observed among them, seems to me to resolve itself easily.

In effect, one may say that these difficulties disappear if, to the minor generalizations of nature, we add the four following laws which concern the organism, and which govern all the acts which are forced upon it by the operation of the life forces.

First law: Life, by its unique forces, tends continually to increase the volume of every body which possesses it, and to extend the dimensions of those parts to as great limits as it can bring itself.

Second law: The production of a new organ in an animal body, results from an unexpected new need which continues to make itself felt, and from a new movement which this need brings forth and keeps going.

Third law: The development of organs and their force of action are constantly in proportion to the use of these organs.



J.B. Lamarck

Fourth law: All that which has been acquired, developed or changed, in the organization of the individuals in the course of their life, is conserved by the generation and transmitted to the new individuals which arise from those which have survived the changes.

It is impossible to understand anything of the construction of the organism, and especially of the operations of nature in regard to the animals, without the recognition of these laws, in a word, without truly taking them into consideration. In consequence, I am going to present the same successively, with only the development necessary to demonstrate their reality and importance.

First Law

It is known that every living body does not cease to grow, from the instant when it is animated by life, up to a particular moment of its existence, which is relative to that of the individual race. The body would increase during the entire course of its life, if a well-known cause did not put an end to its growth after the first quarter, approximately, of its duration.

The active life being constituted by the vital movements, it should be known that it is principally in the movements of the fluids peculiar to the living body that there resides the power which life possesses of extending the volume and the walls of the

body; for nutrition alone is never enough; being in no sense a force; and it can increase, from within or without, the volume and the walls of the body on which it acts.

But if, in each individual, the power of life tends without ceasing to increase the size of the body and its walls, that power does not prevent the length of life from bringing gradually and constantly, in the state of the walls, the changes (a progressive stiffening and rigidity) which put an end to the growth of the individual, and afterward an end also to the life itself which it possesses. And so, these are those increasing and well-known changes which constitute the cause that, contrary to the tendency of life, limits the growth of the individual, and the same which necessarily brings its death after a time in proportion to the length of its growth. . . .

Second Law

The foundation of this law derives its proof from the third of these known facts, there can be no doubt; for, if the forces which form an organ, by their growth, develop that organ further, that is to say, increasing its size and its power, which is constantly proved by fact, one may be assured, that the forces which will act upon it, coming to birth by feeling a new need, will necessarily give birth to a new organ proper to meet the new need, if that organ did not exist before. . . .

Third Law

This is not a supposition, an indefinite presumption; the law which I present is positive, confirmed by observation, and belongs to the sum of known facts, which can serve to demonstrate the foundation of it.

Instead of reducing it to its simplest expression, as here, I have presented it, in my *Philosophy of Zoology* (vol. I, chap. 7), with the kind of development necessary at that time, and I have expressed it in the following manner:

"In every animal which has not passed the end of its development, the more frequent and extended use of a certain organ, strengthens little by little that organ, develops it, increases it, and gives it strength proportional to the duration of that use; in the same way the constant lack of use of such organ, insensibly causes it to fail, weakens it, progressively diminishes its powers, (*Turn to next page*)

Acquired Characteristics—Continued

and ends by making it disappear." *Phil. Zool.*, p. 235. . . .

I regard this same law as one of the most powerful means employed by nature to diversify the races; and on reflecting upon it I know that it includes the necessity of that which precedes it, that is to say, of the second, to which it furnishes the proof.

Effectively, the cause which forces an organ frequently and constantly used to develop, which therefore increases its size and power of action, in a word, which causes the forces of life and the fluids of the body to flow there repeatedly, has necessarily also the power to cause to come into being, little by little and in the same way, an organ which has not existed and which has become necessary.

But the second of these laws and the third by which it acts, would be without effect, and consequently useless, if the animals always existed in the same circumstances, if they in general and always kept the same habits and if they were never changed nor formed anew; something which has been, in effect, believed and which has no foundation.

The error into which we have fallen in this regard, takes its source in the difficulty which we find of including in our observations a considerable period of time. There results for us the appearance of stability in the things which we see, a stability, which nevertheless, nowhere exists. . . .

In order to continue such an opinion and hold to an error of that kind, it is indeed necessary to keep oneself from collecting and considering the facts which we have presented from all; and it is necessary to reject all the observations which confirm them; for things are surely very different. . . .

If one now reflects what enormous diversity of circumstances of living conditions, of exposure, or climate, of nutritive substances at their disposition, of favorable surroundings, etc., the plants and the animals have had to endure, in proportion as the existing races have found it necessary to change their habitat and although these changes come about with extreme slowness and in consequence during a considerable time, their reality, compelled by different causes, has none the less put the races which have found themselves exposed to them to the necessity of changing little by little their manner of living, and their habitual behavior.

By the effects of the 2nd and 3rd laws cited above, these changes of

habit therefore must have forced the birth of new organs, and have been able afterward to develop them, if their use is subsequently very frequent; they have been able to deteriorate in the same way, and at last atrophy, those of the existing organs which thereafter have proved useless.

Another cause of change of habit which has helped to diversify the varieties of the animals and to multiply the races, is the following:

In proportion as the animals, by partial emigration, changed their place of living and went to different parts of the surface of the earth; newcomers in new situations, they would be exposed to new dangers which exact new actions to escape them; for the most of them devour one another to preserve their existences.

I have no need to enter into more detail to show the influence of this cause which it is necessary to add to that which embraces the different circumstances of the new homes, of the new climates, and of the new ways of living following such emigration.

But, one might say, since the animals have gradually populated every place where they can live, since all the waters are peopled with species which can nourish them, since the dry parts of the globe serve as habitation to the species which we see; things are stable in respect to them; circumstances capable of forcing them to changes of living conditions have no place; and all the races, at least in the future, will remain always the same.

To that I reply that this opinion again seems to me an error; and that I am entirely persuaded that it is.

It is a great advantage, in effect, to suppose that there has been absolute stability in the state of the surface of our world as we know it; in the condition of its waters, whether fresh or salt, in the depth of its valleys, the elevation of its mountains, the disposition and the composition of its particular places; in the different climates which now correspond to the different parts of the land with which they are now associated; etc., etc.

All these objects should, it seems to us, remain just about the same in the state in which we observe them, for we cannot be witnesses ourselves to their changes, and our history and our written observations from dates so little removed from us do not show it to convince us of our error. Nevertheless we do not lack positive facts which indicate it; but as this is not the place to recall them, I shall confine

myself to the expression of my belief; know:

That everything changes unceasingly on the surface of the globe, although with extreme slowness in respect to us; and that the changes which occur there, necessarily force the races of plants and animals to adapt themselves to them, which helps to diversify them without real discontinuity. . . .

Fourth Law

This law, without which nature could not diversify the animals, as she has done, and establish among them a progression in the composition of their organization and in their faculties, is explained also in my *Philosophie zoologique* (vol. I. p. 235).

"Everything which nature has caused to be acquired or lost in the individuals by the influence of circumstances to which their race has been for a long time exposed, and, in consequence, by the predominant influence of the use of such organ, or similarly lack of constant use of such part, she conserves, by generation, to the new individuals who carry it on, provided that the changes acquired are common to the two sexes, or to those which have produced the new individuals."

This expression of the same law offers some details which it would be better to reserve for development and application, which, however, is scarcely necessary. . . .

In truth, in sexual reproduction, the mixture between individuals which have not equally been subjected to the same modifications in their organization, seems to offer some exception to the results of this law; since some of the individuals which have suffered some of the changes do not transmit them all, or only communicate them partially to those which they produce. But it is easy to realize that this is scarcely a real exception; the law itself can have only a partial and imperfect application in these circumstances.

By the four laws which I have indicated to you, all the facts of organization seem to me to be easily explained; the progress in the composition of organization of the animals and in their faculties, seems to me easy to conceive; finally, the means which nature has employed to diversify the animals, and to bring all to the state in which we see them, is through them easily determinable.

Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck (1744-1829) was an authority on botany until 49, afterward on invertebrate zoology. He was blind before his "Histoire naturelle" was completed